Draft

Remedial Investigation Report
for Soil, Sediment, and Surface Water
at RVAAP-50 Atlas Scrap Yard

Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract No. W912QR-04-D-0028
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Prepared by:

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14. ABSTRACT

This Remedial Investigation Report for Atlas Scrap Yard presents physical characteristics, geology, and hydrogeology of Atlas Scrap Yard; compiles historical and newly acquired environmental data; summarizes nature and extent of contamination in soil; evaluates contaminant fate and transport; and provides human health and ecological risk assessments. These evaluations indicate there were no CERCLA-related chemicals of concern (COCs) that pose unacceptable risk for the Resident Receptor. Therefore, this report recommends No Further Action (NFA) with respect to soil, sediment, and surface water to attain Unrestricted (Residential) Land Use.

15. SUBJECT TERMS

Cleanup goals, risk assessment, weight of evidence, nature and extent, fate and transport, recommended alternative

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Leidos has completed the Remedial Investigation Report for Soil, Sediment, and Surface Water at RVAAP-50 Atlas Scrap Yard at the Ravenna Army Ammunition Plant, Ravenna, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer’s needs consistent with law and existing United States Army Corps of Engineers (USACE) policy.

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06/18/2014

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Significant concerns and the explanation of the resolution are as follows:

Internal Leidos Independent Technical Review comments are recorded on a Document Review Record per Leidos quality assurance procedure QAAP 3.1. This Document Review Record is maintained in the project file. Changes to the report addressing the comments have been verified by the Study/Design Team Leader. As noted above, all concerns resulting from independent technical review of the project have been considered.

06/18/2014

Lisa Jones-Bateman
Senior Program Manager
Date

PLACEHOLDER FOR:

Documentation of Ohio EPA Approval of Final Document

(Documentation to be provided once approval is issued.)

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ARNG = Army National Guard
OHARNG = Ohio Army National Guard
Ohio EPA CO = Ohio Environmental Protection Agency, Central Office
Ohio EPA DERR = Ohio Environmental Protection Agency, Division of Environmental Response and Revitalization
REIMS = Ravenna Environmental Information Management System
USACE = United States Army Corps of Engineers

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ACRONYMS AND ABBREVIATIONS

ADR	Automated Data Review
amsl	Above Mean Sea Level
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
ARNG	Army National Guard
ASA	Active Storage Area
AT123D	Analytical Transient 1-, 2-, 3-Dimensional
bgs	Below Ground Surface
BHC	Hexachlorobenzene
BSV	Background Screening Value
Camp Ravenna	Camp Ravenna Joint Military Training Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMCOC	Contaminant Migration Chemical of Concern
CMCOPC	Contaminant Migration Chemical of Potential Concern
COC	Chemical of Concern
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSEM	Conceptual Site Exposure Model
CSM	Conceptual Site Model
DAF	Dilution Attenuation Factor
DERR	Division of Environmental Response and Revitalization
DFFO	Director’s Final Findings and Orders
DNT	Dinitrotoluene
DoD	United States Department of Defense
DPT	Direct Push Technology
DQO	Data Quality Objective
EcoSSL	Ecological Soil Screening Level
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ERS	Ecological Risk Screening
ESV	Ecological Screening Value
EU	Exposure Unit
FCR	Field Change Request
f_{oc}	Soil Organic Carbon-Content
FS	Feasibility Study
FWCUG	Facility-Wide Cleanup Goal
FWERWP	Facility-Wide Ecological Risk Work Plan
FWGWMP	Facility-Wide Groundwater Monitoring Program
FWHHRAM	Facility-Wide Human Health Risk Assessor Manual
FWQAPP	Facility-Wide Quality Assurance Project Plan

ACRONYMS AND ABBREVIATIONS (CONTINUED)

FWSAP	Facility-Wide Sampling and Analysis Plan
gpm	Gallons Per Minute
GPS	Global Positioning System
GRA	General Response Action
GSSL	Generic Soil Screening Level
HELP	Hydrologic Evaluation of Landfill Performance
HHRA	Human Health Risk Assessment
HHRS	Human Health Risk Screening
HI	Hazard Index
HLC	Henry's Law Constant
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	Hazard Quotient
IA	Inactive Area
IDW	Investigation-Derived Waste
ILCR	Incremental Lifetime Cancer Risk
INRMP	Integrated Natural Resources Management Plan
IRIS	Integrated Risk Information System
ISM	Incremental Sampling Method
K_ds	Distribution Coefficients
K_{oc}	Water/Organic Carbon Partition Coefficient
K_{ow}	Octanol-Water Partition Coefficient
LDR	Land Disposal Restriction
MARC	Multiple Award Remediation Contract
MCL	Maximum Contaminant Level
MDC	Maximum Detected Concentration
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
MI	Multi-Incremental
MMRP	Military Munitions Response Program
mph	Miles per hour
MRS	Munitions Response Site
NCP	National Contingency Plan
NFA	No Further Action
NOAEL	No Observed Adverse Effect Level
OE	Ordnance and Explosives
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
ORAM	Ohio Rapid Assessment Method
PAH	Polycyclic Aromatic Hydrocarbon
PBA	Performance-Based Acquisition
PBA08 RI	Performance-Based Acquisition 2008 Remedial Investigation

ACRONYMS AND ABBREVIATIONS (CONTINUED)

PBA08 SAP	Performance Based Acquisition 2008 Supplemental Investigation Sampling and Analysis Plan Addendum No. 1
PBT	Persistent, Bioaccumulative, and Toxic
PCB	Polychlorinated Biphenyl
PP	Proposed Plan
PRG	Preliminary Remediation Goal
QA	Quality Assurance
QC	Quality Control
R	Retardation Factor
RAO	Remedial Action Objective
RD	Remedial Design
RDA	Recommended Dietary Allowance
RDI	Recommended Daily Intake
RDX	Cyclotrimethylenetrinitramine
REIMS	Ravenna Environmental Information Management System
RfD	Reference Dose
RI	Remedial Investigation
ROD	Record of Decision
RRSE	Relative Risk Site Evaluation
RSL	Regional Screening Level
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SESOIL	Seasonal Soil Compartment Model
SOR	Sum-of-Ratios
SRC	Site-Related Contaminant
SSL	Soil Screening Level
SSSL	Site-Specific Soil Screening Level
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TestAmerica	TestAmerica Laboratories, Inc.
TNB	Trinitrobenzene
TNT	2,4,6-Trinitrotoluene
TR	Target Risk
UCL	Upper Confidence Limit
URF	Unit Risk Factor
USACE	United States Army Corps of Engineers
USACHPPM	United States Army Center for Health Promotion and Preventative Medicine
USEPA	United States Environmental Protection Agency
U.S. Army	United States Department of the Army
USP&FO	U.S. Property and Fiscal Officer

ACRONYMS AND ABBREVIATIONS (CONTINUED)

VOC	Volatile Organic Compound
WOE	Weight-of-Evidence

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION AND SCOPE

This document was prepared by Leidos; formerly a part of Science Applications International Corporation (SAIC), under the U.S. Army Corps of Engineers (USACE), Louisville District, Multiple Award Remediation Contract (MARC) W912QR-04-D-0028, Delivery Order No. 0001, entitled 2008 Performance-based Acquisition (PBA) for Environmental Investigation and Remediation at the Ravenna Army Ammunition Plant (RVAAP).

This Remedial Investigation (RI) Report addresses soil, sediment, and surface water at Atlas Scrap Yard located within the former RVAAP. Atlas Scrap Yard is designated as area of concern (AOC) RVAAP-50. This RI Report was prepared in accordance with the Ohio Environmental Protection Agency (Ohio EPA) Director's Final Findings and Orders (DFFO) for RVAAP, dated June 10, 2004, and conforms to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requirements.

This RI Report for Atlas Scrap Yard presents the following:

- A description of the operational history and environmental setting for Atlas Scrap Yard;
- A summary of all Atlas Scrap Yard historical investigations;
- A summary of field activities and results of the Performance-based Acquisition 2008 Remedial Investigation (PBA08 RI), conducted from February 2010 through April 2010 and April 2011 at the AOC;
- A description of the nature and extent of contamination, including the identification of site-related contaminants (SRCs) by screening all eligible historical and PBA08 RI data against RVAAP background screening values (BSVs), essential human nutrients, and frequency of detection/weight-of-evidence (WOE) screening;
- An evaluation of contaminant fate and transport that identifies contaminant migration chemicals of potential concern (CMCOPCs) and contaminant migration chemicals of concern (CMCOCs) that may pose a future threat to groundwater;
- A human health risk assessment (HHRA) to identify chemicals of potential concern (COPCs) and chemicals of concern (COCs);
- An ecological risk assessment (ERA) to identify chemicals of potential ecological concern (COPECs) and chemicals of ecological concern; and
- Conclusions of the report.

Under the scope of this RI Report, the term "sediment" refers to frequently or permanently inundated wet sediment, as defined by RVAAP guidelines. Sediment and perennial surface water are not present within Atlas Scrap Yard. Most surface water occurs as intermittent storm water in drainage ditches within the AOC. Identified wetland areas within the AOC are ephemeral and contain water on an intermittent basis. Therefore, surface water samples have not been collected within the AOC and sediment within drainage ditches and wetland areas is considered dry sediment. As further discussed in Section ES.3.1, nature and extent evaluation includes sediment and surface water samples collected from the primary drainage ditch exiting the AOC to the east and flowing beneath Paris-Windham Road into Load Line 12. Dry sediment is not covered with water for extended periods and typically is dry within seven days of a precipitation event. Dry sediment does not function as a permanent habitat for aquatic organisms, although it may serve as a natural medium for the growth of terrestrial organisms. Surface water is only present at the AOC during times of heavy rainfall; therefore, wet sediment and perennial surface water are not considered media of concern at Atlas Scrap Yard. The entire ground surface at Atlas Scrap Yard is evaluated as soil in the nature and extent characterization, fate and transport evaluation, and HHRA. The nine identified wetlands (created by vernal surface water) are evaluated as part of the ERA. These definitions and terminology are consistent with the *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010a) (herein referred to as the FWCUG Report).

The scope of this RI Report does not include a full evaluation of groundwater contamination, nature and extent, risk assessment, and remedial alternatives (if required). Groundwater will be evaluated as an individual AOC for the entire facility (designated as RVAAP-66) and addressed in a separate RI Report. However, the potential for soil contaminants to leach to and migrate in groundwater is evaluated in this RI Report to determine whether soil remedial actions to protect groundwater may be necessary. The storm and sanitary sewers present at Atlas Scrap Yard will be evaluated under RVAAP-67 Facility-Wide Sewers.

ES.2 EVALUATION OF FUTURE USE

In February 2014, the U.S. Department of the Army (U.S. Army) and Ohio EPA amended the risk assessment process to address changes in the RVAAP restoration program. The *Final Technical Memorandum: Land Uses and Revised Risk Assessment Process for the RVAAP Installation Restoration Program* (ARNG 2014) identified three Categorical Land Uses and Representative Receptors to be considered during the RI phase of the CERCLA process. Unrestricted (Residential) Land Use, using the Resident Receptor (Adult and Child) as the Representative Receptor, is considered protective for all three Land Uses at Camp Ravenna. Therefore, if an AOC meets the requirements for Unrestricted (Residential) Land Use, then the AOC is also considered to have met the requirements of the other Land Uses, and the other Land Uses do not require evaluation.

ES.3 AOC DESCRIPTION

Atlas Scrap Yard, formally known as the construction camp, is approximately 73 acres and is located in the southeastern portion of Camp Ravenna. There is no fence around the AOC as a perimeter boundary, but the AOC is bordered by Newton Falls Road to the north and Paris-Windham Road to the east. Load Line 4 is located to the south of the AOC. The interior of the AOC is currently vegetated with shrub/scrub vegetation in unpaved areas and is forested around its perimeter. The north-central portion of the AOC is sparsely vegetated due to extensive gravel cover and mulch-like material. The majority of the AOC is part of the Military Munitions Response Program (MMRP), designated as Munitions Response Site (MRS) RVAAP-050-R-01.

Atlas Scrap Yard has served several operational functions over the history of former RVAAP, but the AOC was never used for munitions production activities. From 1940-1945, Atlas Scrap Yard operated as a construction camp to house workers and their families while the facility was being constructed. By the end of World War II, the majority of buildings and structures at Atlas Scrap Yard were demolished or relocated to other areas of the facility. The structures that remained were used to support roads and grounds maintenance activities. These remaining structures were razed after the Vietnam War. After the Vietnam War, the AOC became a stockpile storage area for bulk materials, including gravel, railroad ballasts, sand, and culvert pipes. Coal, used for building process heat, was piled in several areas of the AOC. The central-east portion of the AOC was a staging area for salvaged ammunition boxes from demilitarized Vietnam War munitions.

The AOC can be divided into two exposure units for evaluation, the active storage area (ASA) and inactive area (IA). The ASA consists of approximately 16 acres and is located in the north central portion of the AOC. The ASA has historically and is currently used for stockpiling a variety of salvaged inert materials, including railroad ties and concrete and brick. The ASA contains staging areas, multiple access roads, and parking areas made up of slag and asphalt gravel, and is currently the location of staged railroad ties and telephone poles. The IA is 57 acres and is generally not actively utilized for storage. Potential Atlas Scrap Yard chemicals include residues from storing material at the AOC such as explosives, target analyte list (TAL) metals, and semi-volatile organic compounds (SVOCs).

ES.4 FINDINGS OF THE REMEDIAL INVESTIGATION

This section presents the data used in this RI and the SRC, COPC, and COC screening and evaluation processes. Summaries of the contaminant nature and extent, fate and transport, HHRA, and ERA are also presented, followed by the conclusions of the RI.

ES.4.1 Data Use and Sample Selection Process

Quality-assured sample data from the Characterization of 14 AOCs (MKM 2007) was used with data from the PBA08 RI to evaluate nature and extent of contamination at Atlas Scrap Yard. These investigations used incremental sampling methods (ISM) and discrete sampling methods.

All available sample data collected were evaluated to determine suitability for use in various key RI data screens and evaluations (nature and extent, fate and transport, risk assessment). Evaluating data suitability for use in the PBA08 RI involved two primary considerations: (1) how the current AOC conditions are represented; and (2) sample collection methods (e.g., discrete vs. ISM).

New data collected in 2010 and 2011 as part of the PBA08 RI focused on delineating the extent of contaminants in surface soil [0-1 ft below ground surface (bgs)] and subsurface soil (1-13 ft bgs).

Since ISM was used for surface soil (0-1 ft bgs) as part of the Characterization of 14 AOCs, ISM was also used for surface soil sampling during the PBA08 RI. The PBA08 RI sampled locations with the greatest likelihood of contamination (e.g., adjacent to or within former site feature areas, such as storage piles). The samples were analyzed for chemicals identified in the historical investigations.

In addition to ISM for surface soil samples, surface soil and subsurface soil samples were collected using discrete sampling methods. Soil samples were analyzed for TAL metals, explosives, and polycyclic aromatic hydrocarbons (PAHs). Additionally, 15% of the soil samples and all sediment and surface water samples were analyzed for RVAAP full-suite analytes [i.e., TAL metals, explosives, propellants (nitrocellulose and nitroguanidine), SVOCs, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), and pesticides]. Data quality objectives (DQOs) and the scope of the PBA08 RI were outlined in the PBA 2008 Supplemental Investigation Sampling Analysis Plan Addendum No. 1 (USACE 2009).

The PBA08 RI sampling completed for Atlas Scrap Yard is summarized below:

- Fifty-three ISM surface soil samples from 0-1 ft bgs were collected to delineate the extent of chemicals above screening levels in previously sampled areas and to characterize areas not formerly sampled;
- Three discrete surface soil samples from 0-1 ft bgs were collected for chromium speciation analyses;
- Nineteen soil borings were installed and discrete surface and subsurface soil samples were collected from each boring to depths up to 13 ft bgs;
- One co-located surface water and sediment sample was collected at Load Line 12 to characterize current conditions and assess exit pathways from Atlas Scrap Yard; and
- Four undisturbed samples were collected from two subsurface soil borings for geotechnical analysis.

ES.4.2 SRC/COPC/COC and Selection Processes

The process presented in Figure ES-1 was used to identify the SRCs and COPCs used in the COC selection process. The SRCs, COPCs, and COCs for each exposure medium are presented in Table ES-1.

ES.4.2.1 SRC Screening Process

The steps involved in the SRC screening process are summarized below.

- Data quality assessment: PBA08 RI data were produced, reviewed, and reported by the laboratory in accordance with specifications in the PBA08 Sampling and Analysis Plan (SAP), the Louisville District analytical quality assurance (QA) guidelines, and the laboratory's QA manual. TestAmerica Laboratories, Inc. performed in-house analytical data reduction under the direction of the laboratory project manager and QA officer. Leidos performed a systematic process, utilizing automated data review software for data verification to ensure the precision and accuracy of the analytical data were adequate for their intended use. “Definitive Data” were reported consistent with the deliverables identified in the project SAP. In addition to the Leidos data review, USACE performed a 10% validation of all data to evaluate data usability. Historical data quality assessments can be found in their respective investigation reports.

- Background screening: The maximum detected concentrations (MDCs) of inorganic chemicals were compared to RVAAP BSVs. If BSVs were exceeded, the respective inorganic chemicals were retained as SRCs. No BSVs were established for organic chemicals. As such, all detected organic chemicals were retained as SRCs.
- Screening of essential human nutrients: Chemicals that are considered essential nutrients (e.g., calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) are an integral part of the human food supply and are often added to foods as supplements. Essential nutrients detected at or below their recommended daily allowance or recommended daily intake (RDA/RDI) screening levels were eliminated as SRCs.
- Frequency of detection/WOE screening: Chemicals that were not detected in a given medium were eliminated as SRCs. For chemicals with at least 20 discrete samples and a frequency of detection of less than 5%, a WOE approach was used to determine if the chemical was related to the AOC. This screening was applied to all organic and inorganic chemicals with the exception of explosives and propellants; all detected explosives and propellants were considered SRCs regardless of frequency of detection. At Atlas Scrap Yard, 20 discrete subsurface soil samples were available for frequency of detection screening; however, no SRCs were screened out on this basis. The frequency of detection/WOE screening was not applied to ISM samples.

ES.4.2.2 COPC Screening Process

To determine COPCs, the MDC of all SRCs was screened against the most stringent chemical-specific facility-wide cleanup goals (FWCUGs) at a target cancer risk level of 1E-06 and a non-carcinogenic target hazard quotient (HQ) of 0.1 for the Resident Receptor (Adult and Child) and National Guard Trainee. If no FWCUGs existed for an SRC, the USEPA Residential Regional Screening Level (RSL) (from RSL table dated November 2012) was used. The HHRA was initiated prior to completion of the Technical Memorandum; therefore, the RSL table dated November 2012 was used. If the MDC exceeded the FWCUG or RSL, the chemical was identified as a COPC.

ES.4.2.3 COC Selection Process

The COC determination process is as follows:

- Report all carcinogenic- and non-carcinogenic-based FWCUGs corresponding to a target risk (TR) of 1E-05 and target HQ of 1.0 using the most stringent of the Resident Receptor

Adult and Resident Receptor Child FWCUGs to evaluate Unrestricted (Residential) Land Use for each COPC. If no FWCUG is available for a COPC, the Residential RSL, adjusted to represent a TR of 1E-05 or target HQ of 1.0, is used.

- Report critical effect and target organ for each non-carcinogenic-based FWCUG.
- Compare selected FWCUG to the exposure point concentration (EPC), including a sum-of-ratios (SOR):
    - For non-carcinogens, compare the EPC to the target HQ FWCUG. Sum the ratios of the EPC/FWCUG for COPCs that affect similar target organs or do not have an identified target organ.
    - For carcinogens, compare the EPC to the TR FWCUG. Sum the ratios of the EPC/FWCUG for all carcinogens.
- The COPC is identified as a COC if:
    - The EPC exceeds the Resident Receptor (Adult and Child) FWCUG for either the 1E-05 target cancer risk or the 1.0 target HQ; or
    - The SOR for all carcinogens or all non-carcinogens that may affect the same organ is greater than one. Chemicals contributing at least 10% to the SOR are also considered COCs. Chemicals contributing greater than 5% but less than 10% to the SOR must be further evaluated before being eliminated as COCs.

ES.4.3 Summary of Contaminant Nature and Extent

The 2004 Characterization of 14 AOCs, 2010 PBA08 RI, and subsequent 2011 PBA08 RI sampling data provides effective characterization of the nature and extent of the contamination at the AOC, and no further sampling is required.

As discussed previously, surface water exists only as storm water runoff. Consequently, sediment and perennial surface water are not media of concern within Atlas Scrap Yard. However, sediment samples ASYsd-024M-SD (Characterization of 14 AOCs) and L12sd-308 (PBA08 RI for Load Line 12) located in the ditch east of Atlas Scrap Yard along Paris-Windham Road are included in the nature and extent evaluation. One surface water sample (L12sw-308) was collected in the ditch east of Atlas Scrap Yard along Paris-Windham Road under the PBA08 RI for Load Line 12. Sample location L12sw-308 is included in the risk assessments in the *Phase III Remedial Investigation Report for Sediment and Surface Water at the RVAAP-12 Load Line 12* (USACE 2010c).

This RI Report evaluates all available data with respect to usability and identifies SRCs. Data were aggregated by environmental media (e.g., soil) and spatially to account for AOC-specific data types and physical characteristics. Soil was evaluated as surface soil (0-1 ft bgs) and subsurface soil (> 1 ft bgs). Figures ES-2 and ES-3 illustrate all sample locations used in evaluating contaminant nature and extent.

The predominant SRCs in surface and subsurface soil at Atlas Scrap Yard were PAHs, which were observed in all surface soil samples analyzed across the entire AOC. Inorganic chemicals were also observed in soil at concentrations above their respective background concentrations throughout the AOC. Detections of explosives, propellants, VOCs, pesticides, and PCBs were limited in frequency. A summary of observations for each medium is presented below.

ES.4.3.1 Surface Soil

The predominant SRCs for surface soil at Atlas Scrap Yard were inorganic chemicals and SVOCs, the majority of which were PAHs. Of the 53 SRCs identified in surface soil, 26 were SVOCs (16 were PAHs). Although SVOCs are widely distributed in surface soil, the highest concentrations of SRCs were observed in the north-central portion of the AOC in the vicinity of the ASA. As indicated by the April 2011 sampling event, the highest concentrations of PAHs are from the parking areas made up of slag and asphalt gravel (locations ASY-116M, ASY-117M, ASY118M, and ASY-119M) and in the ditch adjacent to an access road (locations ASY-123M and ASY-126M). The lower PAH concentrations from the April 2011 sampling event were from the sample areas encircling the existing railroad tie pile.

Sixteen inorganic chemicals were identified as SRCs in surface soil, with the highest number of inorganic SRCs detected at their maximum concentration at historical sample location ASYss-019M located in the vicinity of the former incinerator. Eight explosives, one propellant (nitrocellulose), one VOC (acetone), and one PCB (PCB-1260) were also identified as SRCs. No pesticides were detected or identified as SRCs in surface soil.

ES.4.3.2 Subsurface Soil

Thirty SRCs were identified in subsurface soil. Seventeen SVOCs were identified as SRCs, 16 of which were PAHs. The sample with the greatest number and highest concentrations of PAH SRCs was the 1-4 ft bgs interval at ASYsb-063, located within a drainage ditch east of Atlas Scrap Yard along the west side of Paris-Windham Road. All 16 PAH SRCs were detected at ASYsb-063, with 15 observed at their maximum concentrations in the 1-4 ft bgs sample, and likely sourced from road runoff. Seven inorganic chemicals were identified as SRCs in subsurface soil. Detections of inorganic chemicals above background concentrations were generally sporadic across the AOC and occurred within a narrow range of concentration. Two explosives [3-nitrotoluene and octahydro-1,3,5,7-tetranitroi-1,3,5,7-tetrazocane (HMX)], one propellant (nitrocellulose), and three VOCs (2-butanone, carbon disulfide, and toluene) were also identified as SRCs in subsurface soil. No pesticides or PCBs were identified as SRCs for subsurface soil.

ES.4.3.3 Sediment

The ISM sample (ASYsd-024M-SD) and discrete sample (L12sd-308) collected from the drainage ditch east of Atlas Scrap Yard were screened separately for SRCs due to the use of different sampling methodologies. Twenty-two SRCs were identified for the discrete sample dataset; 11 SRCs were identified for the ISM screening dataset. Seventeen SVOCs were identified as SRCs in the discrete sediment dataset. SVOCs were not analyzed in the historical ISM sediment sample. Five inorganic chemicals were identified as SRCs in discrete sediment; 10 inorganic SRCs were identified for the ISM sediment dataset. Explosives were not detected or identified as SRCs for the discrete sediment sample, and the explosive 2-amino-4,6-dinitrotoluene (DNT) was identified as an SRC for the ISM sediment dataset only. No PCBs were detected or identified as SRCs for the discrete dataset for Atlas Scrap Yard; these analyses were not performed on the historical ISM sample.

ES.4.3.4 Surface Water

Twenty-five SRCs were identified in surface water for Atlas Scrap Yard: 17 inorganic chemicals (16 metals and nitrate), seven SVOCs (six PAHs), and one pesticide [delta-hexachlorobenzene (BHC)]. Six of the inorganic chemicals observed in surface water sample L12sw-308 (aluminum, arsenic, barium, copper, manganese, and zinc) had concentrations that were on average an order of magnitude higher than their respective background concentrations. With the exception of bis(2-ethylhexyl)phthalate, all SVOC SRCs detected at surface water location L12sw-308 were also detected in the co-located PBA08 RI sediment sample at this location (L12sd-308). No propellants, explosives, PCBs, or VOCs were detected in surface water for Atlas Scrap Yard.

ES.4.4 Summary of Contaminant Fate and Transport

All SRCs identified in the surface soil, subsurface soil, and sediment at Atlas Scrap Yard were evaluated through the stepwise contaminant fate and transport evaluation. The evaluation included analysis of two contaminant migration pathways: (1) leaching and migration from soil to groundwater; and (2) partitioning contaminants from sediment to surface water within the drainage ditch along Paris-Windham Road with transferal to groundwater through surface water/groundwater interaction.

Maximum concentrations of SRCs identified in surface and subsurface soil were evaluated using a series of generic screening steps to identify initial contaminant migration CMCOPCs. Initial CMCOPCs for soil were further evaluated using the Seasonal Soil Compartment (SESOIL) model to predict leaching concentrations and identify final CMCOPCs based on RVAAP BSVs and the lowest risk-based screening criteria among USEPA maximum contaminant levels (MCLs), USEPA tap water RSLs, or RVAAP groundwater FWCUGs for the Resident Receptor Adult. Final CMCOPCs were evaluated using the Analytical Transient 1-, 2-, 3-Dimensional (AT123D) model to predict groundwater mixing concentrations beneath source areas and concentrations at the nearest downgradient groundwater receptor locations to the AOC (e.g., streams). Maximum SRC concentrations in sediment were evaluated using an analytical solution to identify final CMCOPCs for evaluation using AT123D. The AT123D modeling results were evaluated with respect to AOC groundwater monitoring data, as well as model limitations and assumptions, to identify chemicals to be retained as CMCOCs that may warrant further evaluation in a Feasibility Study (FS).

Conclusions of the soil and sediment screening, leachate modeling, and groundwater modeling are as follows:

- The AT123D model predicted maximum future groundwater concentrations for the final soil CMCOPCs 2-nitrotoluene, 3-nitrotoluene, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-methylnaphthalene, and naphthalene that exceed groundwater screening criteria beneath soil source areas, but do not exceed groundwater screening criteria at the downgradient receptor locations [i.e., unnamed tributary to Sand Creek (flowing northwest) and unnamed tributary to the Mahoning River (flowing southwest)]. Predicted groundwater concentrations of the final sediment CMCOPCs barium; chromium; copper; lead; mercury; selenium; 2-amino-4,6-DNT; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene also do not exceed groundwater screening criteria at the downgradient receptor location [unnamed tributary to Cobbs Ponds (flowing northeast)].
- Evaluation of modeling results, with respect to current AOC groundwater data and model limitations, indicate that identified CMCOPCs are not currently impacting groundwater beneath the source areas and that modeling assumptions are conservative. Evaluation of predicted breakthrough curves show peak concentrations for sediment CMCOPCs and for four soil CMCOPCs (nitrotoluene, 3-nitrotoluene, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) would have occurred in the past. Potential future impacts predicted by the model for remaining soil CMCOPCs would likely be mitigated by factors such as chemical and biological degradation, lateral dispersivity, and AOC–specific variations soil geochemistry.

All SRCs were eliminated as posing future impacts to groundwater, and no further action (NFA) is necessary for surface soil, subsurface soil, and sediment to protect groundwater.

ES.4.5 Summary of the Human Health Risk Assessment

The HHRA identified COCs and conducted risk management analysis to identify COCs requiring potential remediation based on potential risks to human receptors. Camp Ravenna is a controlled access facility. Atlas Scrap Yard is located in the central portion of the facility and is currently used for railroad tie and salvaged inert materials storage. An evaluation using Resident Receptor (Adult and Child) FWCUGs was used to evaluate Unrestricted (Residential) Land Use. Unrestricted (Residential) Land Use is considered protective for all categories of Land Use on the former RVAAP/Camp Ravenna.

Media of concern evaluated in the HHRA were surface soil (0-1 ft bgs) and subsurface soil (1-13 ft bgs). Surface water and sediment samples were not collected within the AOC during the PBA08 RI, as perennial surface water bodies are not present at the AOC. The only soil COCs identified were PAHs [benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene]. Concentrations of these chemicals detected in soil either exceeded FWCUGs or contributed to an SOR greater than one.

At the ASA, PAHs are present at the highest concentrations at locations consisting of parking areas made up of slag and asphalt gravel (locations ASY-116M, ASY-117M, ASY-118M, and ASY-119M) and the ditchline paralleling the site access road (ASY-123M and ASY-126M). In addition, there is ongoing storage of railroad ties and salvaged inert materials at the AOC. These do not represent a CERCLA-related release. At the IA, PAHs are present at much lower concentrations. Evaluation of PAH concentrations associated with common anthropogenic (non-CERCLA) sources using available data from RVAAP background soil samples and other regional environmental studies of environmental concentrations of PAHs indicate the PAH concentrations at the IA are indicative of releases from road dust, vehicle exhaust, tire wear particles, ballast and pavement from roads and parking areas, and slag used as fill. Thus, there are no CERCLA-release related sources of PAHs at this AOC. No CERCLA-release related COCs pose an unacceptable risk to human health; therefore no COCs require remediation or evaluation in an FS.

ES.4.6 Summary of the Ecological Risk Assessment

There is chemical contamination present in soil at Atlas Scrap Yard. This contamination was identified using historical and PBA08 RI data. Wetlands are important and significant ecological resources near contamination in the AOC. These findings invoked a Level II assessment.

The Level II assessment evaluated soil data and identified COPECs. There are 28 integrated COPECs for soil at Atlas Scrap Yard. Aluminum; arsenic; cadmium; chromium; cobalt; copper; lead; manganese; mercury; selenium; silver; zinc; 2,6-DNT; benz(a)anthracene; benzo(a)pyrene; bis(2-ethylhexyl)phthalate; chrysene; and naphthalene are the 18 integrated COPECs that exceeded their background concentrations and ecological screening values (ESVs). Nine chemicals (2-amino-4,6-DNT; 2-nitrotoluene; 3-nitrotoluene; 4-amino-2,6-DNT; HMX; nitrocellulose; tetryl; carbazole; and dibenzofuran) are integrated COPECs because they did not have an ESV. Mercury and PCB-1260 are persistent, bioaccumulative, and toxic (PBT) compounds.

The integrated soil COPECs were further evaluated with technical and refinement factors in Step 3A. The factors in Step 3A showed there are no integrated COPECs that are of ecological concern requiring remediation or further evaluation. Consequently, the ERA for Atlas Scrap Yard can conclude with Level II that NFA is necessary from the ecological perspective.

ES.4.7 Conclusions of the Remedial Investigation

Historical investigations and the PBA08 RI have adequately characterized Atlas Scrap Yard. Further investigation is not warranted at this AOC for the following reasons: (1) the nature and extent of impacted media has been sufficiently characterized; (2) the fate and transport modeling did not identify soil CMCOCs requiring further evaluation or remediation to protect groundwater; (3) there are no CERCLA-release related human health COCs identified in soil, sediment, or surface water requiring further evaluation in an FS or remediation; and (4) remedial actions to protect ecological resources are not warranted. Accordingly, NFA is necessary for soil, sediment and surface water at Atlas Scrap Yard to attain Unrestricted (Residential) Land Use.

The next step in the CERCLA process is to prepare a proposed plan (PP) to solicit public input with respect to NFA for soil, sediment, and surface water. The PP will provide a brief summary of the history, characteristics, risks, and the basis for NFA. Comments on the PP received from state and federal agencies and the public will be considered in preparation of a record of decision (ROD) to document the final remedy. The ROD will also include a responsiveness summary addressing comments received on the PP.

Table ES-1. SRCs, COPCs, and COCs in Soil

	SRCs[a]		COPCs[b]		COCs[c]	
Detected Analyte	**0-1 ft bgs**	**1-13 ft bgs**	**0-1 ft bgs**	**1-13 ft bgs**	**0-1 ft bgs**	**1-13 ft bgs**
Metals						
Aluminum	X	--	X	--	--	--
Arsenic	X	X	X	X	--	--
Barium	X	--	--	--	--	--
Beryllium	X	X	--	--	--	--
Cadmium	X	X	X	--	--	--
Chromium	X	--	X	--	--	--
Cobalt	X	X	X	X	--	--
Copper	X	--	--	--	--	--
Lead	X	X	X	--	--	--
Manganese	X	--	X	--	--	--
Mercury	X	--	--	--	--	--
Nickel	X	--	--	--	--	--
Selenium	X	X	--	--	--	--
Silver	X	X	--	--	--	--
Thallium	X	--	--	--	--	--
Zinc	X	--	--	--	--	--
Explosives						
1,3,5-Trinitrobenzene	X	--	--	--	--	--
2,6-Dinitrotoluene	X	--	--	--	--	--
2-Amino-4,6-Dinitrotoluene	X	--	--	--	--	--
2-Nitrotoluene	X	--	--	--	--	--
3-Nitrotoluene	X	X	--	--	--	--
4-Amino-2,6-Dinitrotoluene	X	--	--	--	--	--
HMX	X	X	--	--	--	--
Nitrocellulose	X	X	--	--	--	--
Tetryl	X	--	--	--	--	--
Semi-volatile Organic Compounds						
2-Methylnaphthalene	X	--	--	--	--	--
4-Methylphenol	X	--	--	--	--	--
Acenaphthene	X	X	--	--	--	--
Acenaphthylene	X	X	--	--	--	--
Anthracene	X	X	--	--	--	--
Benz(a)anthracene	X	X	X	X	X	--
Benzenemethanol	X	--	--	--	--	--

Table ES-1. SRCs, COPCs, and COCs in Soil (continued)

Detected Analyte	SRCs[a]		COPCs[b]		COCs[c]	
	0-1 ft bgs	1-13 ft bgs	0-1 ft bgs	1-13 ft bgs	0-1 ft bgs	1-13 ft bgs
Benzenemethanol	X	--	--	--	--	--
Benzo(a)pyrene	X	X	X	X	X	--
Benzo(b)fluoranthene	X	X	X	X	X	--
Benzo(ghi)perylene	X	X	--	--	--	--
Benzo(k)fluoranthene	X	X	X	--	--	--
Bis(2-ethylhexyl)phthalate	X	X	--	--	--	--
Butyl benzyl phthalate	X	--	--	--	--	--
Carbazole	X	--	--	--	--	--
Chrysene	X	X	X	--	--	--
Di-n-butyl phthalate	X	--	--	--	--	--
Dibenz(a,h)anthracene	X	X	X	X	X	--
Dibenzofuran	X	--	--	--	--	--
Diethyl phthalate	X	--	--	--	--	--
Fluoranthene	X	X	--	--	--	--
Fluorene	X	X	--	--	--	--
Indeno(1,2,3-cd)pyrene	X	X	X	X	X	--
Naphthalene	X	X	--	--	--	--
Phenanthrene	X	X	--	--	--	--
Phenol	X	--	--	--	--	--
Pyrene	X	X	--	--	--	--
Pesticides/PCBs						
PCB-1260	X	--	--	--	--	--
Volatile Organic Compounds						
Acetone	X	--	--	--	--	--
2-Butanone	--	X	--	--	--	--
Carbon disulfide	--	X	--	--	--	--
Toluene	--	X	--	--	--	--

[a] SRCs determined for surface soil (0-1 ft bgs) and all subsurface soil depths (> 1 ft bgs) based on RVAAP facility-wide soil background values.

[b] COPCs determined using most restrictive Facility-Wide Cleanup Goals (total risk = 10^{-6}/hazard index =0.1) for either Resident or National Guard Trainee receptors.

[c] COCs determined using most restrictive Facility-Wide Cleanup Goals (total risk = 10^{-5}/hazard index =1.0) for Resident Adult or Child and Sum-of-Ratios.

COC = Chemical of concern.
COPC = Chemical of potential concern.
Ft bgs = Feet below ground surface.
HMX = Octahydro-1,3,5,7-tetranitroi-1,3,5,7-tetrazocane.
PCB = Polychlorinated biphenyl.
SRC = Site-related contaminant.
X = Chemical identified as a SRC, COPC, or COC.
-- = Chemical not identified as a SRC, COPC, or COC.

Screening methods, receptors and exposure depths defined in the RVAAP Facility-Wide Human Health Risk Assessor's Manual (USACE 2005b) and Facility-Wide Human Health Cleanup Goals Report (USACE 2010a) and Position Paper for Human Health FWCUGs (USACE 2012b).

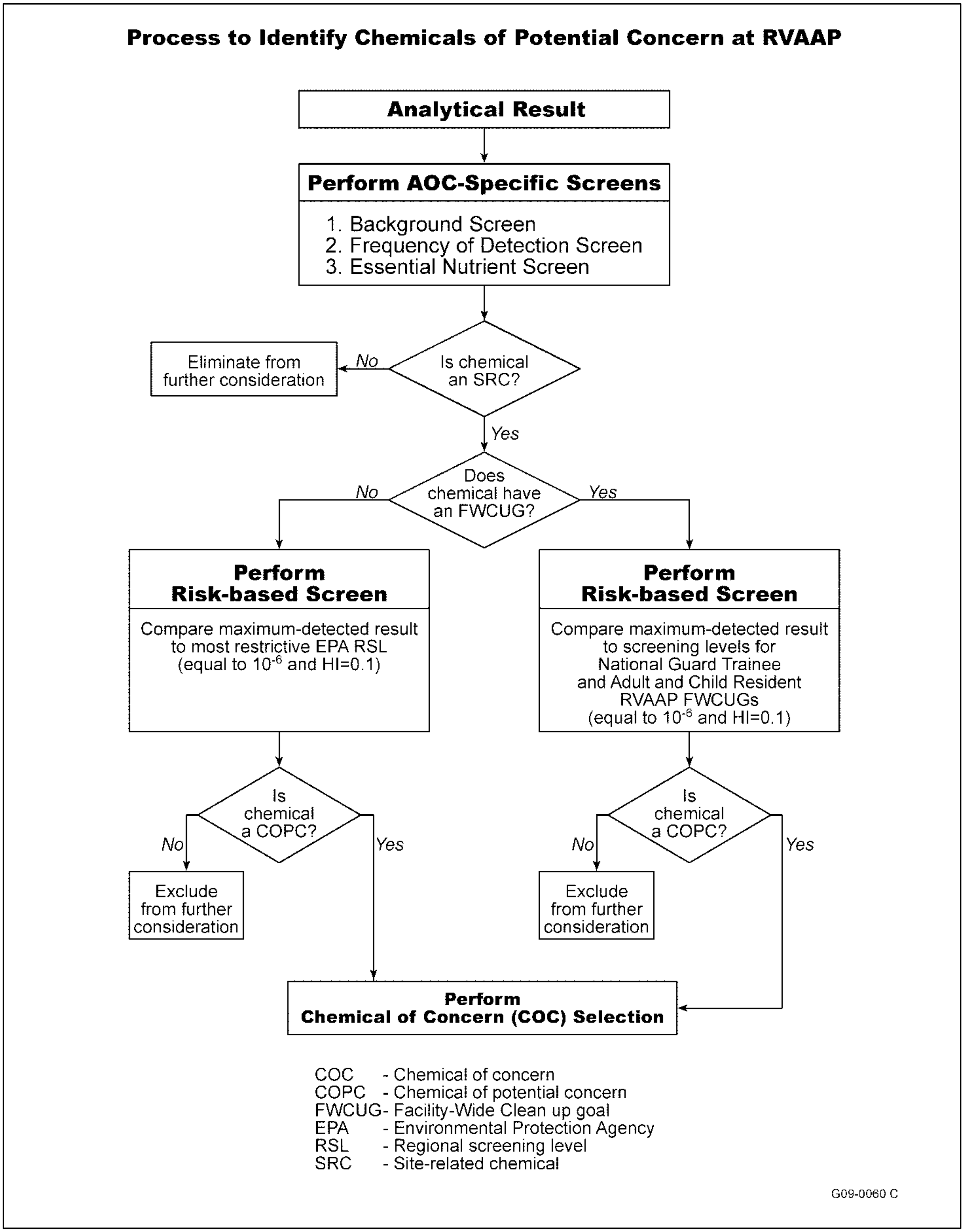

Figure ES-1. Process to Identify RVAAP COPCs in the Human Health Risk Assessment (USACE 2010a)

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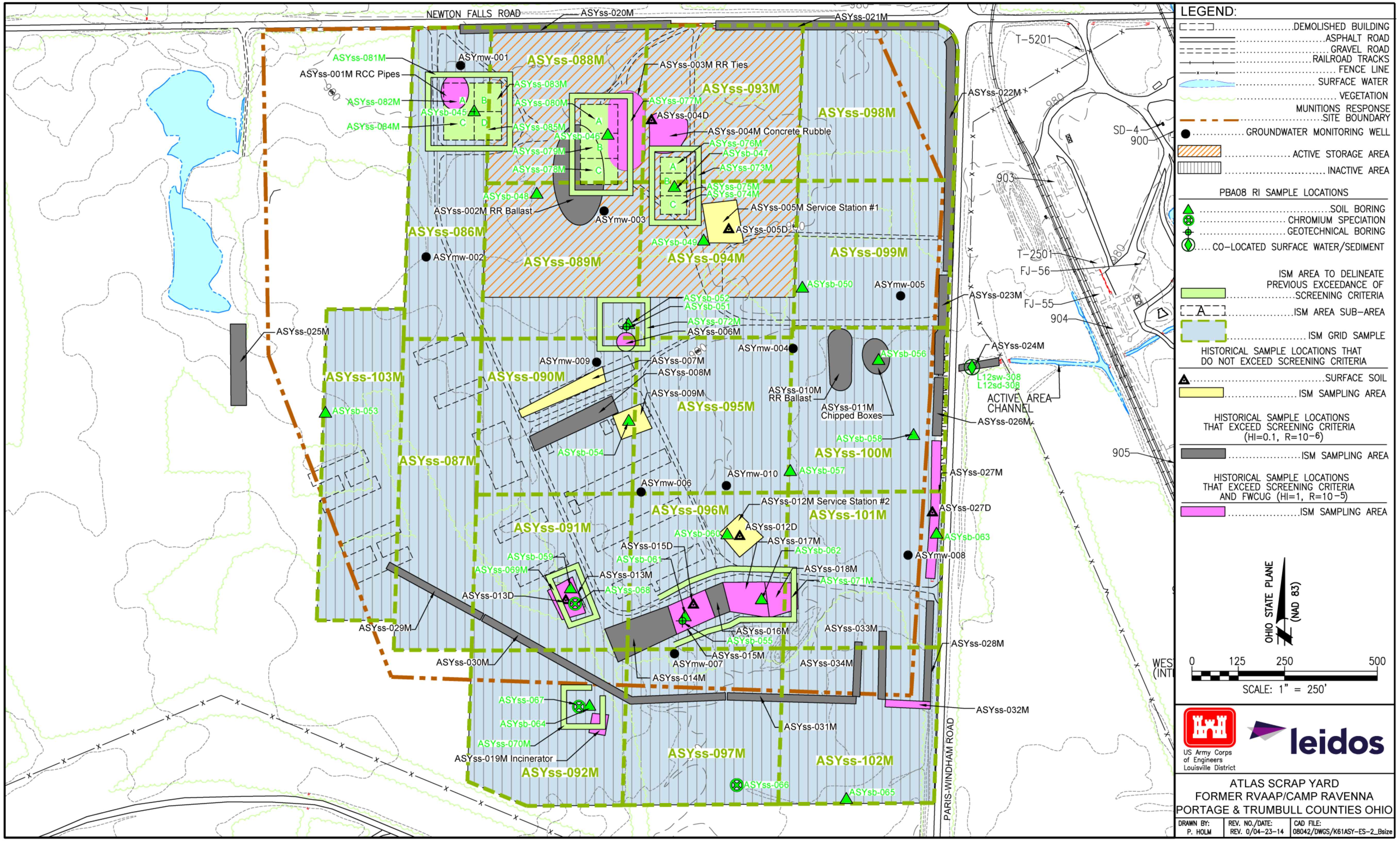

Figure ES-2. PBA08 RI and Historical RI Sampling Locations

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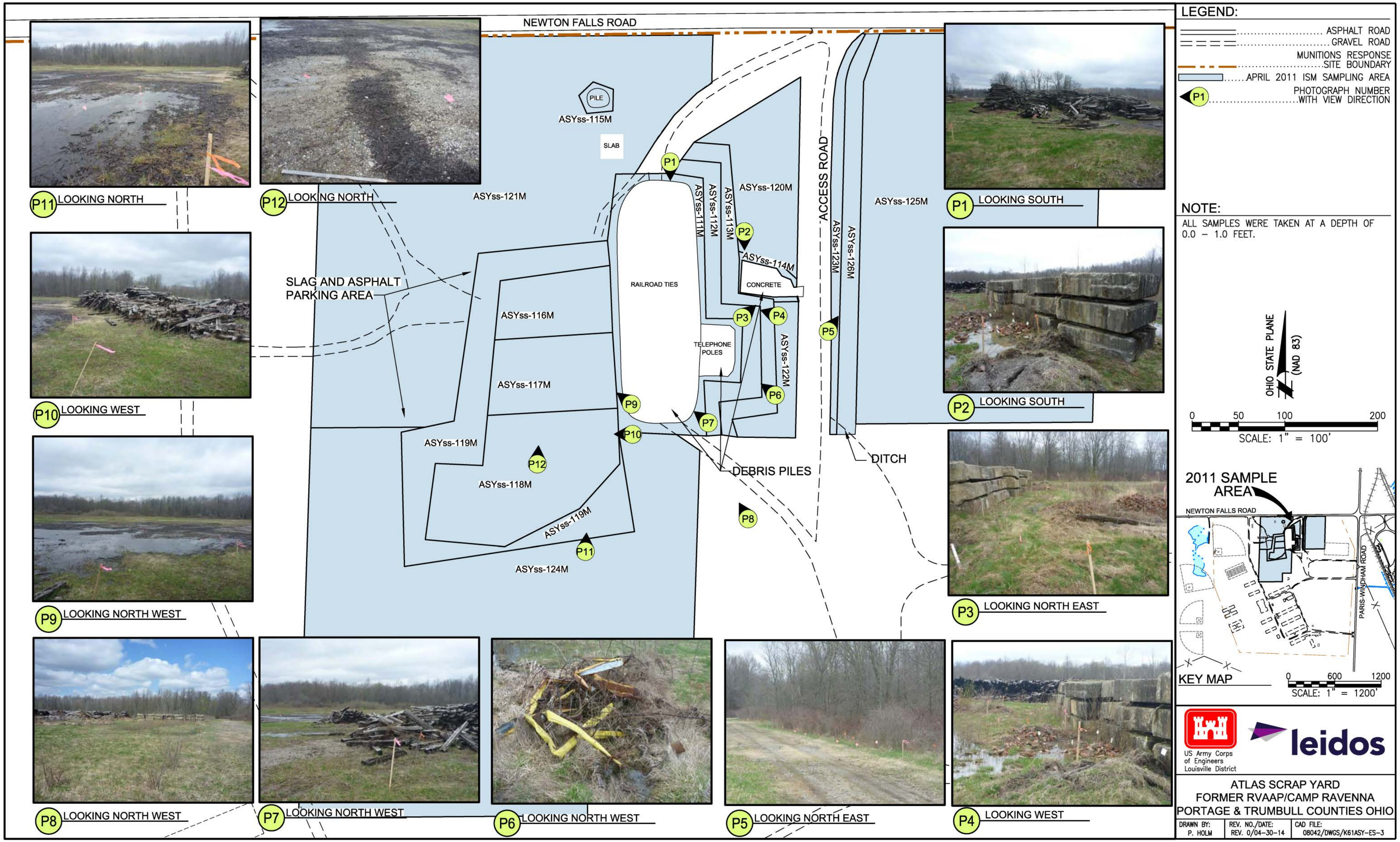

Figure ES-3. April 2011 Active Storage Area Sample Locations

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1.0 INTRODUCTION

This document was prepared by Leidos; formerly a part of Science Applications International Corporation (SAIC), under the U.S. Army Corps of Engineers (USACE), Louisville District, Multiple Award Remediation Contract (MARC) W912QR-04-D-0028, Delivery Order No. 0001, entitled 2008 Performance-based Acquisition (PBA) for Environmental Investigation and Remediation at the former Ravenna Army Ammunition Plant (RVAAP).

This Remedial Investigation (RI) Report addresses soil, sediment, and surface water at Atlas Scrap Yard at the former RVAAP. Atlas Scrap Yard is designated as area of concern (AOC) RVAAP-50 within the former RVAAP (now known as Camp Ravenna) in Portage and Trumbull counties, Ohio (Figures 1-1 and 1-2). Planning and performance of all elements of this PBA are in accordance with the requirements of the Ohio Environmental Protection Agency (Ohio EPA) Director's Final Findings and Orders (DFFO) for RVAAP, dated June 10, 2004 (Ohio EPA 2004). The DFFO requires conformance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to implement an RI to characterize the AOC, develop a Feasibility Study (FS) Report (if necessary) and evaluate remedial alternatives to address contamination presenting unacceptable risk to human health and the environment, present a preferred alternative in a proposed plan (PP), and document stakeholder selection and acceptance of the preferred final remedy in a record of decision (ROD). Figure 1-3 presents this process.

This RI Report for Atlas Scrap Yard presents the following:

- A description of the operational history and environmental setting for Atlas Scrap Yard;
- A summary of all Atlas Scrap Yard historical investigations;
- A summary of field activities and results of the Performance-based Acquisition 2008 Remedial Investigation (PBA08 RI), conducted from February 2010 through April 2010 and April 2011 at the AOC;
- A description of the nature and extent of contamination, including the identification of site-related contaminants (SRCs) by screening all eligible historical and PBA08 RI data against RVAAP background screening values (BSVs), essential human nutrients, and frequency of detection/weight-of-evidence (WOE) screening;
- An evaluation of contaminant fate and transport that identifies contaminant migration chemicals of potential concern (CMCOPCs) and contaminant migration chemicals of concern (CMCOCs) that may pose a future threat to groundwater;
- A human health risk assessment (HHRA) to identify chemicals of potential concern (COPCs) and chemicals of concern (COCs);
- An ecological risk assessment (ERA) to identify chemicals of potential ecological concern (COPECs) and chemicals of ecological concern; and
- Conclusions of the report.

Based on the outcome of the evaluation in this RI Report, the preferred alternative will be submitted for public review and comment in a PP. Public comments will be considered in the final selection of a remedy, which will be documented in the ROD.

1.1 EVALUATION OF LAND USE

In February 2014, the U.S. Department of the Army (U.S. Army) and Ohio EPA amended the risk assessment process to address changes in the RVAAP restoration program. The *Final Technical Memorandum: Land Uses and Revised Risk Assessment Process for the RVAAP Installation Restoration Program* (ARNG 2014) (herein referred to as the Technical Memorandum) identified three Categorical Land Uses and Representative Receptors to be considered during the RI phase of the CERCLA process. Unrestricted (Residential) Land Use, using the Resident Receptor (Adult and Child) as the Representative Receptor, is considered protective for all three Land Uses at Camp Ravenna. Therefore, if an AOC meets the requirements for Unrestricted (Residential) Land Use, then the AOC is also considered to have met the requirements of the other Land Uses, and those other Land Uses do not require evaluation.

1.2 PURPOSE

The purpose of the PBA08 RI at Atlas Scrap Yard was to supplement data from previous sampling events to delineate the nature and extent of contamination, evaluate contaminant fate and transport, and complete an HHRA and ERA to support remedial decisions. Depending on the results of the RI, a conclusion of NFA is provided or an FS will be completed to evaluate potential remedies and future actions.

1.3 SCOPE

The scope of this RI Report is to present: (1) the nature and extent of contamination, fate and transport of contaminants in the environment, and risk assessments for surface and subsurface soil at Atlas Scrap Yard; and (2) a conclusion of NFA or remedial alternatives for meeting RAOs for any CERCLA-related COCs requiring remediation at the AOC.

For the purposes of this report, the term “surface soil” includes dry sediment. Dry sediment refers to unconsolidated inorganic and organic material within conveyances, ditches, or low lying areas that occasionally may be covered with water, usually following a precipitation event or due to snowmelt. Dry sediment is not covered with water for extended periods and typically is dry within seven days of precipitation. Dry sediment does not function as a permanent habitat for aquatic organisms, although it may serve as a natural medium for the growth of terrestrial organisms. Dry sediment is addressed the same as surface soil [0-1 ft below ground surface (bgs)] in terms of contaminant nature and extent, fate and transport, and risk exposure models. The term “sediment,” as used in this report, refers to wet sediment within conveyances, ditches, wetlands, or water bodies that are inundated for extended periods of time. These definitions and terminology usage are consistent with the *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant, Ravenna, Ohio*

(USACE 2010a) (herein referred to as the FWCUG Report). Sediment and perennial surface water are not present within the AOC. Surface water is only present at the AOC during times of heavy rainfall and discharges towards Load Line 12 under Paris-Windham Road.

Potential impacts to groundwater from soil (e.g., contaminant leaching) are evaluated in this report, as protectiveness to groundwater is included in the fate and transport analysis. However, groundwater will be evaluated as an individual AOC for the entire facility (designated as RVAAP-66) and addressed in a separate RI Report. All buildings and structures at Atlas Scrap Yard have been demolished; therefore, they are not evaluated as continuing sources of contamination in this report.

Only sanitary sewers are present at Atlas Scrap Yard; evidence of a former storm sewer network could not be found. As part of the RVAAP-67 Facility-Wide Sewers RI, sewer sediment, sewer water, and pipe bedding material media were sampled and evaluated and inorganic chemicals and semi-volatile organic compounds (SVOCs) were identified as the predominant sewer SRCs. Additionally, for sewers at the Atlas Scrap Yard, fate and transport modeling was performed, and an HHRA and ERA were conducted for sewers. These evaluations concluded that NFA is necessary with respect to the Facility-Wide Sewers within Atlas Scrap Yard. The full evaluation with conclusion is presented in the *Remedial Investigation/Feasibility Study Report for RVAAP-67 Facility-Wide Sewers* (USACE 2012d).

1.4 REPORT ORGANIZATION

This report is organized in accordance with Ohio EPA and USEPA CERCLA RI and applicable USACE guidance. The following is a summary of the components of the report and a list of appendices:

- Section 2.0 provides the history of the former RVAAP and Atlas Scrap Yard and a summary of previous investigations;
- Section 3.0 describes the environmental setting at Camp Ravenna and Atlas Scrap Yard, including the geology, hydrogeology, climate, population, and ecological resources;
- Section 4.0 describes the specific methods used for collecting field data during the PBA08 RI and the approach taken to manage analytical data and laboratory programs;
- Section 5.0 presents the data generated during historical investigations and the PBA08 RI, methodology for screening data, and discusses the occurrence and distribution of contamination at the AOC;
- Section 6.0 presents an evaluation of contaminant fate and transport;
- Section 7.0 includes the methods and results of the HHRA and ERA;
- Section 8.0 provides the conclusions of the RI;
- Section 9.0 summarizes the framework for conducting the necessary agency and public involvement activities; and
- Section 10.0 provides references.
- Appendices:
  Appendix A. Field Sampling Logs

Appendix B. Project Quality Assurance Summary
Appendix C. Data Quality Control Summary Report
Appendix D. Laboratory Analytical Results and Chains of Custody
Appendix E. Fate and Transport Modeling Results
Appendix F. Investigation-derived Waste Management Reports
Appendix G. Human Health Risk Assessment Tables
Appendix H. Ecological Risk Assessment Information and Data
Appendix I. Ordnance and Explosives Avoidance Survey Report

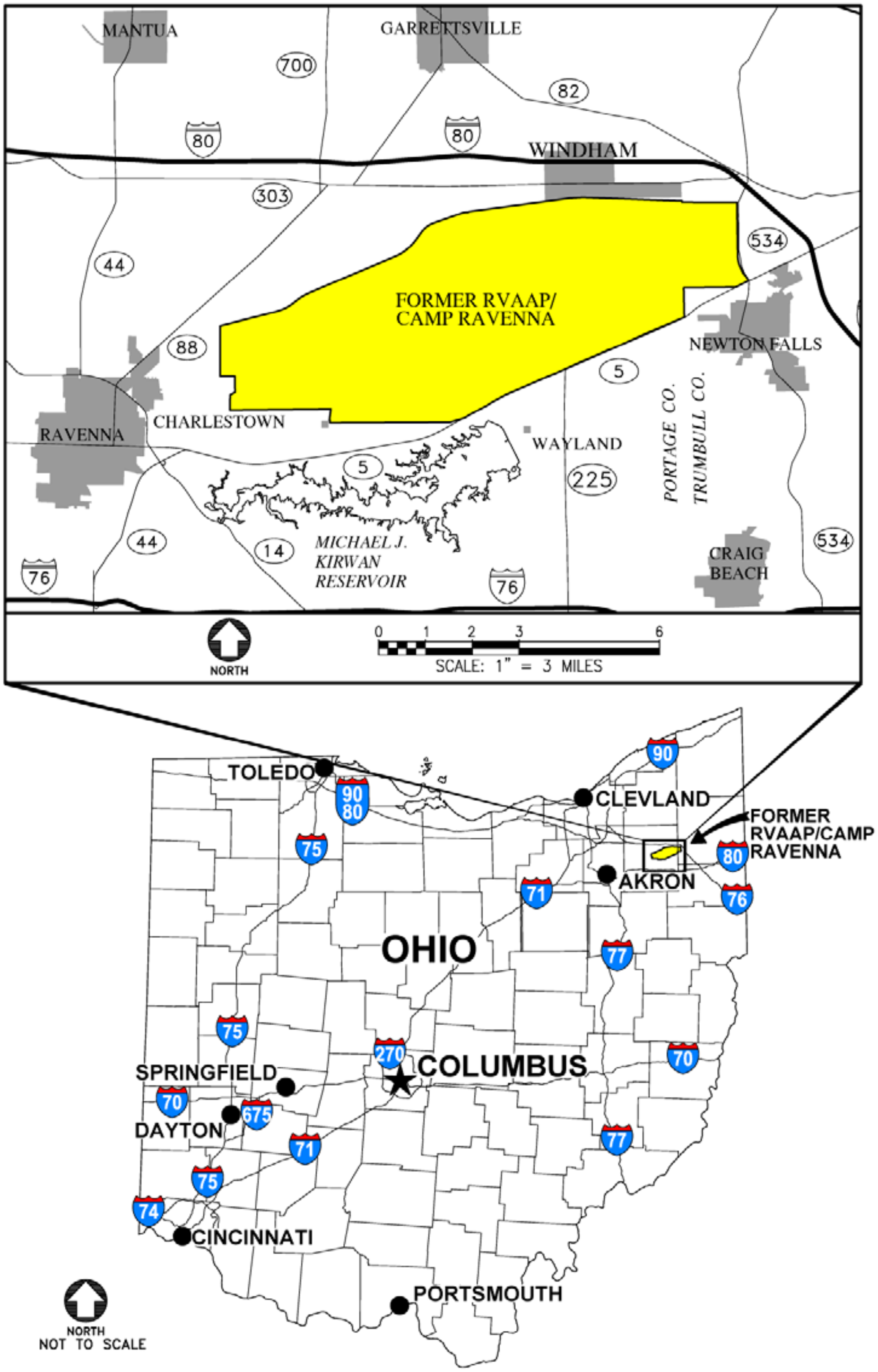

Figure 1-1. General Location and Orientation of Camp Ravenna

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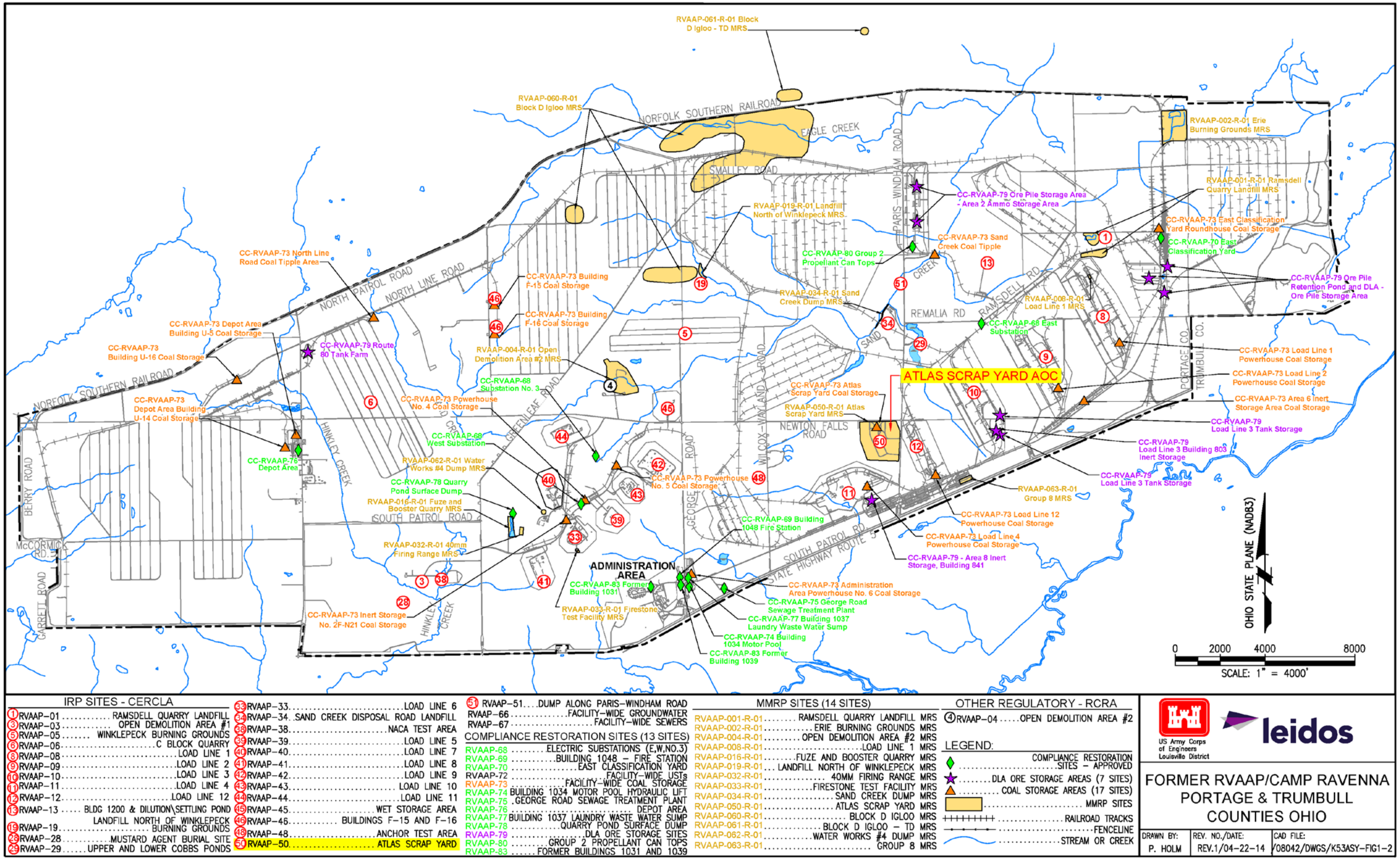

Figure 1-2. Location of AOCs and Munitions Response Sites at Camp Ravenna

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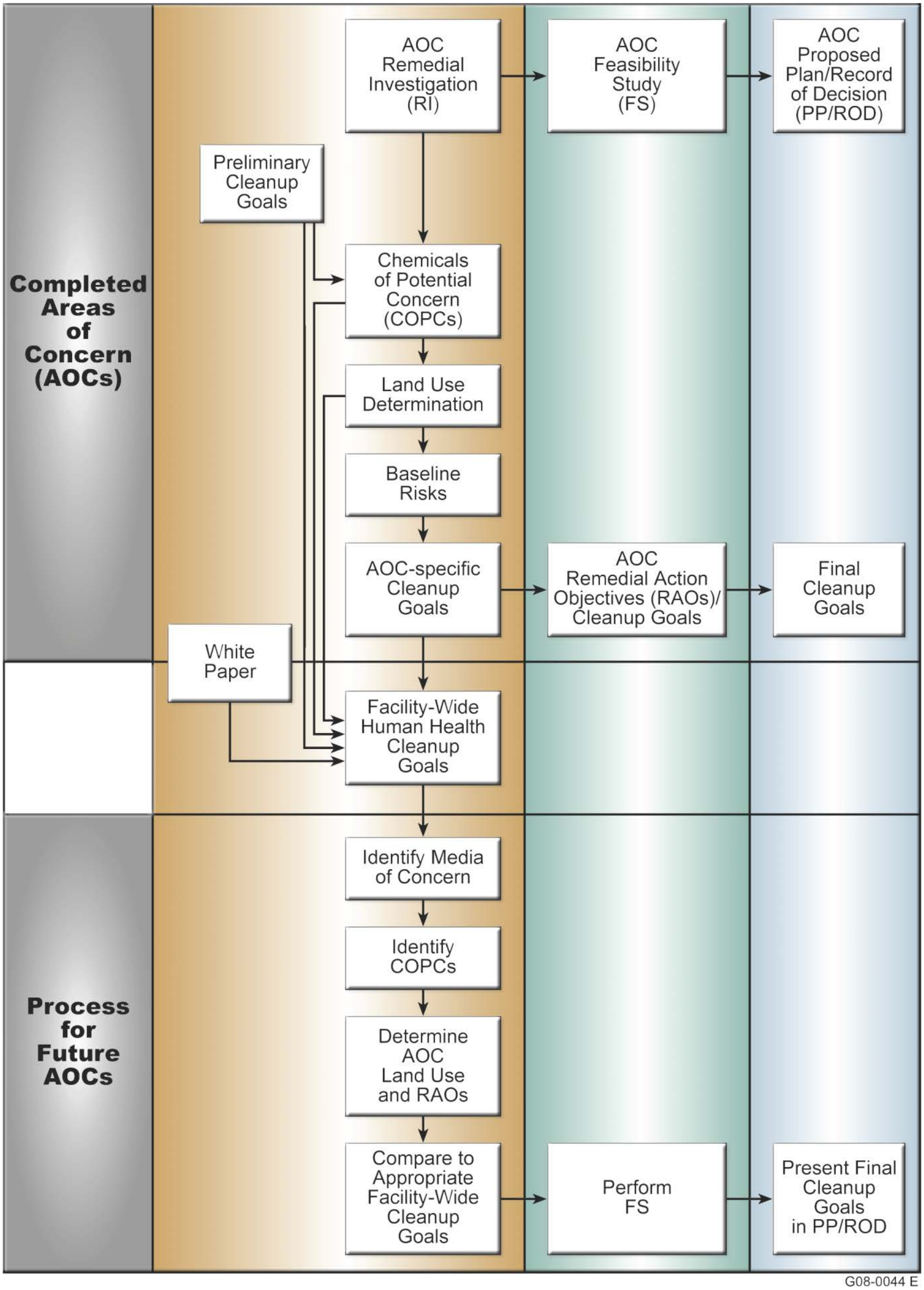

Figure 1-3. Process for Developing Remedial Decisions at Areas of Concern (USACE 2010a)

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2.0 BACKGROUND

This section provides a description of the Camp Ravenna facility and Atlas Scrap Yard and of the operational history, building demolition activities, and previous investigations at Atlas Scrap Yard.

2.1 FACILITY-WIDE BACKGROUND INFORMATION

2.1.1 General Facility Description

The facility, consisting of 21,683 acres, is located in northeastern Ohio within Portage and Trumbull counties, approximately 4.8 kilometers (3 miles) east/northeast of the City of Ravenna and approximately 1.6 kilometers (1 mile) northwest of the City of Newton Falls. The facility, previously known as RVAAP, was formerly used as a load, assemble, and pack facility for munitions production. As of September 2013, administrative accountability for the entire acreage of the facility has been transferred to the U.S. Property and Fiscal Officer (USP&FO) for Ohio and subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a military training site (Camp Ravenna). References in this document to RVAAP relate to previous activities at the facility as related to former munitions production activities or to activities being conducted under the restoration/cleanup program.

2.1.2 Demography and Land Use

Camp Ravenna occupies east-central Portage County and southwestern Trumbull County. Census projections for 2010 indicate the populations of Portage and Trumbull counties are 161,419 and 210,312, respectively. Population centers closest to Camp Ravenna are Ravenna (population of 11,724) and Newton Falls (population of 4,795).

The facility is located in a rural area and is not close to any major industrial or developed areas. Approximately 55% of Portage County, where the majority of Camp Ravenna is located, consists of either woodland or farmland acreage. The closest major recreational area, the Michael J. Kirwan Reservoir (also known as West Branch Reservoir), is located adjacent to the western half of Camp Ravenna, south of State Route 5.

Camp Ravenna is federally owned and is licensed to the OHARNG for use as a military training site. Restoration activities at Camp Ravenna are managed by the Army National Guard and OHARNG. Training and related activities at Camp Ravenna include field operations and bivouac training, convoy training, maintaining equipment, C-130 aircraft drop zone operations, helicopter operations, and storing heavy equipment.

2.2 ATLAS SCRAP YARD BACKGROUND INFORMATION

2.2.1 Operational History

Atlas Scrap Yard, formally known as the construction camp, is approximately 73 acres and is located in the southeastern portion of Camp Ravenna (Figure 2-1). There is no fence around the AOC as a perimeter boundary, but the AOC is bordered by Newton Falls Road to the north and Paris-Windham Road to the east. Load Line 4 is located to the south of the AOC. The interior of the AOC is currently vegetated with shrub/scrub vegetation in unpaved areas and is forested around its perimeter. The north-central portion of Atlas Scrap Yard is sparsely vegetated due to extensive gravel and mulch-like material cover. Additionally, stockpiles of concrete debris, railroad ties, and telephone poles are present.

Atlas Scrap Yard has served several operational functions over the history of the former RVAAP, but the AOC was never used for munitions production activities. From 1940 to 1945, Atlas Scrap Yard operated as a construction camp to house workers and their families during construction of the facility. By the end of World War II, the majority of buildings and structures at Atlas Scrap Yard were demolished or relocated to other areas of the facility. Following WWII through the 1950s, four additional storage structures were constructed in the north central storage and stockpiling area. These new structures, along with the pre-WWII structures that remained, were used to support roads and grounds maintenance activities. All remaining structures were razed after the Vietnam War. After the Vietnam War, the north central portion of Atlas Scrap Yard became exclusively utilized as a stockpile storage area for bulk material, including gravel, railroad ballasts, sand, culvert pipe, railroad ties, and telephone poles. This north central portion of Atlas Scrap Yard is still actively utilized for ongoing materials storage. Coal, used for building process heat, was piled in several areas of AOC, including the north central stockpiling area (SAIC 2011). The central-east portion of the AOC was a staging area for salvaged ammunition boxes from demilitarized Vietnam War munitions.

The AOC can be divided into two exposure units, an active storage area (ASA) and an inactive area (IA), as illustrated on Figure 2-1. The ASA consists of approximately 16 acres and is located in the north central portion of the AOC. The ASA was historically used as a crushed slag parking area from 1940-1945 when the construction camp was operational (Wilbur et al., 1942). Since 1945, the ASA has been utilized for stockpiling a variety of salvaged inert materials, including railroad ties and concrete and brick and is currently active.

The remaining 57 acres of the IA in Atlas Scrap Yard are not actively utilized for storage. Potential Atlas Scrap Yard chemicals within the IA are residues from storing material at the AOC such as explosives, target analyte list (TAL) metals, and SVOCs.

Historical facilities at Atlas Scrap Yard included 25 buildings used during World War II and eight buildings used from 1945 through the Vietnam War. The locations of the former buildings are shown on Figure 2-1. There are no records to document the existence of Buildings T-1 and T-24.

A building utilization summary for the construction camp period (1940-1945) is listed below:

- Buildings T-2, T-3, T-4, T-17, and T-18 - Offices;
- Building T-5 - Field Hospital;
- Building T-6 - Materials Testing Laboratory;
- Buildings T-7, T-8, T-9, T-10, T-11, and T-21 - Dormitories;
- Building T-12 - Cafeteria;
- Building T-13 - Workman's Sheds;
- Building T-14 - Garage;
- Buildings T-15 and T-22 - Service Stations;
- Building T-16 - Blacksmith Shop;
- Building T-19 - Fire Station;
- Building T-20 - Tool Crib;
- Building T-23 - Commissary;
- Building T-25 - Truck Grease Rack; and
- The Incinerator Building

According to AOC schematics, areas denoted as parking areas for these buildings were composed of crushed slag. Although no formal demolition report exists, all buildings except for Buildings T-14, T-16, T-18, and T-19 were recorded as having been demolished or relocated by December 1944. All buildings were razed, with material salvaged for use in maintenance construction except Buildings T-2, T-4, T-5, T-12, and T-20 that were directly relocated to the Administration Area. The brick structure associated with the incinerator is still present, but other components associated with the incinerator have been razed.

The four buildings (T-14, T-16, T-18, and T-19) that remained at Atlas Scrap Yard after the 1944 demolition were used for roads and ground equipment storage. According to AOC schematic B-1006-1, four additional buildings (T-3901, T-4703, T-4704, and T-4705) were constructed between 1945 and 1955 in the north-central portion of the AOC for roads and grounds maintenance activities (APCO 1955). A summary of buildings used for maintenance activities is provided below:

- Buildings T-14, T-16, and T-19 - Roads and Grounds Equipment Storage;
- Building T-18 - Roads and Grounds Office and Supply;
- Building T-3901 - Roads and Grounds Personnel;
- Building T-4703 - Storage Shed;
- Building T-4704 - Electrical Transmission Salvage Material Storage; and
- Building T-4705 - Roads and Grounds Storage.

Schematics indicate the north-central former parking area was used as a supply dump by the highway department (Anonymous 1944). No records exist to document the exact time period this area was used as a supply dump; however, material such as railroad ties and concrete debris are still actively stockpiled in this area. Demolition of all eight buildings occurred sometime after 1971. There is no formal demolition record documenting the date the buildings were razed.

The majority of the AOC is part of the Military Munitions Response Program (MMRP), designated as Munitions Response Site (MRS) RVAAP-050-R-01. Investigating the presence of munitions and explosives of concern (MEC) was not included as part of this RI, as it is a separate, ongoing investigation. Piles of scrap munitions, including tracer elements, 152mm M411 A1 trainers, 152mm prop charges, 152mm XM625 and M625A1 rounds, and other miscellaneous debris were previously identified in the central portion of the AOC (around Building T-18). Two parallel lines of 90mm packing boxes were identified in the east central portion of the AOC (USACHPPM 1998). The MRS boundary within Atlas Scrap Yard, per the MMRP Site Inspection Report (E2M 2008), is illustrated in Figure 2-1. The presence of MEC was not observed during the PBA08 RI field effort.

2.2.2 Previous Investigations

Atlas Scrap Yard has been included in various assessments and investigations conducted at the former RVAAP, including:

- Relative Risk Site Evaluation for Newly Added Sites (USACHPPM 1998); and
- Characterization of 14 AOCs (MKM 2007).

2.2.2.1 Relative Risk Site Evaluation for Newly Added Sites

In 1998, the U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) completed the *Relative Risk Site Evaluation for Newly Added Sites* (USACHPPM 1998), which identified and provided a risk evaluation for 13 newly discovered and previously uninvestigated AOCs for the purpose of prioritizing future remedial or corrective activities. Of the 13 identified AOCs, five were assigned a Relative Risk Site Evaluation (RRSE) score of “high,” and the remaining eight were assigned a score of “medium.”

The RRSE evaluated the soil pathway (human receptor endpoint) at Atlas Scrap Yard using data from seven surface soil samples analyzed for SVOCs, polychlorinated biphenyls (PCBs), herbicides, explosives, and TAL metals. The groundwater pathway (human receptor endpoint) was evaluated using data from one groundwater and two subsurface soil samples analyzed for the same compounds as surface soil, with the addition of volatile organic compounds (VOCs). Sediment was not identified at the AOC, and surface water was determined to occur only intermittently as storm water runoff. Therefore, sediment and surface water were not evaluated as part of the RRSE. The site map included in the 1998 RRSE illustrates locations where munitions, scrap metal, and other debris were observed.

Groundwater concentrations were calculated by modeling analytical data from a subsurface soil sample collected from the depth interval of 12-16 ft bgs in the eastern portion of the AOC. The groundwater sample was collected in the center of the AOC at a depth of 7 ft bgs. Ten inorganic chemicals, three VOCs (acetone, benzene, and toluene), one SVOC (naphthalene), and one explosive

(1,2,3-trichlorobenzene) were identified for groundwater based on detected concentrations and model calculations. Fifteen inorganic chemicals and 17 SVOCs were detected in surface soil. No explosives were detected. Concentrations of analytes detected in surface soil and groundwater are presented in Appendix D of the RRSE (USACHPPM 1998).

Human receptor endpoints were evaluated based on the available surface soil and groundwater data. The RRSE scored Atlas Scrap Yard as a “medium-priority” AOC due to potentially contaminated surface soil and groundwater potentially migrating and affecting human and ecological receptors (USACHPPM 1998).

2.2.2.2 Characterization of 14 AOCs

The Characterization of 14 AOCs [as described in the *Characterization of 14 AOCs at the Ravenna Army Ammunition Plant* (MKM 2007)] was performed to accomplish the following:

- Provide data for future assessments that may be conducted;
- Develop a conceptual site model (CSM);
- Identify key elements to be considered in future actions;
- Assess potential sources of contamination;
- Identify whether releases of contamination extend beyond the AOC boundary;
- Provide an initial assessment of the nature and lateral extent of contamination; and
- Provide preliminary human health risk screening (HHRS) and ecological risk screening (ERS) evaluations.

Results of this characterization are presented in the Characterization of 14 AOCs (MKM 2007) report. The following investigation field activities were conducted from August 2004 to May 2005 to assess the potential impacts from former operations at Atlas Scrap Yard (MKM 2007):

- Collected 33 multi-incremental (MI) surface soil (0-1 ft bgs) samples;
- Collected eight discrete surface soil (0-1 ft bgs) samples;
- Collected three surface soil quality assurance/quality control (QA/QC) samples;
- Excavated eight test trenches;
- Installed, developed, and sampled 10 groundwater monitoring wells;
- Collected geotechnical samples from monitoring well borings;
- Completed in-situ permeability testing (slug tests);
- Collected one incremental sampling method (ISM) sediment sample taken from a drainage ditch exiting the AOC;
- Collected surface water samples from sanitary sewers;
- Collected sediment samples from sanitary sewers;
- Completed sampling location and monitoring well survey; and
- Completed an electromagnetic geophysical investigation over the two former service stations with underground storage tanks.

The Characterization of 14 AOCs report utilized MI samples. This sampling technique is currently referred to as ISM. All ISM surface soil and sediment samples were analyzed for TAL) metals, explosives, and cyanide. In addition, four ISM surface soil samples were analyzed for SVOCs and three were analyzed for propellants, pesticides, and PCBs. Discrete surface soil samples were collected from six ISM sample areas for VOC analyses to fulfill requirements of conducting a full suite of analyses for 10% of the ISM sample population. Discrete VOC samples were not subjected to ISM sample processing. A summary of the analytes detected in the ISM samples during the Characterization of 14 AOCs are presented in Table 2-1 for surface soil and Table 2-2 for sediment.

During test trench excavation, activities were concluded upon encountering groundwater. Saturated conditions were encountered from 7.2-14 ft bgs. No visual evidence of contamination or MEC was encountered during trenching activities.

An HHRS and ERS for Atlas Scrap Yard were included in the Characterization of 14 AOCs report. The HHRS compared chemical concentrations detected in samples to RVAAP screening criteria in effect at that time, which included facility-wide background concentrations for inorganic chemicals and USEPA Region 9 residential preliminary remediation goals (PRGs). Constituents were retained if they did not have screening values. The results of the HHRS identified contaminants above screening criteria in surface soil and groundwater at Atlas Scrap Yard, as summarized in Table 2-3. Sediment and surface water samples collected during the investigation were associated only with infrastructure (i.e., sumps, basins, and sewers) or the ditch exiting the AOC and are not included in Table 2-2. Sediment and surface water were not present within drainage conveyances within the AOC during the Characterization of 14 AOCs investigation.

The ERS compared chemical concentrations detected in Atlas Scrap Yard environmental media to RVAAP facility-wide background concentrations for inorganic chemicals and ecological screening values (ESVs). The ERS followed screening methodology guidance presented in the *RVAAP Facility-Wide Ecological Risk Work Plan* (USACE 2003c) (herein referred to as the FWERWP) and *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2003). Chemicals were retained if they did not have screening values. Table 2-4 presents the chemicals identified in the ERS as exceeding screening values for Atlas Scrap Yard. Sediment and surface water samples collected during the investigation were associated only with infrastructure (i.e., sumps, basins, and sewers) or the ditch exiting the AOC and are not included in Table 2-2. Sediment and surface water were not present within drainage conveyances within the AOC during the Characterization of 14 AOCs investigation.

The Characterization of 14 AOCs report recommended that a full risk assessment should be considered to assist in the overall risk management decisions for Atlas Scrap Yard.

Table 2-1. Analytes Detected at Atlas Scrap Yard ISM Surface Soil Samples – Characterization of 14 AOCs

Analyte (mg/kg)	Freq of Detect	Minimum Detect	Maximum Detect	Average Detect
Inorganic Chemicals				
Aluminum	33/ 33	8100	24000	14500
Arsenic	33/ 33	4.8	41	10.6
Barium	33/ 33	51	290	129
Beryllium	33/ 33	0.54	4.5	1.55
Cadmium	26/ 33	0.09	9.5	0.875
Calcium	33/ 33	910	140000	29200
Chromium	33/ 33	12	64	21.6
Cobalt	33/ 33	2.1	19	6.84
Copper	33/ 33	8	200	23.7
Iron	33/ 33	11000	28000	19300
Lead	33/ 33	14	1200	75.1
Magnesium	33/ 33	1400	14000	4910
Manganese	33/ 33	95	3500	934
Mercury	28/ 33	0.02	0.64	0.1
Nickel	33/ 33	7.2	31	16.9
Potassium	33/ 33	890	2300	1400
Selenium	24/ 33	0.46	1.8	0.92
Silver	4/ 33	0.62	5.2	2.85
Sodium	33/ 33	250	1000	495
Thallium	4/ 33	0.24	0.35	0.275
Vanadium	33/ 33	10	26	18.5
Zinc	33/ 33	43	1800	156
Explosives and Propellants				
2-Amino-4,6-Dinitrotoluene	5/ 33	0.05	0.29	0.12
2-Nitrotoluene	2/ 33	0.24	0.43	0.335
3-Nitrotoluene	1/ 33	0.09	0.09	0.09
Nitrocellulose	2/ 3	1	1.7	1.35
Pesticides/PCBs				
PCB-1260	1/ 3	0.054	0.054	0.054
Semi-volatile Organic Compounds				
2-Methylnaphthalene	4/ 4	0.012	0.38	0.114
4-Methylphenol	2/ 4	0.015	0.016	0.0155
Acenaphthene	3/ 4	0.018	0.18	0.0847
Acenaphthylene	3/ 4	0.013	0.26	0.099
Anthracene	4/ 4	0.012	0.84	0.27
Benz(a)anthracene	4/ 4	0.073	2.9	1.01
Benzenemethanol	1/ 4	0.25	0.25	0.25
Benzo(a)pyrene	4/ 4	0.1	3.2	1.18
Benzo(b)fluoranthene	4/ 4	0.12	5.2	1.74
Benzo(ghi)perylene	4/ 4	0.079	2.1	0.852
Benzo(k)fluoranthene	4/ 4	0.079	2.2	0.77
Bis(2-ethylhexyl)phthalate	2/ 4	0.064	1.5	0.782
Butyl benzyl phthalate	1/ 4	0.24	0.24	0.24
Carbazole	1/ 4	0.15	0.15	0.15

Table 2-1. Analytes Detected at Atlas Scrap Yard ISM Surface Soil Samples - Characterization of 14 AOCs (continued)

Analyte (mg/kg)	Freq of Detect	Minimum Detect	Maximum Detect	Average Detect
Chrysene	4/ 4	0.12	3.4	1.15
Dibenz(a,h)anthracene	3/ 4	0.052	0.75	0.354
Dibenzofuran	3/ 4	0.011	0.14	0.063
Fluoranthene	4/ 4	0.12	4.2	1.58
Fluorene	3/ 4	0.018	0.13	0.066
Indeno(1,2,3-cd)pyrene	4/ 4	0.068	1.7	0.692
Naphthalene	4/ 4	0.013	0.31	0.0955
Phenanthrene	4/ 4	0.059	1.1	0.495
Phenol	2/ 4	0.0083	0.031	0.0197
Pyrene	4/ 4	0.14	4.5	1.62
Volatile Organic Compounds				
Acetone	1/ 6	0.022	0.022	0.022

mg/kg = Milligram per kilogram.
PCB = Polychlorinated biphenyl.

Table 2-2. Analytes Detected at Atlas Scrap Yard ISM Sediment Samples – Characterization of 14 AOCs

Analyte (mg/kg)	Freq of Detect	Minimum Detect	Maximum Detect	Average Detect
Inorganic Chemicals				
Aluminum	1/ 1	15000	15000	15000
Arsenic	1/ 1	10	10	10
Barium	1/ 1	140	140	140
Beryllium	1/ 1	1.2	1.2	1.2
Cadmium	1/ 1	1.8	1.8	1.8
Calcium	1/ 1	5500	5500	5500
Chromium	1/ 1	20	20	20
Cobalt	1/ 1	7.3	7.3	7.3
Copper	1/ 1	31	31	31
Iron	1/ 1	17000	17000	17000
Lead	1/ 1	37	37	37
Magnesium	1/ 1	2100	2100	2100
Manganese	1/ 1	420	420	420
Mercury	1/ 1	0.14	0.14	0.14
Nickel	1/ 1	20	20	20
Potassium	1/ 1	1400	1400	1400
Selenium	1/ 1	2.7	2.7	2.7
Sodium	1/ 1	450	450	450
Vanadium	1/ 1	24	24	24
Zinc	1/ 1	310	310	310
Explosives				
2-Amino-4,6-Dinitrotoluene	1/ 1	0.08	0.08	0.08

mg/kg = Milligram per kilogram.

Table 2-3. Human Health Chemicals of Potential Concern per the Characterization of 14 AOCs Report

Surface Soil		Groundwater
Aluminum	Benz(a)anthracene	Arsenic
Arsenic	Benzo(a) pyrene	Bis(2-ethylhexyl)phthalate
Cadmium	Benzo(b)fluoranthene	
Chromium	Benzo(ghi)perylene	
Iron	Dibenz(a,h)anthracene	
Lead	Indeno(1,2,3-c)pyrene	
Manganese	Phenanthrene	
2-methylnaphthalene	2-Amino-4,6-dinitrotoluene	
Acenaphthylene		

Adapted from Table L10-14: Characterization of 14 AOCs at the Ravenna Army Ammunition Plant (MKM 2007).

Table 2-4. Chemicals Exceeding Ecological Screening Values per the Characterization of 14 AOCs Report

Surface Soil		Groundwater
Aluminum Arsenic Barium Cadmium Chromium Copper Iron Lead Magnesium Nickel Selenium Silver Zinc Mercury	Arochlor 1260 4-methylphenol Benzo(a) pyrene Bis(2-ethylhexyl)phthalate Butylbenzyl phthalate Dibenzofuran Naphthalene 2-Amino-4,6-dinitrotoluene 2-Nitrotoluene 3-Nitrotolune Nitrocellulose	Medium not evaluated

Adapted from Table L10-14: Characterization of 14 AOCs at the Ravenna Army Ammunition Plant (MKM 2007).

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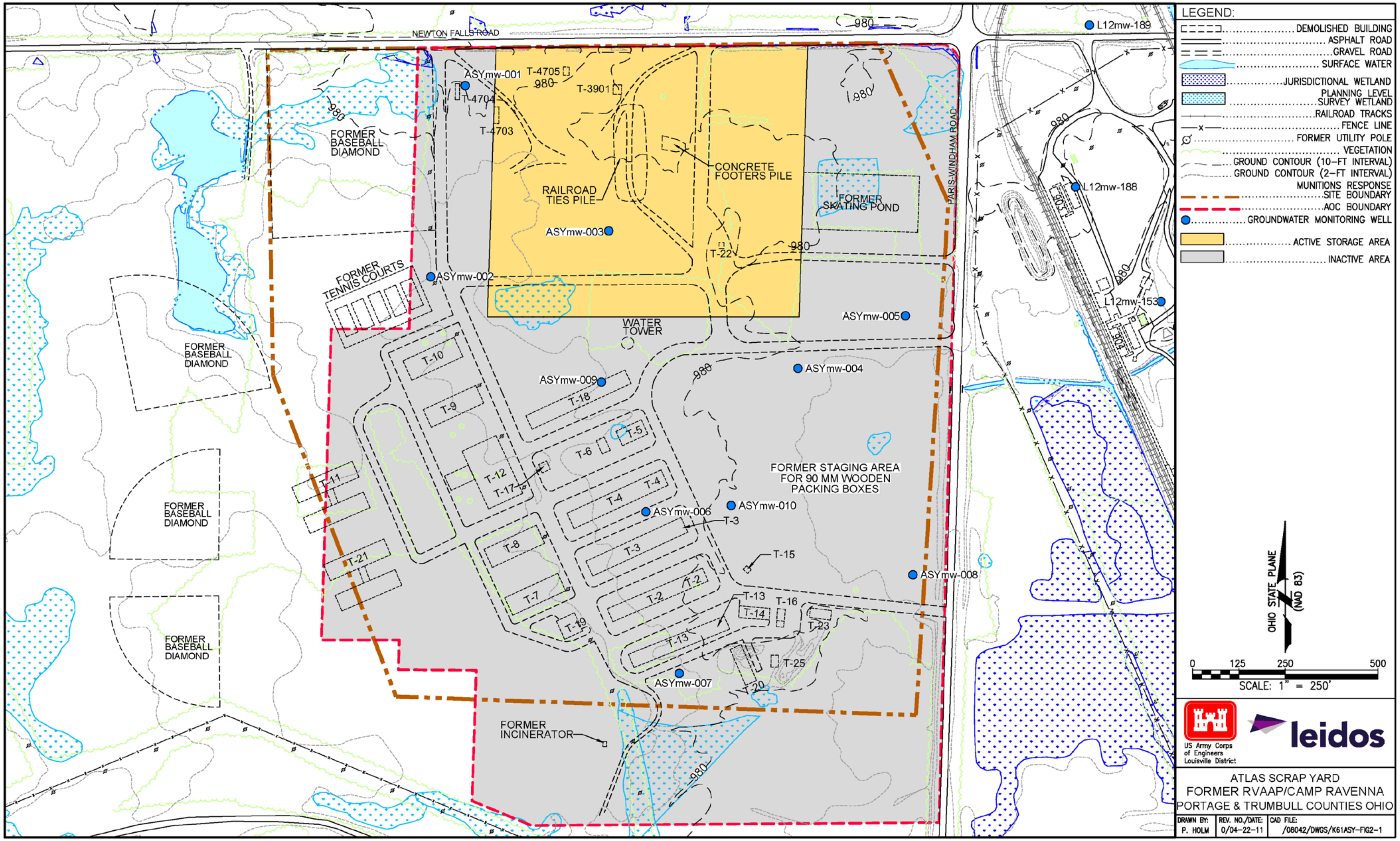

Figure 2-1. Site Features

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3.0 ENVIRONMENTAL SETTING

This section describes the physical features, topography, geology, hydrogeology, and environmental characteristics of Camp Ravenna and Atlas Scrap Yard that are factors in identifying the potential contaminant transport pathways, receptor populations, and exposure scenarios to evaluate human health and ecological risks. This section also presents a preliminary CSM based on Atlas Scrap Yard characteristics and historical investigation data to provide a framework to evaluate contaminant nature and extent, fate and transport, and human health and ecological risk. An updated CSM is presented in Section 8.0 to integrate the results of evaluations performed in this report.

3.1 CAMP RAVENNA PHYSIOGRAPHIC SETTING

Camp Ravenna is located within the Southern New York Section of the Appalachian Plateaus physiographic province (USGS 1968). This province is characterized by elevated uplands underlain primarily by Mississippian and Pennsylvanian age bedrock units that are horizontal or gently dipping. The province is characterized by its rolling topography, with incised streams having dendritic drainage patterns. The Southern New York Section has been modified by glaciation, which has rounded ridges, filled major valleys, and blanketed many areas with glacially-derived unconsolidated deposits (e.g., sand, gravel, and finer-grained outwash deposits). As a result of glacial activity in this section, old stream drainage patterns were disrupted in many locales, and extensive wetland areas have developed.

3.2 SURFACE FEATURES AND AOC TOPOGRAPHY

The topography of Camp Ravenna is gently undulating with an overall decrease in ground elevation from a topographic high of approximately 1,220 ft above mean sea level (amsl) in the far western portion of the facility to low areas at approximately 930 ft amsl in the far eastern portion of the facility. USACE mapped the facility topography in February 1998 using a 2 ft (60.1 cm) contour interval with an accuracy of 0.02 ft (0.61 cm). USACE based the topographic information on aerial photographs taken during the spring of 1997. This USACE survey is the basis for the topographical information illustrated in figures found in this report.

Atlas Scrap Yard is a 73-acre AOC located southwest of the intersection of Newton Falls Road and Paris-Windham Road, north of Load Line 4, in the southeast portion of Camp Ravenna (Figure 1-2). All buildings and structures have been demolished. Remaining features at Atlas Scrap Yard include several one-lane gravel/slag access roads that enter the AOC from the north and east (Figure 2-1). Small construction drainage ditches border the access roads and are also located throughout the AOC.

Topographic relief at the AOC is low, with a topographic high in the northwestern portion of the AOC that slopes downward to the topographic low in the central-eastern boundary of the AOC. Ground elevations within Atlas Scrap Yard range from approximately 976–986 ft amsl (Figure 3-1). Surface water follows topographic relief and drains into roadside ditches along the eastern portion of the AOC.

3.3 SOIL AND GEOLOGY

3.3.1 Regional Geology

The regional geology at Camp Ravenna consists of horizontal to gently dipping bedrock strata of Mississippian and Pennsylvanian age overlain by varying thicknesses of unconsolidated glacial deposits. The bedrock and unconsolidated geology at Camp Ravenna and geology specific to Atlas Scrap Yard are presented in the following subsections.

3.3.2 Soil and Glacial Deposits

Bedrock at Camp Ravenna is overlain by deposits of the Wisconsin-aged Lavery Till in the western portion of the facility and the younger Hiram Till and associated outwash deposits in the eastern portion. Unconsolidated glacial deposits vary considerably in their character and thickness across Camp Ravenna, from zero in some of the eastern portions of the facility to an estimated 150 ft (46 m) in the south-central portion (Figure 3-2).

Thin coverings of glacial material have been completely removed as a consequence of human activities at locations such as Ramsdell Quarry. Bedrock is present at or near the ground surface in many locations, such as at Load Line 1 and the Erie Burning Grounds (USACE 2001a). Where this glacial material is still present, its distribution and character indicate its origin is ground moraine. These tills consist of laterally discontinuous assemblages of yellow-brown, brown, and gray silty clays to clayey silts, with sand and rock fragments. Lacustrine sediment from bodies of glacial-age standing water has also been encountered in the form of deposits of uniform light gray silt greater than 50-ft thick in some areas (USACE 2001a).

Soil at Camp Ravenna is generally derived from the Wisconsin-age silty clay glacial till. Distributions of soil types are discussed and mapped in the *Soil Survey of Portage County, Ohio* (USDA 1978). Much of the native soil at Camp Ravenna was disturbed during construction activities in former production and operational areas of the facility.

The Sharon Member of the Pennsylvanian Pottsville Formation is the primary bedrock beneath Camp Ravenna. In the western half of the facility, the upper members of the Pottsville Formation, including the Connoquenessing Sandstone (also known as the Massillon Sandstone), Mercer Shale, and uppermost Homewood Sandstone, have been found. The regional dip of the Pottsville Formation measured in the western portion of Camp Ravenna is between 5-11.5 ft per mile to the south.

3.3.3 Geologic Setting of Atlas Scrap Yard

The bedrock formation underlying the unconsolidated deposits at Atlas Scrap Yard, as inferred from existing geologic data, is the Pennsylvanian age Pottsville Formation, Sharon Sandstone Member (Figure 3-3). When encountered, bedrock was observed at Atlas Scrap Yard at 20-29 ft bgs during monitoring well installation activities as part of the Characterization of 14 AOCs. The sandstone unit of the Sharon member (informally referred to as the Sharon Conglomerate) is a highly porous, loosely cemented, permeable, cross-bedded, frequently fractured and weathered orthoquartzite sandstone, which is locally conglomeritic. The Sharon Conglomerate exhibits locally occurring thin shale lenses in the upper portion of the unit. Upper members of the Pottsville Formation are not present at the AOC. Bedrock was not encountered in any of the 21 soil or geotechnical borings installed to a maximum depth of 13 ft bgs during the PBA08 RI (Appendix A).

Atlas Scrap Yard is located within Hiram Till glacial deposits. The two soil types observed at the AOC are the Mahoning silt loam (2-6% slopes) and the Trumbull silt loam (0-2% slopes). Mahoning silt loam is a gently sloping, poorly drained soil formed in silty clay loam or clay loam glacial till, generally where bedrock is greater than 6 ft bgs. The Mahoning silt loam has low permeability, with rapid runoff and seasonal wetness and is present primarily in the central 60% of the AOC (USDA 2010). The Trumbull silt loam covers the remaining 40% of the AOC and is poorly drained soil formed in silty clay till, generally where bedrock is greater than 6 ft bgs. The Trumbull silt loam is typically formed in depressions with a moderate water capacity with groundwater existing near ground surface (USDA 2010).

As observed in PBA08 RI soil borings, the composition of unconsolidated deposits at the AOC generally consist of yellowish-brown to gray, medium dense, silty clay tills with trace gravel, with sand content generally increasing with depth. Groundwater, when encountered, ranged from 8.45-13 ft bgs within a fine- to medium-grained sand in the PBA08 RI soil borings. PBA08 RI boring logs, containing geologic descriptions of unconsolidated deposits at Atlas Scrap Yard, are included in Appendix A. Geologic descriptions of subsurface soil samples collected during the PBA08 RI are generally consistent with the conclusions from the Characterization of 14 AOCs. Cross sections of the Atlas Scrap Yard subsurface were created from monitoring well lithology records to illustrate lateral distribution and variation of the discontinuous glacial sediment (MKM 2007).

Geotechnical analyses conducted during the Characterization of 14 AOCs classify samples collected from ASYmw-001 at 4-6 ft bgs, ASYmw-003 at 6-8 ft bgs, and ASYmw-007 at 8-10 ft bgs as brown, lean clay with sand and trace gravel (MKM 2007). Four geotechnical samples were collected from Atlas Scrap Yard during the PBA08 RI. Results are consistent with the Characterization of 14 AOCs. A summary of geotechnical analysis, including porosity, density, and moisture content, is presented in Section 5.2.4.

3.4 HYDROGEOLOGY

3.4.1 Regional Hydrogeology

Sand and gravel aquifers are present in the buried-valley and outwash deposits in Portage County, as described in the *Phase I Remedial Investigation Report for High-Priority Areas of Concern* (USACE 1998). Generally, these saturated zones are too thin and localized to provide large quantities of water for industrial or public water supplies; however, yields are sufficient for residential water supplies. Lateral continuity of these aquifers is unknown. Recharge of these units is derived from surface water infiltration of precipitation and surface streams. Specific groundwater recharge and discharge areas at Camp Ravenna have not been delineated.

The thickness of the unconsolidated interval at Camp Ravenna ranges from thin to absent in the eastern and northeastern portion of Camp Ravenna to an estimated 150 ft in the central portion of the facility. The groundwater table occurs within the unconsolidated zone in many areas of the facility. Because of the heterogeneous nature of the unconsolidated glacial material, groundwater flow patterns are difficult to determine with a high degree of accuracy. Vertical recharge from precipitation likely occurs via infiltration along root zones and desiccation cracks and partings within the soil column. Laterally, most groundwater flow likely follows topographic contours and stream drainage patterns, with preferential flow along pathways (e.g., sand seams, channel deposits, or other stratigraphic discontinuities) having higher permeability than surrounding clay or silt-rich material. Figure 3-4 illustrates facility-wide potentiometric surface data in the unconsolidated interval from the January 2010 contemporaneous measurement event (EQM 2010).

Within bedrock units at Camp Ravenna, the principle water-bearing aquifer is the Sharon Sandstone/Conglomerate. Depending on the existence and depth of overburden, the Sharon Sandstone/Conglomerate ranges from an unconfined to a leaky artesian aquifer. Water yields from on-site water supply wells completed in the Sharon Sandstone/Conglomerate ranged from 30-400 gallons per minute (gpm) (USATHAMA 1978). Well yields of 5-200 gpm were reported for on-site bedrock wells completed in the Sharon Sandstone/Conglomerate (Kammer 1982). Other local bedrock units capable of producing water include the Homewood Sandstone, which is generally thinner and only capable of well yields less than 10 gpm, and the Connoquenessing Sandstone. Wells completed in the Connoquenessing Sandstone in Portage County have yields ranging from 5-100 gpm but are typically less productive than the Sharon Sandstone/Conglomerate due to lower permeability (Winslow et al. 1966).

Figure 3-5 shows the potentiometric surface within bedrock strata at Camp Ravenna in January 2010 (EQM 2010). The bedrock potentiometric map shows a more uniform and regional eastward flow direction than the unconsolidated zone that is not as affected by local surface topography. Due to the lack of well data in the western portion of Camp Ravenna, general flow patterns are difficult to discern. For much of the eastern half of Camp Ravenna, bedrock potentiometric elevations are higher than the overlying unconsolidated potentiometric elevations, indicating an upward hydraulic gradient. This evidence suggests there is a confining layer that separates the two aquifers. In the far eastern area, the two potentiometric surfaces are at approximately the same elevation, suggesting that hydraulic communication between the two aquifers is occurring.

3.4.2 Atlas Scrap Yard Hydrologic/Hydrogeologic Setting

Ten groundwater monitoring wells were installed at Atlas Scrap Yard during the Characterization of 14 AOCs. Initial depths to groundwater encountered during well installation varied from 11.7 ft bgs in ASYmw-002 to 18 ft bgs in ASYmw-001. All monitoring wells are currently sampled under the Facility-Wide Groundwater Monitoring Program (FWGWMP). Monitoring wells ASYmw-007, ASYmw-008, and ASYmw-010 are screened in unconsolidated zone groundwater, while ASYmw-001 through ASYmw-006 and ASYmw-009 are screened in the Sharon Sandstone.

The potentiometric surface at the AOC is shown on Figure 3-1. The estimated groundwater flow directions reflect the January 2010 facility-wide potentiometric data presented in the *Facility-Wide Groundwater Monitoring Program Report on the January 2010 Sampling Event* (EQM 2010). Water level elevations at the AOC had a range of 967.54-973.63 ft amsl. Available historical data does not show large seasonal fluctuation changes in the general groundwater flow direction. The local potentiometric surface within Atlas Scrap Yard shows the groundwater flow pattern to the west. Facility-wide potentiometric data (Figures 3-4 and 3-5) indicate flow is generally to the south-southeast (unconsolidated zone) and southwest (bedrock zone). The average horizontal hydraulic gradient for the unconsolidated zone is approximately 0.0046 ft/ft.

Results of slug tests performed at the 10 groundwater monitoring wells during the Characterization of 14 AOCs indicate an average hydraulic conductivity of 3.89E-04 cm/s (MKM 2007). Table 3-1 presents the slug test results for each well.

Table 3-1. Hydraulic Conductivities Measured During the Characterization of 14 AOCs

Monitoring Well ID	Screened Interval (ft bgs)	Geologic Material Adjacent to Screen	Hydraulic Conductivity (cm/s)
ASYmw-001	11 – 21	Clayey Silt / Sandstone	5.18E-04
ASYmw-002	9.5 – 19.5	Silty Sand / Sandstone	1.35E-03
ASYmw-003	11 – 21	Clayey Silt / Sandy Silt / Sandstone	7.71E-04
ASYmw-004	17 – 27	Clayey Silt / Sandy Silt / Sandstone	9.41E-05
ASYmw-005	14 – 24	Sandy Silt / Sandstone	1.09E-04
ASYmw-006	16 – 26	Clayey Silt / Sandy Silt / Sandstone	1.07E-04
ASYmw-007	16 – 26	Silty Sand / Sandstone	1.75E-04
ASYmw-008	15 – 25	Clayey Silt / Silty Clay	3.33E-04
ASYmw-009	11.5 – 21.5	Silty Sand / Sandy Silt / Sandstone	1.81E-04
ASYmw-010	17 – 27	Clayey Silt / Silty Sand	2.25E-04

Source: *Characterization of 14 AOCs* (MKM 2007).
ft bgs = Feet below ground surface.
cm/s = Centimeters per second.
ID = Identification.

3.4.3 Surface Water

3.4.3.1 Regional Surface Water

Camp Ravenna resides within the Mahoning River watershed, which is part of the Ohio River Basin. The west branch of the Mahoning River is the main surface stream in the area that flows adjacent to the west end of the facility, generally in a north to south direction, before flowing into the Michael J. Kirwan Reservoir, located to the south of State Route 5 (Figure 1-1). The west branch of the Mahoning River flows out of the reservoir and parallels the southern Camp Ravenna boundary before joining the Mahoning River east of Camp Ravenna. The western and northern portions of Camp Ravenna display low hills and a dendritic surface drainage pattern. The eastern and southern portions are characterized by an undulating to moderately level surface, with less dissection of the surface drainage. The facility is marked with marshy areas and flowing and intermittent streams whose headwaters are located in the upland areas of the facility.

The three primary watercourses that drain Camp Ravenna are (Figure 1-2):

1. South Fork Eagle Creek;
2. Sand Creek; and
3. Hinkley Creek.

These watercourses have many associated tributaries. Sand Creek has a drainage area of 13.9 square miles (36 km^2) and generally flows in a northeast direction to its confluence with South Fork Eagle Creek. In turn, South Fork Eagle Creek continues in a northerly direction for 2.7 miles (4.3 km) to its confluence with Eagle Creek. The drainage area of South Fork Eagle Creek is 26.2 square miles (67.8 km^2), including the area drained by Sand Creek. Hinkley Creek originates just southeast of the intersection between State Route 88 and State Route 303 to the north of the facility. Hinkley Creek, with a drainage area of 11.0 square miles (28.5 km^2), flows in a southerly direction through the facility and converges with the west branch of the Mahoning River south of the facility (USACE 2001a).

Approximately one-third of Camp Ravenna meets the regulatory definition of a wetland, with the majority of the wetland areas located in the eastern portion of the facility. Wetland areas at Camp Ravenna include seasonal wetlands, wet fields, and forested wetlands. Many of the wetland areas are the result of natural drainage or beaver activity; however, some wetland areas are associated with anthropogenic settling ponds and drainage areas.

Approximately 50 ponds are scattered throughout the facility. Many were constructed within natural drainage ways to function as settling ponds or basins for process effluent and runoff. Others are natural in origin, resulting from glacial action or beaver activity. Water bodies at Camp Ravenna support aquatic vegetation and biota as described in Section 3.6.2. Storm water runoff is controlled primarily by natural drainage except in former operations areas where an extensive storm sewer network helps to direct runoff to drainage ditches and settling ponds. In addition, the storm sewer system was one of the primary drainage mechanisms for process effluent while production facilities were operational.

3.4.3.2 Atlas Scrap Yard Surface Water

Surface water drainage generally follows the topography of Atlas Scrap Yard and occurs as intermittent storm water runoff flowing into natural and constructed drainage ditches or conveyances along Newton Falls Road on the north side of Atlas Scrap Yard and along Paris-Windham Road on the east side of the production area (Figure 3-1). Surface water flowing in ditches or other drainage features is the primary migration pathway for contamination to leave Atlas Scrap Yard. Surface water exits from the eastern portion of Atlas Scrap Yard. The surface drainage flows north, eventually draining to Cobbs Ponds approximately 1,500 ft northeast of Atlas Scrap Yard. During the PBA08 RI, stagnant surface water was observed in the drainage ditch parallel to Paris-Windham Road. The intermittent storm water runoff could not drain from this conveyance due to beaver dams obstructing flow downstream.

3.5 CLIMATE

The general climate of Camp Ravenna is continental and characterized by moderately warm and humid summers, reasonably cold and cloudy winters, and wide variations in precipitation from year to year. The climate data presented below for Camp Ravenna were obtained from available National Weather Service records for the 30-year period of record from 1981 to 2010 at the Youngstown Regional Airport, Ohio (http://www.weather.gov/climate/xmacis.php?wfo=cle). Wind speed data for Youngstown, Ohio, are from the National Climatic Data Center for the available 53-year period of record from 1950 through 2002 (http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/avgwind.html).

Average annual rainfall in Camp Ravenna is 38.86 inches, with the highest monthly average occurring in July (4.31 inches) and the lowest monthly average occurring in February (2.15 inches). Average annual snowfall totals approximately 62.9 inches with the highest monthly average occurring in January (17.1 inches). Due to the influence of lake-effect snowfall events associated with Lake Erie (located approximately 35 miles to the northwest of Camp Ravenna), snowfall totals vary widely throughout northeastern Ohio.

The average annual daily temperature in Camp Ravenna is 49.3ºF, with an average monthly high temperature of 70.9ºF in July and an average monthly low temperature of 26.1ºF in January. The highest daily maximum temperature of 100ºF occurred in July 1988, and the record low temperature of -22ºF occurred in January 1994. The prevailing wind direction at Camp Ravenna is from the southwest, with the highest average wind speed occurring in January [11.4 miles per hour (mph)] and the lowest average wind speed occurring in August (7.4 mph). Thunderstorms occur approximately 35 days per year and are most abundant from April through August. Camp Ravenna is susceptible to tornadoes; minor structural damage to several buildings on facility property occurred as the result of a tornado in 1985.

3.6 POTENTIAL RECEPTORS AT ATLAS SCRAP YARD

The following sections discuss potential representative human and ecological receptors at Atlas Scrap Yard.

3.6.1 Human Receptors

Camp Ravenna is a controlled-access facility. Atlas Scrap Yard is located in the southeastern portion of the facility and is not currently used for training. However, the north-central portion of the AOC is used for storage of railroad ties and salvaged inert materials. The potential representative human receptor at Atlas Scrap Yard is the National Guard Trainee for military training. Unrestricted (Residential) Land Use is considered protective for Military Training Land Use at Camp Ravenna.

Therefore, if an AOC meets the requirements for Unrestricted (Residential) Land Use, then the AOC is also considered to have met the requirements of Military Training Land Use.

3.6.2 Ecological Receptors

Camp Ravenna has a diverse range of vegetation and habitat resources. Habitats present within the facility include large tracts of closed-canopy hardwood forest, scrub/shrub open areas, grasslands, wetlands, open-water ponds and lakes, and semi-improved administration areas. The vegetation and habitat resources referenced in this report are taken from and documented in the *Integrated Natural Resources Management Plan and Environmental Assessment for the Ravenna Training and Logistics Site, Portage and Trumbull Counties, Ohio* (OHARNG 2008) (herein referred to as the INRMP). Revisions to this document and the Rare Species List are underway; however, documents associated with PBA08 will reference and utilize information from the 2008 INRMP.

Vegetation at Camp Ravenna can be grouped into three categories: herb-dominated, shrub-dominated, and tree-dominated. Approximately 60% of the facility is covered by forest- or tree-dominated vegetation. The facility has seven forest formations, four shrub formations, eight herbaceous formations, and one non-vegetated formation (OHARNG 2008).

Surface water features within Camp Ravenna include a variety of streams, ponds, floodplains, and wetlands. Numerous streams drain the facility, including approximately 19 miles of perennial streams. The total combined length of streams at the facility is 212 linear miles. Approximately 153 acres of ponds are found on the facility. These ponds provide valuable wildlife habitat and support wood ducks, hooded mergansers, mallards, Canada geese, and many other birds and wildlife species. Some ponds have been stocked with fish and are used for fishing and hunting (OHARNG 2008).

Wetlands are abundant and prevalent throughout the facility. These wetland areas include seasonal wetlands, wet fields, and forested wetlands. Most of the wetland areas on the facility are the result of natural drainage and beaver activity; however, some wetland areas are associated with anthropogenic settling ponds and drainage areas.

An abundance of wildlife is present on the facility; 35 species of land mammals, 214 species of birds, 41 species of fish, and 34 species of amphibians and reptiles have been identified. No federally listed species are known to reside at the facility, and no critical habitat occurs (OHARNG 2008). Ohio state-listed plant and animal species have been identified through confirmed sightings and/or biological inventories at the facility and are presented in Table 3-2.

The interior of Atlas Scrap Yard is currently vegetated with shrub/scrub vegetation in unpaved areas and is forested around its perimeter. The north-central portion (ASA) of Atlas Scrap Yard is sparsely vegetated due to extensive gravel/slag cover and mulch-like material. Additional information specific to ecological resources at Atlas Scrap Yard is included in Section 7.3.

3.7 PRELIMINARY CONCEPTUAL SITE MODEL

A preliminary CSM was developed in the *Performance-Based Acquisition 2008 Supplemental Investigation Sampling and Analysis Plan Addendum No. 1* (herein referred to as the PBA08 SAP) to develop sampling rationales and data quality objectives (DQOs) for the PBA08 RI at Atlas Scrap Yard (USACE 2009). The PBA08 SAP was developed in accordance with the *Facility-Wide Sampling and Analysis Plan* (USACE 2001a) (herein referred to as the FWSAP). An updated version of the FWSAP was developed in February 2011 and approved by the Ohio EPA; however, the PBA08 RI was implemented prior to approval of this updated version. The preliminary CSM included a description of primary (active) and secondary (e.g., residual contaminants in soil) contaminant sources, migration pathways, contaminant discharge points, and potential receptors based on operational history and prior investigations. This preliminary CSM, summarized below, is further refined in Section 8.0 to integrate results of the contaminant nature and extent evaluation, fate and transport modeling, HHRA, and ERA.

3.7.1 Contaminant Sources

No primary contaminant sources from building structures remain at Atlas Scrap Yard in the IA. However, the ASA contains piles of metal debris, concrete, and railroad ties that may be continuing contaminant sources still present at the AOC. These materials are staged on top of a historic parking lot constructed of crushed slag and asphalt gravel which may act as a source of PAHs to the soil. Secondary sources (contaminated media) identified in previous investigations and further characterized during the PBA08 RI are described in the following sections.

3.7.1.1 Soil

Based on previous characterizations, contaminated surface soil in Atlas Scrap Yard may represent a potential secondary source of contamination to groundwater. Analysis of Atlas Scrap Yard surface soil data under the Characterization of 14 AOCs identified several metals, explosives, one propellant (nitrocellulose), one PCB, and several SVOCs in surface soil as COPCs for human and ecological receptors. Subsurface soil has not been previously evaluated. Thirty-five surface soil ISM samples, three chromium speciation samples, 19 soil borings, and two geotechnical borings were installed during the PBA08 RI to further define the horizontal and vertical extent of contamination.

Table 3-2. Federal and State-listed Species List

CAMP RAVENNA JOINT MILITARY TRAINING CENTER RARE SPECIES LIST
27 April 2010

I. Species confirmed to be on Camp Ravenna property by biological inventories and confirmed sightings.

A. State Endangered

1. American bittern, *Botaurus lentiginosus* (migrant)
2. Northern harrier, *Circus cyaneus*
3. Yellow-bellied Sapsucker, *Sphyrapicus varius*
4. Golden-winged warbler, *Vennivora chrysoptera*
5. Osprey, *Pandion haliaetus* (migrant)
6. Trumpeter swan, *Cygnus buccinators* (migrant)
7. Mountain Brook Lamprey, *Ichthyomyzon greeleyi*
8. Graceful Underwing, *Catocala gracilis*
9. Tufted Moisture-loving Moss, *Philonotis Fontana var. caespitosa*
10. Bobcat, *Felis rufus*
11. Narrow-necked Pohl's Moss, *Pohlia elongata var. elongate*
12. Sandhill Crane, *Grus Canadensis* (probable nester)
13. Bald Eagle, *Haliaetus leucocephalus* (nesting pair)

B. State Threatened

1. Barn owl, *Tyto alba*
2. Dark-eyed junco, *Junco hyemalis* (migrant)
3. Hermit thrush, *Catharus guttatus* (migrant)
4. Least bittern, *Ixobrychus exilis*
5. Least flycatcher, *Empidonax minimus*
6. *Psilotreta indecisa* (caddis fly)
7. Simple willow-herb, *Epilobium strictum*
8. Woodland Horsetail, *Equisetum sylvaticum*
9. Lurking leskea, *Plagiothecium latebricola*
10. Pale sedge, *Carex pallescens*

C. State Potentially Threatened Plants

1. Gray Birch, *Betula populifolia*
2. Butternut, *Juglans cinerea*
3. Northern rose azalea, *Rhododendron nudiflorum var. roseum*
4. Hobblebush, *Viburnum alnifolium*
5. Long Beech Fern, *Phegopteris connectilis (Thelypteris phegopteris)*
6. Straw sedge, *Carex straminea*
7. Water avens, *Geum rivale*
8. Tall St. John's wort, *Hypercium majus*
9. Swamp oats, *Sphenopholis pensylvanica*
10. Shining ladies'-tresses, *Spiranthes lucida*
11. Arbor Vitae, *Thuja occidentalis*
12. American Chestnut, *Castanea dentate*

Table 3-2. Federal and State-listed Species List (continued)

D. State Species of Concern

1. Pygmy shrew, *Sorex hovi*
2. Star-nosed mole, *Condylura cristata*
3. Woodland jumping mouse, *Napaeozapus insignis*
4. Sharp-shinned hawk, *Accipiter striatus*
5. Marsh wren, *Cistothorus palustris*
6. Henslow's sparrow, *Ammodramus henslowii*
7. Cerulean warbler, *Dendroica cerulea*
8. Prothonotary warbler, *Protonotaria citrea*
9. Bobolink, *Dolichonyx oryzivorus*
10. Northern bobwhite, *Colinus virginianus*
11. Common moorhen, *Gallinula chloropus*
12. Great egret, *Ardea alba* (migrant)
13. Sora, *Porzana carolina*
14. Virginia Rail, *Rallus limicola*
15. Creek heelsplitter, *Lasmigona compressa*
16. Eastern box turtle, *Terrapene carolina*
17. Four-toed Salamander, *Hemidacrylium scuta/um*
18. *Stenonema ithica* (mayfly)
19. *Apamea mixta* (moth)
20. *Brachylomia algens* (moth)
21. Sedge wren, *Cistothorus platensis*

E. State Special Interest

1. Canada warbler, *Wilsonia canadensis*
2. Little blue heron, *Egretta caerula*
3. Magnolia warbler, *Dendroica magnolia*
4. Northern waterthrush, *Seiurus noveboracensis*
5. Winter wren, *Troglodytes troglodytes*
6. Back-throated blue warbler, *Dendroica caerulescens*
7. Brown creeper, *Certhia americana*
8. Mourning warbler, *Oporornis philadelphia*
9. Pine siskin, *Carduelis pinus*
10. Purple finch, *Carpodacus purpureus*
11. Red-breasted nuthatch, *Sitta canadensis*
12. Golden-crowned kinglet, *Regulus satrapa*
13. Blackburnian warbler, *Dendroica fusca*
14. Blue grosbeak, *Guiraca caerulea*
15. Common snipe, *Gallinago gallinago*
16. American wigeon, *Anas americana*
17. Gadwall, *Anas strepera*
18. Green-winged teal, *Anas crecca*
19. Northern shoveler, *Anas clypeata*
20. Redhead duck, *Aytya americana*
21. Ruddy duck, *Oxyura jamaicensis*

NOTE: There are currently no federally listed species or critical habitat on Camp Ravenna Joint Military Training Center property. There are a few species currently under federal observation for listing, but none listed.

3.7.1.2 Sediment and Surface Water

Surface water at Atlas Scrap Yard occurs as intermittent storm water runoff within natural and constructed drainage ditches or conveyances (Figure 3-1). Sediment within these drainage ditches is considered dry sediment and is addressed with surface soil as a potential secondary source of contaminants. Overland flow associated with storm events generally follows the topography of the AOC and drains into the ditch west of Paris-Windham Road and south of Newton Falls Road. No sediment or surface water samples, with the exception of samples collected from building structures (i.e., sumps and sewers), have been previously collected at Atlas Scrap Yard except for one sample east of Paris-Windham Road. Surface water flow is a primary migration pathway for contamination to leave the Atlas Scrap Yard, flowing through ditches and surface water drainage features that exit the AOC following precipitation events. One co-located surface water sample and one sediment sample were collected at Load Line 12 to characterize current conditions and assess exit pathways from Atlas Scrap Yard.

3.7.1.3 Groundwater

Previous groundwater sampling results at Atlas Scrap Yard identified one metal (arsenic) and one SVOC [bis(2-ethylhexyl)phthalate] as COPCs (MKM 2007). Groundwater discharge to surface water features (e.g., via base flow to streams or springs) does not occur within the AOC boundary. The closest potential groundwater discharge location, based on regional flow patterns, is at Cobbs Ponds, northeast of the AOC. However, the local potentiometric surface (shown in Figure 3-1) shows the groundwater flow pattern to the west. Considering possible localized flow variations, several potential discharge locations [i.e., unnamed tributary to Sand Creek (flowing northwest), unnamed tributary to Cobbs Ponds (flowing northeast), and unnamed tributary to the Mahoning River flowing southwest)] are possible. Leaching of soil chemicals to groundwater, with subsequent lateral migration to a surface water receptor, represents a potential contaminant release mechanism and migration pathway.

Groundwater at Camp Ravenna is evaluated on a facility-wide basis, sampled under the FWGWMP, and will be evaluated through the CERCLA process in a separate report. Potential leaching of soil contaminants to groundwater is evaluated through fate and transport modeling in this RI.

3.7.2 Migration Pathways

Two contaminant migration pathways are identified based on AOC characteristics and historical data: lateral migration of surface soil through storm water runoff, and vertical migration of soil contaminants to groundwater. Surface water represents a periodic mechanism for lateral migration of residual contaminants from surface soil within the former operations area to the drainage conveyances across the AOC. Contaminants in surface water may migrate in a dissolved phase or be adsorbed to particulates and re-suspended during periods of heavy runoff. Leaching of soil contaminants to groundwater (vertical migration), with subsequent lateral migration, is also a potential migration pathway. Modeling of contaminant leaching from soil and sediment sources and transport via groundwater is included in this RI; however, a full evaluation of the groundwater pathway will be addressed in a separate report.

3.7.3 Contaminant Discharge Points

Residual contamination from surface soil potentially migrates laterally in storm water runoff, which flows towards drainage ditches that exit the AOC. The closest identified potential discharge point for surface water is Cobbs Ponds, approximately 1,500 ft northeast of the AOC. Leaching of soil contaminants to groundwater, with subsequent lateral migration to either surface water discharge or exposure points, are potential migration pathways and are further evaluated in Section 6.0.

3.7.4 Potential Receptors

Potential human health and ecological receptors for the AOC, based on current and future land use and present-day ecological resources, were discussed in Section 3.6. There is future potential for human exposure to contaminants and terrestrial and aquatic receptors are present in the AOC’s vicinity. Therefore, an HHRA and ERA were conducted as part of the PBA08 RI, and the results are integrated into the updated CSM presented in Section 8.0.

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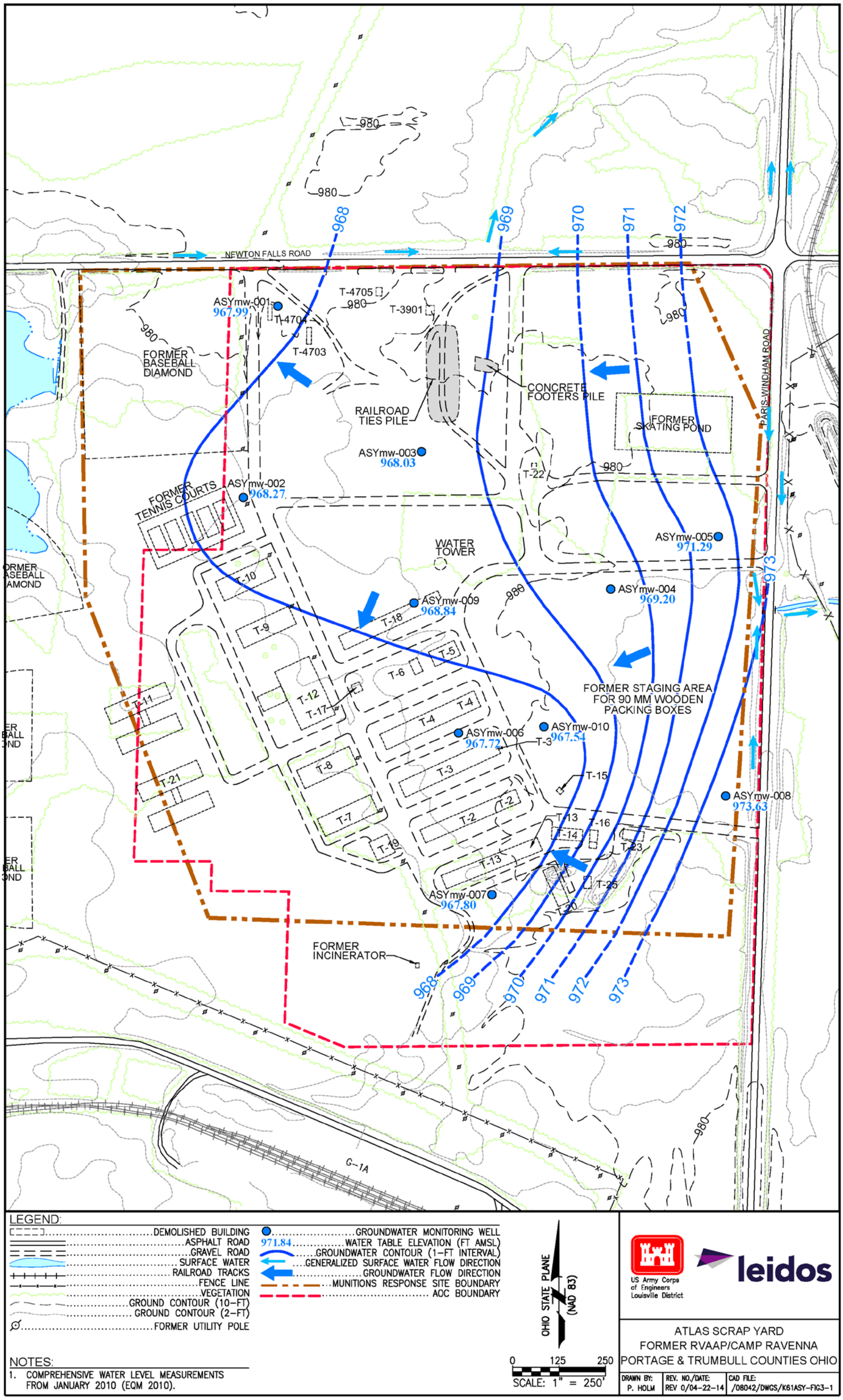

Figure 3-1. Topography, Groundwater Flow, and Surface Water Flow at Atlas Scrap Yard

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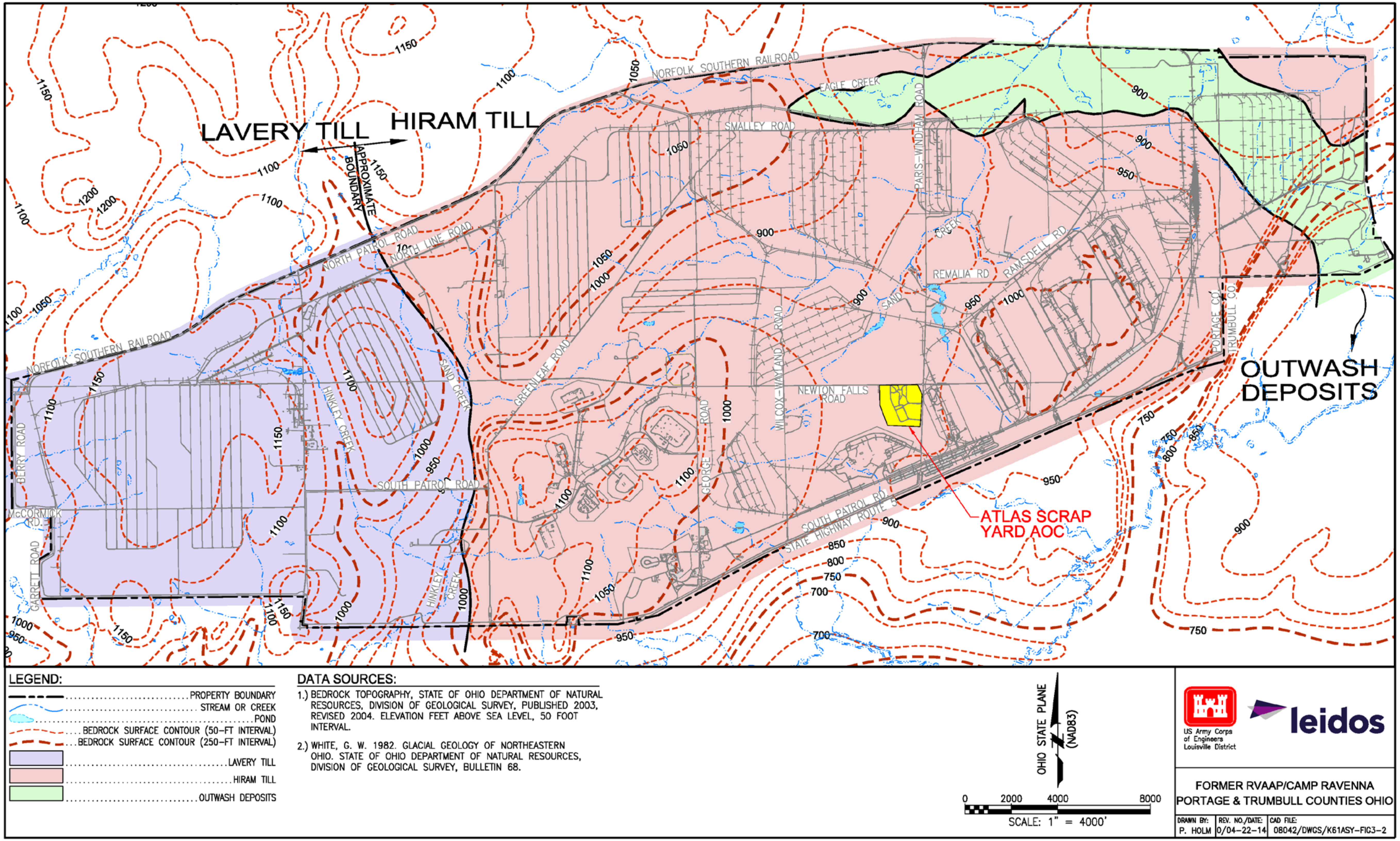

DATA SOURCES:

1.) BEDROCK TOPOGRAPHY, STATE OF OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SURVEY, PUBLISHED 2003, REVISED 2004. ELEVATION FEET ABOVE SEA LEVEL, 50 FOOT INTERVAL.

2.) WHITE, G. W. 1982. GLACIAL GEOLOGY OF NORTHEASTERN OHIO. STATE OF OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SURVEY, BULLETIN 68.

Figure 3-2. Geologic Map of Unconsolidated Deposits on Camp Ravenna

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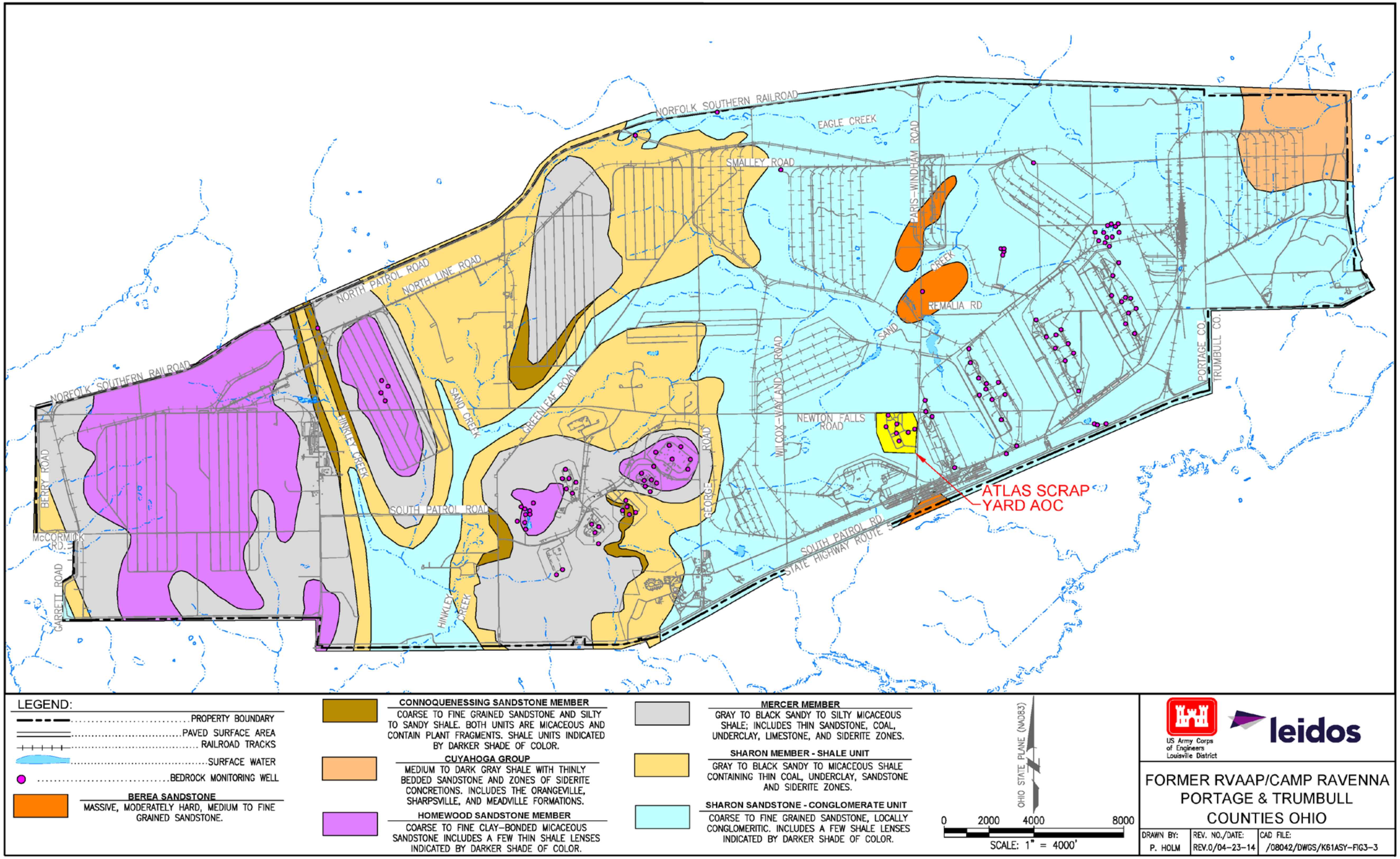

Figure 3-3. Geologic Bedrock Map and Stratigraphic Description of Units on Camp Ravenna

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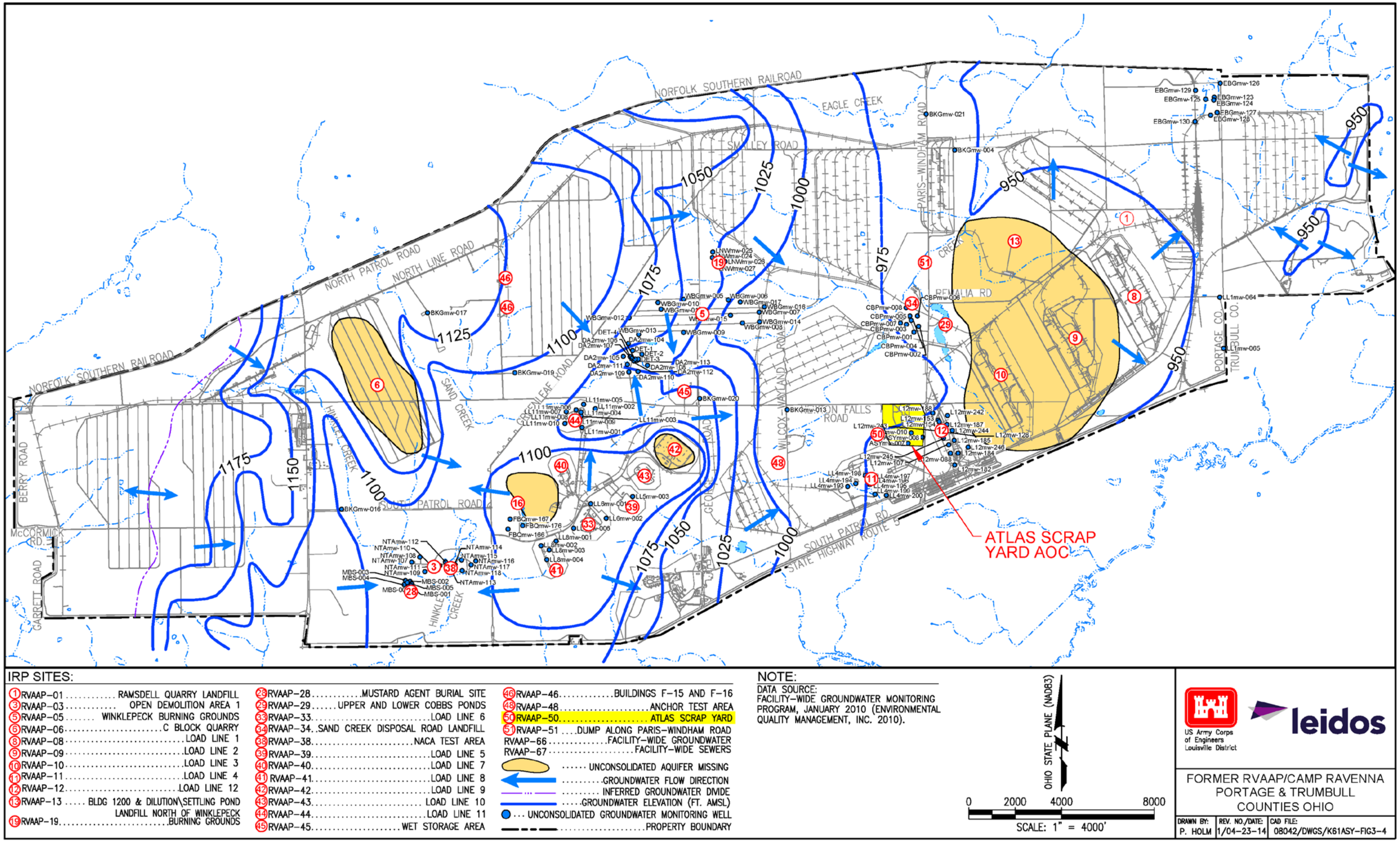

Figure 3-4. Potentiometric Surface of Unconsolidated Aquifer at Camp Ravenna

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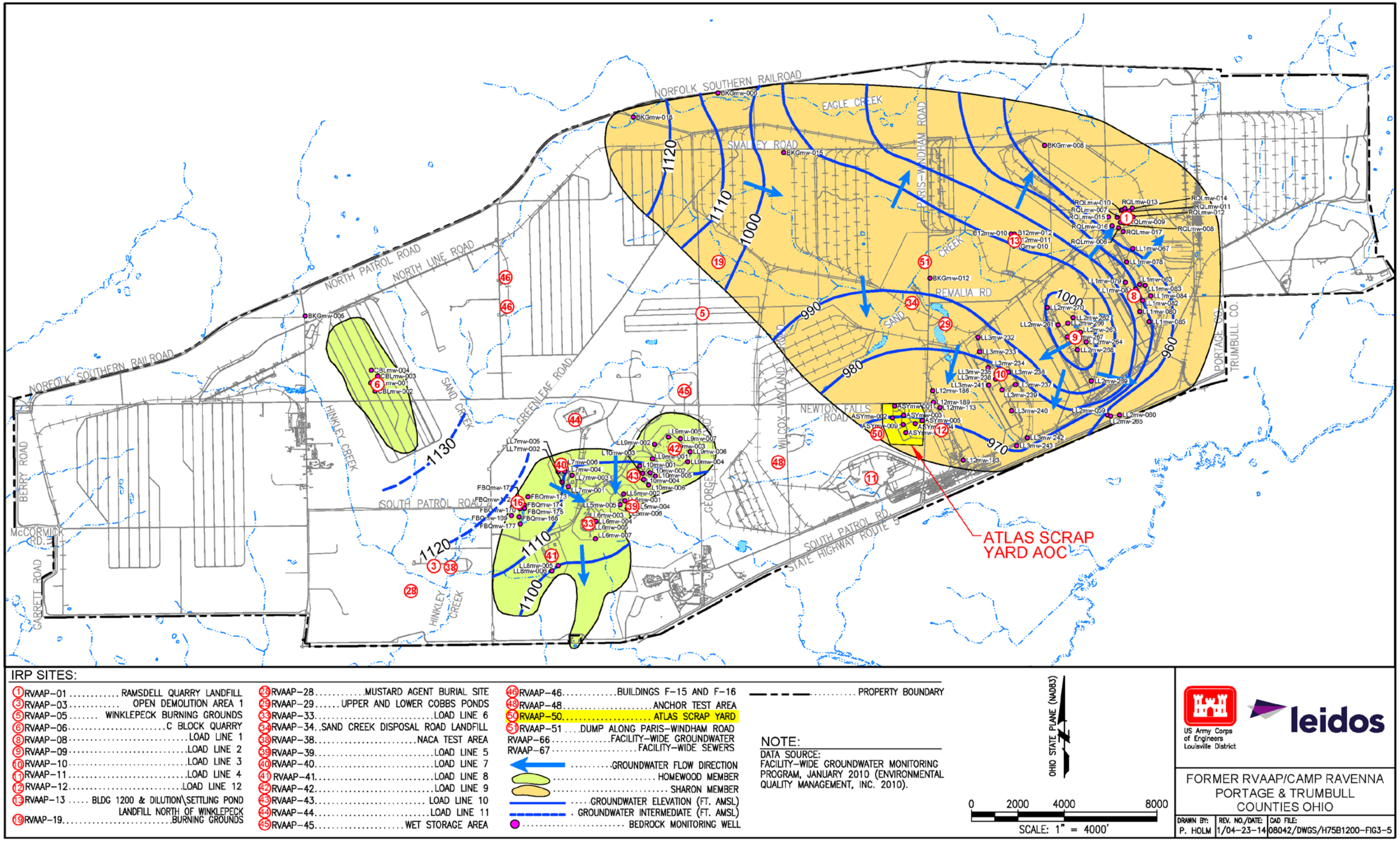

Figure 3-5. Potentiometric Surface of Bedrock Aquifers at Camp Ravenna

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4.0 REMEDIAL INVESTIGATION

This section presents the methods used for the developing DQOs, collecting field data, and managing analytical data and laboratory programs for the PBA08 RI at Atlas Scrap Yard. The PBA08 RI was implemented in accordance with the PBA08 SAP to supplement historical data and complete the RI phase of the CERCLA process. The results of the PBA08 RI sampling are combined with the results of the Characterization of 14 AOCs to evaluate the nature and extent of contamination, assess potential future impacts to groundwater, conduct HHRAs and ERAs, and evaluate the need for remedial alternatives.

As presented in Section 2.2.2, there have been several investigations at Atlas Scrap Yard, including the HHRS and ERS presented in the Characterization of the 14 AOCs report. As part of the PBA08 RI DQOs, an initial screening approach was used to help focus the investigation on specific chemicals and areas to be further evaluated by assessing the nature and extent of contamination observed in historical samples (Section 3.2.2 of the PBA08 SAP). The screening approach presented in the PBA08 SAP compared sample results from previous investigations at Atlas Scrap Yard to chemical-specific Facility-Wide Cleanup Goals (FWCUGs) at the 1E-06 cancer risk level and non-carcinogenic risk Hazard Quotient (HQ) of 0.1, as presented within the RVAAP Facility-Wide Human Health Risk Assessor's Manual (USACE 2005b) (FWHHRAM). The most protective FWCUGs for the three potential receptors are referred to as “screening criteria”. Previous results were also compared to FWCUGs at the higher target risk (TR) of 1E-05 and HQ of 1.0 to facilitate identifying potential source areas that may require additional sampling to refine the extent of contamination. Table 4-1 lists the chemicals with detected concentrations that exceed screening criteria in historical soil samples.

Representatives of RVAAP, Ohio EPA, USACE Louisville, and Camp Ravenna reviewed and approved the PBA08 RI sample locations and rationale as part of the approval process for the PBA08 SAP in December 2009. The PBA08 RI, conducted from February through April 2010, included collecting surface water, sediment, surface soil and subsurface soil using discrete sampling techniques. Additionally, surface soil was collected using ISM techniques. No groundwater samples were collected during the PBA08 RI, as the current conditions of groundwater will be evaluated as an individual AOC for the entire facility (designated as RVAAP-66) and addressed in a separate RI/FS report. The following sections describe the rationale and sample collection methods for each component of the PBA08 RI field investigation.

Table 4-1. Chemicals Detected at Concentrations above Screening Criteria in Previous Investigations

Surface Soil		Subsurface Soil
Aluminum Arsenic Cadmium Chromium Cobalt Lead Manganese	Benz(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene	Medium not sampled

4.1 SOIL AND VADOSE ZONE CHARACTERIZATION

Soil samples were collected during the PBA08 RI to assess contaminant occurrence and distribution in surface and subsurface soil. The decision-making matrices for the surface soil and subsurface soil sampling plans are presented in Figures 4-1 and 4-2, respectively.

4.1.1 Surface Soil Sampling Rationale and Methods

Since ISM was used for surface soil (0-1 ft bgs) as part of the Characterization of 14 AOCs, ISM was also used for surface soil sampling during the PBA08 RI. The PBA08 RI sampled locations with the greatest likelihood of contamination (e.g., adjacent to production buildings or within sediment accumulation areas such as ditches). Each ISM result was evaluated separately against the screening criteria for each chemical analyzed. Surface soil sampling to define the lateral extent of contamination was conducted according to the decision rules approved in the PBA08 SAP and depicted in Figure 4-1. All PBA08 RI surface soil samples collected during the PBA08 RI were collected using ISM or discrete sampling techniques.

Surface soil at Atlas Scrap Yard was evaluated during the PBA08 RI in two separate events. In April 2010, a total of 38 surface soil samples (35 ISM and three discrete) were collected in accordance with the PBA08 SAP. The sample locations in the PBA08 SAP were derived from the sample polygons provided during the development of the SAP. Nineteen ISM samples were collected around former ISM sample areas to delineate locations where chemicals were detected above FWCUGs and to further define the lateral extent of contamination (Figure 4-3). A total of 18 grid ISM samples were collected to complete characterization of the AOC. Grid ISM sample locations ranged from 3.1-4.2 acres in extent, encompassing the entirety of the AOC. Additionally, three discrete samples were collected to evaluate chromium speciation. ISM samples were analyzed for TAL metals, explosives, and polycyclic aromatic hydrocarbons (PAHs). Discrete samples for chromium speciation were analyzed for total and hexavalent chromium. Four ISM samples (15% of the total number of ISM samples collected) were analyzed for RVAAP full-suite analytes [i.e., TAL metals, explosives, propellants (nitrocellulose and nitroguanidine), SVOCs, VOCs, PCBs, and pesticides]. Nitroglycerin was analyzed under USEPA Method 8330 and was reported as an explosive chemical. Table 4-2 presents the specific rationale for each surface soil sample collected in April 2010.

In April 2011, an additional sampling event was conducted to refine locations of PAH contamination in the ASA. Three features within the ASA were targeted during the April 2011 investigation:

1. The debris piles, including railroad tie, concrete debris, and other rubble piles.
2. The parking areas made up of slag and asphalt gravel west of the railroad tie pile.
3. The ditch alongside the access road entering the AOC from Newton Falls Road.

The debris piles (railroad ties, concrete debris, and other rubble piles) were considered for additional evaluation to determine if they were the sources of contamination observed in the 2010 grid samples ASYss-089M and ASYss-088M. The objective of the April 2011 sampling was to collect ISM samples at varying distances to the piles. ISM samples from areas 5 and 10 ft wide were collected immediately adjacent to and around the piles. The parking areas made up of slag and asphalt gravel have been maintained to sustain vehicle or machine traffic at the ASA and are currently covered with gravel and wood chips. These areas were initially sampled in 2010 as ASYss-089M and ASYss-088M. In 2011, these two grid samples were subdivided for sampling based on the current location of the parking/staging area into locations ASY-116M, ASY-117M, ASY-118M, and ASY-119M. The ditch alongside the access road that enters the AOC from Newton Falls Road was originally included in the 2010 grid sample ASYss-093M and was resampled in 2011 as locations ASY-123M and ASY-126M. To isolate contamination within the ditch from the rest of the multi-acre grid sample, ASYss-093M was subdivided into three new ISM sample areas based on field observations and was also resampled in 2011. The ditch was then considered for additional evaluation to determine if potential overland flow during precipitation events has occurred. Figure 4-4 presents the April 2011 sampling scheme and photographs of the ASA features. April 2011 samples are included in Table 4-2. Each sample was analyzed for TAL metals and PAHs.

For the PBA08 RI, the corners of each of the designated ISM sampling areas were located using a digital global positioning system (GPS) and were marked using wooden stakes. Sampling crews selected aliquot locations by walking over the entire ISM sampling area and marking the requisite number of points with flags. At least 30 aliquots were collected for each ISM sample. Aliquot locations were randomly selected in the field and were not predetermined using a grid.

Approximately equal sample volume aliquots were collected from a depth of 0-1 ft bgs using a decontaminated ⅝-inch diameter push probe. A soil description was completed for each ISM sample and is included in Appendix A.

All aliquots collected from a given ISM sample area were combined in a labeled container for transport to the laboratory in accordance with the PBA08 RI SAP. At the laboratory, each sample was air-dried, sieved, and ground for specified non-volatile chemical analyses.

Five QC field duplicates and six QA split samples (including the April 2011 QA/QC samples) were collected from the ISM sample areas to satisfy the QA/QC requirement of 10% of the total samples collected. Four QC samples were collected and sent to the laboratory, but the QC (field duplicate) sample collected at location ASYss-101M could not be analyzed due to a laboratory error described in Appendix B. The QC field duplicate samples were submitted to the laboratory as “blind” and were used to determine whether the field sampling technique was reproducible and as an indicator of sample heterogeneity. The QA split samples were sent to a USACE QA laboratory for independent analysis and evaluation of analytical results obtained by the primary laboratory.

QA/QC samples were collected as replicate ISM samples requiring three separate ISM samples from the same sample area. The QA/QC samples were collected from a set of 30 aliquot locations that were positioned adjacent to the locations used for the initial ISM samples. Aliquots for QA/QC samples were collected in separate, stainless steel bowls and were placed into separate, labeled containers.

The ISM was not utilized for samples collected for VOC analysis because the air drying, mixing, and sieving of aliquots required by the method could result in the loss of VOCs from the sample. For ISM sample areas designated for VOC analysis, one discrete sample was collected from a depth of 0-1 ft bgs within the ISM sample area using the bucket hand auger method described in the PBA08 SAP. The specific location of the discrete sample was randomly chosen. Soil portions designated for VOC analyses were not homogenized in the field but were placed directly in the sample container and compacted to zero headspace.

In addition to the ISM surface soil samples, three discrete chromium speciation samples were collected to evaluate the potential contribution of hexavalent chromium to the total chromium concentrations in soil. Samples from 0-1 ft bgs were collected in accordance with the bucket hand auger method described in Section 4.5.2.1.1 of the FWSAP (USACE 2001a). An updated version of the FWSAP was developed in February 2011 and approved by the Ohio EPA; however, the PBA08 RI was implemented prior to approval of this updated version. Two samples were collected from areas previously identified as having elevated total chromium concentrations, and one sample was collected from an area previously identified as having a total chromium concentration near background concentrations. Field duplicate samples were not collected for chromium speciation samples. A sample log including a soil description was completed for each sample; all logs are included in Appendix A.

After the discrete samples were collected, excess soil was designated as investigation-derived waste (IDW) and placed in lined, labeled 55-gallon drums that were sealed after use and staged at Building 1036. IDW management practices for all media are discussed in Appendix F. Hand auger borings were backfilled to ground surface with dry bentonite chips while hydrating with the project-approved potable water.

Table 4-2. PBA08 RI Surface Soil Samples and Rationales

Sample Type	Depth (ft bgs)	Location	Sample	Date Sampled	Comments/Rationale
ISM	0-1	ASYss-069M	ASYSS-069M-5743-SO	4/5/2010	Delineated lateral extent of previously identified contamination in the IA and further investigate the location of former tar cleaning operations.
ISM	0-1	ASYss-070M	ASYSS-070M-5744-SO	4/5/2010	Delineated lateral extent of previously identified contamination in the IA.
ISM	0-1		ASYSS-070M-6209-FD	4/5/2010	QA/QC
ISM	0-1		ASYSS-070M-6208-QA	4/5/2010	
ISM	0-1	ASYss-071M	ASYSS-071M-5745-SO	4/6/2010	Delineated lateral extent of previously identified contamination in the IA.

Table 4-2. PBA08 RI Surface Soil Samples and Rationales (continued)

Sample Type	Depth (ft bgs)	Location	Sample	Date Sampled	Comments/Rationale
ISM	0-1	ASYss-072M	ASYSS-072M-5746-SO	4/7/2010	Delineated lateral extent of previously identified contamination in the IA.
ISM	0-1	ASYss-073M	ASYSS-073M-5747-SO	4/6/2010	Delineated lateral extent of previously identified contamination in the ASA.
ISM	0-1	ASYss-074M	ASYSS-074M-5748-SO	4/6/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the ASA. Analyzed for RVAAP full-suite analytes.
ISM	0-1	ASYss-075M	ASYSS-075M-5749-SO	4/6/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the ASA.
ISM	0-1	ASYss-076M	ASYSS-076M-5750-SO	4/6/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the ASA. Analyzed for RVAAP full-suite analytes.
ISM	0-1		ASYSS-076M-6211-FD	4/6/2010	QA/QC. Analyzed for RVAAP full-suite analytes.
ISM	0-1		ASYSS-076M-6212-QA	4/6/2010	
ISM	0-1	ASYss-077M	ASYSS-077M-5751-SO	4/7/2010	Delineated lateral extent of previously identified contamination in the ASA.
ISM	0-1	ASYss-078M	ASYSS-078M-5752-SO	4/7/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the ASA.
ISM	0-1	ASYss-079M	ASYSS-079M-5753-SO	4/7/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the ASA.
ISM	0-1	ASYss-080M	ASYSS-080M-5754-SO	4/7/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the ASA.
ISM	0-1	ASYss-081M	ASYSS-081M-5755-SO	4/2/2010	Delineated lateral extent of previously identified contamination in the IA.
ISM	0-1	ASYss-082M	ASYSS-082M-5756-SO	4/2/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the IA.
ISM	0-1	ASYss-083M	ASYSS-083M-5757-SO	4/2/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the IA.

Table 4-2. PBA08 RI Surface Soil Samples and Rationales (continued)

Sample Type	Depth (ft bgs)	Location	Sample	Date Sampled	Comments/Rationale
ISM	0-1	ASYss-084M	ASYSS-084M-5758-SO	4/2/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the IA.
ISM	0-1	ASYss-085M	ASYSS-085M-5759-SO	4/2/2010	Subdivided former ISM area to further delineate lateral extent of contamination in the IA.
ISM	0-1	ASYss-086M	ASYSS-086M-5760-SO	4/2/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-087M	ASYSS-087M-5761-SO	4/2/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-088M	ASYSS-088M-5756-SO	4/5/2010	Characterized ASA not previously sampled.
ISM	0-1	ASYss-089M	ASYSS-089M-5763-SO	4/5/2010	Characterized ASA not previously sampled. Analyzed for RVAAP full-suite analytes.
ISM	0-1	ASYss-090M	ASYSS-090M-5764-SO	4/5/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-091M	ASYSS-091M-5765-SO	4/5/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-092M	ASYSS-092M-5766-SO	4/5/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-093M	ASYSS-093M-5767-SO	4/6/2010	Characterized ASA not previously sampled.
ISM	0-1	ASYss-094M	ASYSS-094M-5768-SO	4/6/2010	Characterized ASA not previously sampled.
ISM	0-1	ASYss-095M	ASYSS-095M-5769-SO	4/6/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-096M	ASYSS-096M-5756-SO	4/5/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-097M	ASYSS-097M-5771-SO	4/6/2010	Characterized IA not previously sampled. Analyzed for RVAAP full-suite analytes.
ISM	0-1	ASYss-098M	ASYSS-098M-5772-SO	4/6/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-099M	ASYSS-099M-5773-SO	4/6/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-100M	ASYSS-100M-5774-SO	4/6/2010	Characterized IA not previously sampled.
ISM	0-1	ASYss-101M	ASYSS-101M-5775-SO	4/6/2010	Characterized IA not previously sampled.
ISM	0-1		ASYSS-101M-6215-FD	4/6/2010	QA/QC. The QC duplicate was not analyzed due to the laboratory error presented in Appendix B, NCR-2010-LOU-001.
ISM	0-1		ASYSS-101M-6214-QA	4/6/2010	
ISM	0-1	ASYss-102M	ASYSS-102M-5776-SO	4/6/2010	Characterized IA not previously sampled.

Table 4-2. PBA08 RI Surface Soil Samples and Rationales (continued)

Sample Type	Depth (ft bgs)	Location	Sample	Date Sampled	Comments/Rationale
ISM	0-1	ASYss-103M	ASYSS-103M-5777-SO	4/5/2010	Characterized IA not previously sampled.
ISM	0-1		ASYSS-103M-6213-FD	4/5/2010	QA/QC.
ISM	0-1		ASYSS-103M-6212-QA	4/5/2010	
Discrete	0-1	ASYss-066	ASYSS-066-5778-SO	4/7/2010	Previous Cr result represents Cr near background concentration.
Discrete	0-1	ASYss-067	ASYSS-067-5779-SO	4/7/2010	Previous Cr result represents elevated Cr concentration.
Discrete	0-1	ASYss-068	ASYSS-068-5780-SO	4/7/2010	Previous Cr result represents elevated Cr concentration.
ISM	0-1	ASYss-111M	ASYss-111M-5835-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-112M	ASYss-112M-5836-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-113M	ASYss-113M-5837-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-114M	ASYss-114M-5838-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-115M	ASYss-115M-5839-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-116M	ASYss-116M-5840-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-117M	ASYss-117M-5841-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-118M	ASYss-118M-5842-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-119M	ASYss-119M-5843-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-120M	ASYss-120M-5844-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-121M	ASYss-121M-5845-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-122M	ASYss-122M-5846-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.

Table 4-2. PBA08 RI Surface Soil Samples and Rationales (continued)

Sample Type	Depth (ft bgs)	Location	Sample	Date Sampled	Comments/Rationale
ISM	0-1	ASYss-123M	ASYss-123M-5847-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-124M	ASYss-124M-5848-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1	ASYss-125M	ASYss-125M-5849-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1		ASYss-125M-6238-FD	4/21/2011	QA/QC.
ISM	0-1		ASYss-125M-6244-QA	4/21/2011	
ISM	0-1	ASYss-126M	ASYss-126M-5850-SO	4/21/2011	Subdivided ASA to delineate Metals and PAH contamination.
ISM	0-1		ASYss-126M-6239-FD	4/21/2011	QA/QC.
ISM	0-1		ASYss-126M-6245-QA	4/21/2011	

ASA = Active Storage Area.
Cr = Chromium.
ft bgs = Feet below ground surface.
IA = Inactive area.
ISM = Incremental Sampling Method.
PAH = Polycyclic aromatic hydrocarbon.
QA/QC = Quality assurance/quality control.
RVAAP = Ravenna Army and Ammunition Plant.

4.1.2 Subsurface Soil Sampling Rationale and Methods

The PBA08 RI used discrete samples from soil borings to complete the characterization of subsurface soil. The subsurface soil decision rules are presented in Figure 4-2 and were based upon prior surface soil sampling results to define the vertical extent of contamination. The subsurface soil was characterized by placing borings in various areas, including areas with previous results greater than the screening criteria, areas with previous results only slightly greater than the screening criteria, and areas not previously sampled. Subsurface soil sampling was conducted according to the decision rules approved in the PBA08 SAP.

In all cases, subsurface borings were biased toward areas where contamination from historic uses or site drainage was most likely. Soil samples from 19 soil borings installed in ISM areas with historical screening criteria exceedances were collected to further delineate the vertical extent of contamination in subsurface soil at the AOC (Figure 4-3). Table 4-3 presents the specific rationale for each subsurface soil sample collected for the PBA08 RI.

Subsurface soil borings were completed by direct push technology (DPT) using a Geoprobe® and/or hand auger. DPT soil samples were collected in a single-use, acetate liner at discrete sample locations and hand auger samples were collected in a chemically decontaminated 3-inch diameter stainless steel auger bucket. The sampling depth intervals were presented in the PBA08 SAP. Each soil boring was sampled at the following intervals: 0-1 ft bgs, 1-4 ft bgs, 4-7 ft bgs, and 7-13 ft bgs. These sample intervals were selected, as documented in the PBA08 SAP, to be able to evaluate surface and subsurface exposure depths for the Resident Receptor (0-1 ft bgs and 1-13 ft bgs) and National Guard Trainee (0-4 ft bgs, 4-7 ft bgs). Each interval was composited and homogenized in a stainless steel bowl, with the exception of VOC samples.

The sample collected from the 7-13 ft bgs interval was archived on site, while the 4-7 ft bgs interval sample was analyzed under an expedited five-day turnaround time. As specified in the PBA08 SAP, if there was one chemical concentration that exceeded screening criteria in the 4-7 ft bgs sample, the 7-13 ft bgs sample was analyzed. In addition, at least 10% of all subsurface samples from 7-13 ft bgs were submitted for laboratory analysis to ensure adequate characterization of the subsurface soil to 13 ft bgs. Three samples collected from the 7-13 ft bgs sample interval were submitted for laboratory analysis for this purpose. None of the archived 7-13 ft bgs samples were analyzed because there were no preliminary screening criteria exceedances.

All subsurface soil samples were analyzed for TAL metals, explosives, and PAHs, and 15% of samples (nine) were analyzed for the RVAAP full-suite analytes [i.e., TAL metals, explosives, propellants (nitrocellulose and nitroguanidine), SVOCs, VOCs, PCBs, and pesticides]. Six QC field duplicates and six QA split samples were collected to satisfy the QA/QC sample requirements of 10% frequency for subsurface soil samples. A lithologic soil description was completed for each soil boring and is included in Appendix A.

Four geotechnical samples were collected from two boring locations to provide soil data for fate and transport modeling. Pilot borings were installed with a Geoprobe® at sample locations ASYsb-051 and ASYsb-055 to a depth of 13 ft bgs to allow lithologic characterization of the soil and to determine the appropriate geotechnical sample intervals (Appendix A). The geotechnical sample location was offset from the pilot boring and drilled with hollow stem auger attachments. Geotechnical samples were then collected beneath the hollow stem augers at the designated sampling interval directly into Shelby Tubes. Undisturbed Shelby Tube samples were collected from 4.0-5.6 ft bgs and 8.5-10.0 ft bgs at location ASYsb-051 and from 4.0-5.5 ft bgs and 9.0-10.5 ft bgs at location ASYsb-055.

The Shelby Tubes were sealed with wax, capped, and submitted for laboratory geotechnical analysis for porosity, bulk density, moisture content, total organic carbon, grain size fraction analysis, and permeability. Laboratory analytical results for geotechnical samples are presented in Appendix D. QA/QC samples were not collected for the geotechnical sample.

After samples were collected, excess soil was designated as IDW and placed in lined, labeled 55-gallon drums that were sealed after use and staged at Building 1036. IDW practices for all media are discussed in Appendix F. Subsurface borings were backfilled to ground surface with dry bentonite chips and hydrated while backfilling with project-approved potable water.

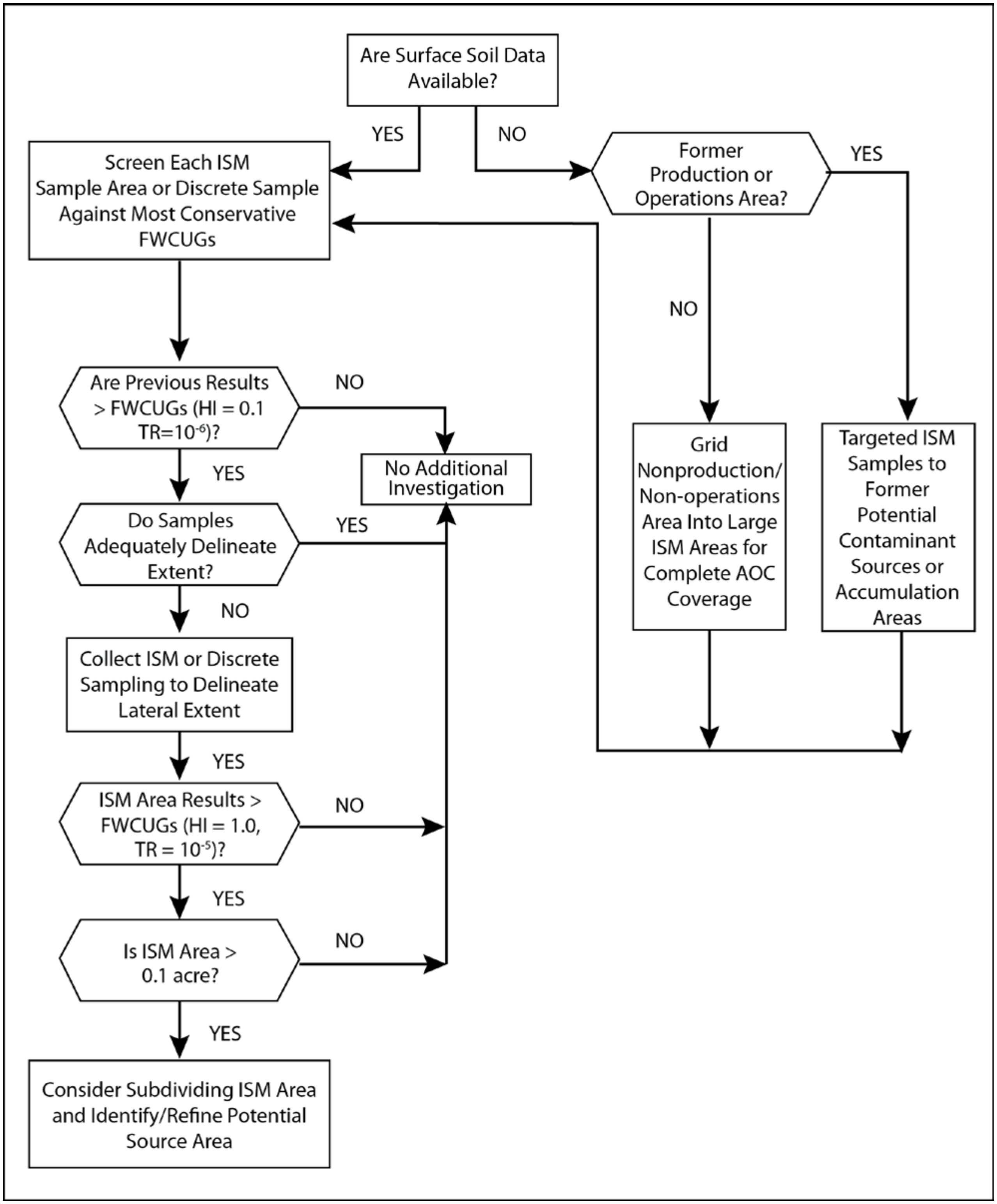


Figure 4-1. PBA08 RI Surface Soil Sampling Decision Flowchart

Table 4-3. PBA08 RI Subsurface Soil Samples and Rationales

Sample Type	Depth (ft bgs)	Location	Sample	Date Sampled	Comments/Rationale
Discrete	0-1	ASYsb-045	ASYSB-045-5660-SO	4/5/2010	Delineated vertical extent of previously identified contamination in the IA.
Discrete	1-4		ASYSB-045-5661-SO	4/5/2010	
Discrete	4-7		ASYSB-045-5662-SO	4/5/2010	
Discrete[a]	7-13		ASYSB-045-5663-SO	4/5/2010	
Discrete	0-1		ASYSB-045-6221-FD	4/5/2010	QA/QC.
Discrete	0-1		ASYSB-045-6229-QA	4/5/2010	
Discrete	0-1	ASYsb-046	ASYSB-046-5664-SO	4/5/2010	Delineated vertical extent of previously identified contamination in the ASA. Analyzed for RVAAP full-suite analytes.
Discrete	1-4		ASYSB-046-5665-SO	4/5/2010	
Discrete	4-7		ASYSB-046-5666-SO	4/5/2010	
NA	7-13		ASYSB-046-5667-SO	NA	
Discrete	0-1	ASYsb-047	ASYSB-047-5668-SO	4/5/2010	Delineated vertical extent of previously identified contamination in the ASA.
Discrete	1-4		ASYSB-047-5669-SO	4/5/2010	
Discrete	4-7		ASYSB-047-5670-SO	4/5/2010	
NA	7-13		ASYSB-047-5671-SO	NA	
Discrete	4-7	ASYsb-047	ASYSB-047-6223-FD	4/5/2010	QA/QC.
Discrete	4-7		ASYSB-047-6231-QA	4/5/2010	
Discrete	0-1	ASYsb-048	ASYSB-048-5672-SO	4/5/2010	Delineated vertical extent of previously identified contamination in the ASA.
Discrete	1-4		ASYSB-048-5673-SO	4/5/2010	
Discrete	4-7		ASYSB-048-5674-SO	4/5/2010	
NA	7-13		ASYSB-048-5675-SO	NA	
Discrete	0-1		ASYSB-048-6222-FD	4/5/2010	QA/QC.
Discrete	0-1		ASYSB-048-6230-QA	4/5/2010	
Discrete	0-1	ASYsb-049	ASYSB-049-5676-SO	4/5/2010	Delineated vertical extent of previously identified contamination in the ASA.
Discrete	1-4		ASYSB-049-5677-SO	4/5/2010	
Discrete	4-7		ASYSB-049-5678-SO	4/5/2010	
Discrete[a]	7-13		ASYSB-049-5679-SO	4/5/2010	
Discrete	8.0-9.5		ASYSB-049-5686-SO	4/6/2010	Collected for SVOCs and VOCs to evaluate field observation of black staining and petroleum odor.
Discrete	0-1	ASYsb-050	ASYSB-050-5680-SO	4/7/2010	Characterized location that appears to be a storm water infiltration gallery or drainage control system (labeled as “8-in tile field drains” on a 1953 utilities map for Atlas Scrap Yard).
Discrete	1-4		ASYSB-050-5681-SO	4/7/2010	
Discrete	4-7		ASYSB-050-5682-SO	4/7/2010	
NA	7-13		ASYSB-050-5683-SO	NA	
Discrete	4.0-5.6	ASYsb-051	ASYSB-051-5684-SO	4/6/2010	Geotechnical.
Discrete	8.5-10		ASYSB-051-5685-SO	4/6/2010	

Table 4-3. PBA08 RI Subsurface Soil Samples and Rationales (continued)

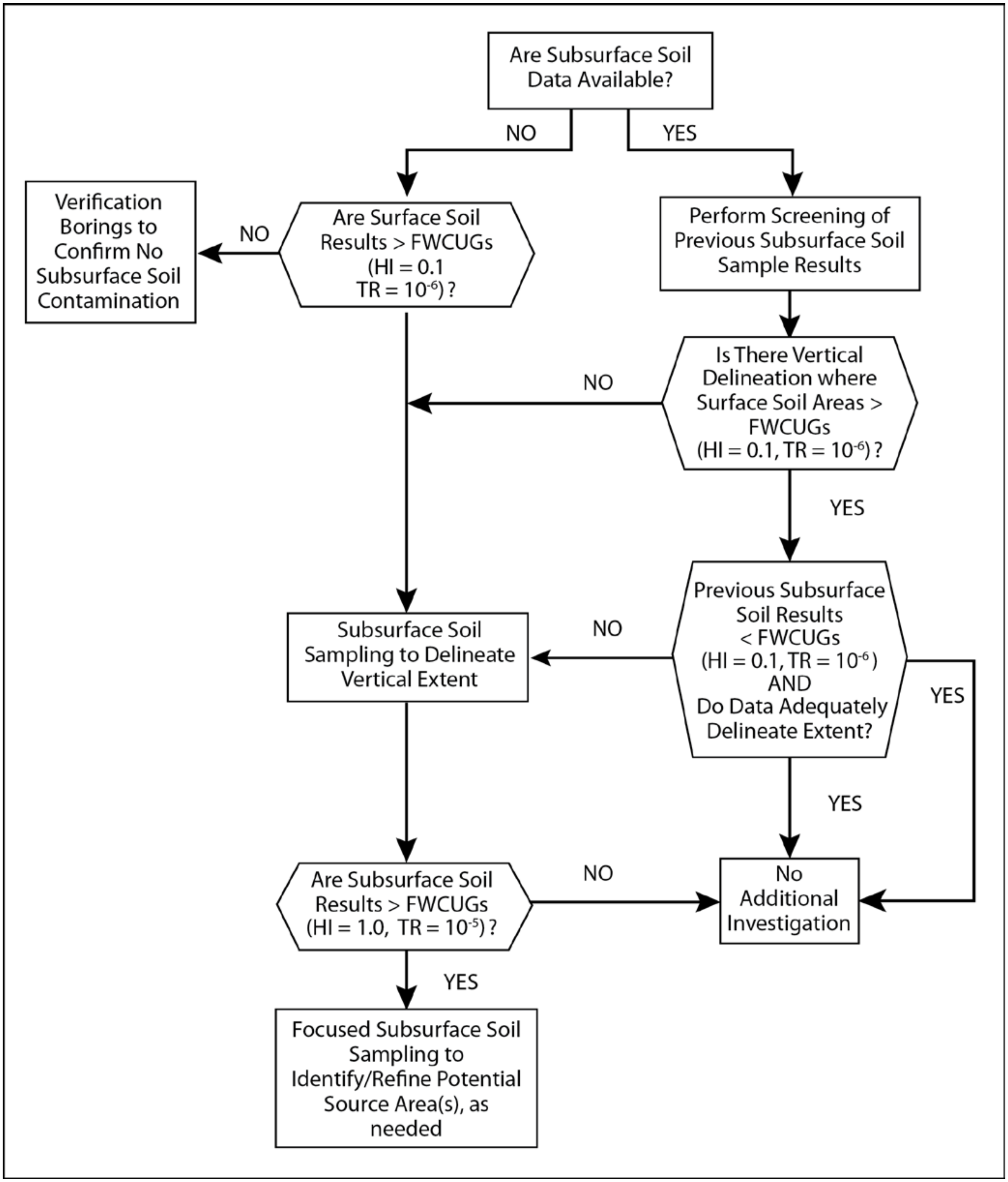
Sample Type	Depth (ft bgs)	Location	Sample	Date Sampled	Comments/Rationale
Discrete	0-1	ASYsb-052	ASYSB-052-5688-SO	4/6/2010	Delineated vertical extent of previously identified contamination in the IA.
Discrete	1-4		ASYSB-052-5689-SO	4/6/2010	
Discrete	4-7		ASYSB-052-5690-SO	4/6/2010	
NA	7-13		ASYSB-052-5691-SO	NA	
NA	7-13		ASYSB-052-6224-FD	NA	QA/QC.
NA	7-13		ASYSB-052-6232-QA	NA	
Discrete	0-1	ASYsb-053	ASYSB-053-5692-SO	4/7/2010	Delineated vertical extent of previously identified contamination in the IA.
Discrete	1-4		ASYSB-053-5693-SO	4/7/2010	
Discrete	4-7		ASYSB-053-5694-SO	4/7/2010	
NA	7-13		ASYSB-053-5695-SO	NA	
Discrete	0-1	ASYsb-054	ASYSB-054-5696-SO	4/6/2010	Confirmed absence of contamination in previously sampled IA. Analyzed for RVAAP full-suite analytes.
Discrete	1-4		ASYSB-054-5697-SO	4/6/2010	
Discrete	4-7		ASYSB-054-5698-SO	4/6/2010	
NA	7-13		ASYSB-054-5699-SO	NA	
Discrete	4-5.5	ASYsb-055	ASYSB-055-5700-SO	4/6/2010	Geotechnical.
Discrete	9-10.5		ASYSB-055-5701-SO	4/6/2010	
Discrete	0-1	ASYsb-056	ASYSB-056-5702-SO	4/7/2010	Delineated vertical extent of previously identified contamination in the IA.
Discrete	1-4		ASYSB-056-5703-SO	4/7/2010	
Discrete	4-7		ASYSB-056-5704-SO	4/7/2010	
NA	7-13		ASYSB-056-5705-SO	NA	
Discrete	0-1	ASYsb-057	ASYSB-057-5706-SO	4/7/2010	Characterized potential former storm sewer terminus.
Discrete	1-4		ASYSB-057-5707-SO	4/7/2010	
Discrete	4-7		ASYSB-057-5708-SO	4/7/2010	
NA	7-13		ASYSB-057-5709-SO	NA	
Discrete	0-1	ASYsb-058	ASYSB-058-5710-SO	4/7/2010	Delineated vertical extent of previously identified contamination in the IA.
Discrete	1-4		ASYSB-058-5711-SO	4/7/2010	
Discrete	4-7		ASYSB-058-5712-SO	4/7/2010	
NA	7-13		ASYSB-058-5713-SO	NA	
Discrete	0-1	ASYsb-059	ASYSB-059-5714-SO	3/30/2010	Delineated vertical extent of previously identified contamination in the IA.
Discrete	1-4		ASYSB-059-5715-SO	3/30/2010	
Discrete	4-7		ASYSB-059-5716-SO	3/30/2010	
Discrete[a]	7-13		ASYSB-059-5717-SO	3/30/2010	
Discrete	4-7		ASYSB-059-6220-FD	3/30/2010	QA/QC
Discrete	4-7		ASYSB-059-6228-QA	3/30/2010	
Discrete	0-1	ASYsb-060	ASYSB-060-5718-SO	3/30/2010	Confirmed absence of contamination in previously sampled area in the IA.
Discrete	1-4		ASYSB-060-5719-SO	3/30/2010	
Discrete	4-7		ASYSB-060-5720-SO	3/30/2010	
NA	7-13		ASYSB-060-5721-SO	NA	
Discrete	0-1	ASYsb-061	ASYSB-061-5722-SO	3/30/2010	Delineated vertical extent of previously identified contamination in the IA.
Discrete	1-4		ASYSB-061-5723-SO	3/30/2010	
Discrete	4-7		ASYSB-061-5724-SO	3/30/2010	
NA	7-13		ASYSB-061-5725-SO	NA	

Table 4-3. PBA08 RI Subsurface Soil Samples and Rationales (continued)

Sample Type	Depth (ft bgs)	Location	Sample	Date Sampled	Comments/Rationale
Discrete	0-1	ASYsb-062	ASYSB-062-5726-SO	3/30/2010	Delineated vertical extent of previously identified contamination in the IA. Analyzed for RVAAP full-suite analytes.
Discrete	1-4		ASYSB-062-5727-SO	3/30/2010	
Discrete	4-7		ASYSB-062-5728-SO	3/30/2010	
NA	7-13		ASYSB-062-5729-SO	NA	
Discrete	1-4		ASYSB-062-6218-FD	3/30/2010	QA/QC. Analyzed for RVAAP full-suite analytes.
Discrete	1-4		ASYSB-062-6226-QA	3/30/2010	
Discrete	0-1	ASYsb-063	ASYSB-063-5730-SO	4/7/2010	Delineated vertical extent of previously identified contamination in the IA; boring terminated at 7 ft due to refusal.
Discrete	1-4		ASYSB-063-5731-SO	4/7/2010	
Discrete	4-7		ASYSB-063-5732-SO	4/7/2010	
NS	7-13		ASYSB-063-5733-SO	NS	
Discrete	0-1	ASYsb-064	ASYSB-064-5734-SO	3/30/2010	Delineated vertical extent of previously identified contamination in the IA.
Discrete	1-4		ASYSB-064-5735-SO	3/30/2010	
Discrete	4-7		ASYSB-064-5736-SO	3/30/2010	
NA	7-13		ASYSB-064-5737-SO	NA	
Discrete	1-4		ASYSB-064-6219-FD	3/30/2010	QA/QC.
Discrete	1-4		ASYSB-064-6227-QA	3/30/2010	
Discrete	0-1	ASYsb-065	ASYSB-065-5738-SO	4/7/2010	Delineated vertical extent of previously identified contamination in the IA; boring terminated at 7 ft due to refusal.
Discrete	1-4		ASYSB-065-5739-SO	4/7/2010	
Discrete	4-7		ASYSB-065-5740-SO	4/7/2010	
NS	7-13		ASYSB-065-5741-SO	NS	

[a] Three samples (10%) from 7-13 ft were submitted for laboratory analysis to characterize subsurface soil to 13 ft bgs.

ASA = Active Storage Area.
ft bgs = Feet below ground surface.
IA = Inactive area.
NA = Sample not analyzed by the laboratory based on preliminary screening criteria of the 4-7 ft sample interval.
NS = Not sampled due to refusal
QA/QC = Quality assurance/quality control.
RVAAP = Ravenna Army and Ammunition Plant
SVOC = Semi-volatile organic compound.
VOC = Volatile organic compound.



1 **Figure 4-2. PBA08 RI Subsurface Soil Sampling Decision Flowchart**

4.2 SURFACE WATER AND SEDIMENT CHARACTERIZATION

Surface water and sediment samples were not collected within the AOC during the PBA08 RI. Surface water is only present at the AOC during periods of heavy precipitation. Storm water runoff at Atlas Scrap Yard ultimately discharges to Load Line 12. One co-located set of sediment and surface water samples (L12sd-308 and L12sw-308) were collected in the ditch east of Atlas Scrap Yard along Paris-Windham Road under the PBA08 RI for Load Line 12 (Figure 4-3). The *Phase III Remedial Investigation Report for Sediment and Surface Water at the RVAAP-12 Load Line 12* (USACE 2010c) contains details of sample collection. The sediment and surface water samples were incorporated into the Atlas Scrap Yard evaluation to represent the potential exit point for runoff or surface drainage from the AOC.

4.3 CHANGES FROM THE WORK PLAN

Changes to the PBA08 SAP are documented in field change requests (FCRs) provided in Appendix B. Changes made in the field based on AOC-specific conditions are not documented on FCRs but on the field sampling logs (Appendix A). These changes are presented in Table 4-4 and on the field sample logs. Revised coordinates for all locations can be found on the field sampling logs.

Table 4-4. Changes from the PBA08 Sample and Analysis Plan

Location	Affected Sample	Date Sampled	Change/Rationale
ASYsb-046	ASYSB-046-5664-SO	4/5/2010	Original sample location was covered by railroad ties and subsequently relocated.
	ASYSB-046-5665-SO	4/5/2010	
	ASYSB-046-5666-SO	4/5/2010	
	ASYSB-046-5667-SO	4/5/2010	
ASYsb-049	ASYSB-049-5686-SO	4/6/2010	Location was added to sample VOCs and SVOCs based on hydrocarbon odor and elevated air monitor readings
ASYsb-061	ASYSB-061-5722-SO	3/30/2010	Sample had to be recollected in adjacent borehole due to poor recovery in original borehole.
ASYsb-062	ASYSB-062-5726-SO	3/30/2010	Original sample location was covered by a concrete pad and subsequently relocated.
	ASYSB-062-5727-SO	3/30/2010	
	ASYSB-062-5728-SO	3/30/2010	
	ASYSB-062-5729-SO	3/30/2010	
	ASYSB-062-6218-FD	3/30/2010	
	ASYSB-062-6226-QA	3/30/2010	
ASYss-066	ASYSS-066-5778-SO	4/7/2010	Original sample location was relocated to the bottom of a ditch.

SVOC = Semi-volatile organic compound.
VOC = Volatile organic compound.

4.4 ANALYTICAL PROGRAM OVERVIEW

The following sections describe the analytical program followed during the PBA08 RI.

4.4.1 Data Quality Objectives

Samples were collected and analyzed according to the FWSAP and PBA08 SAP samples that were prepared in accordance with USACE and USEPA guidance. The FWSAP and PBA08 SAP outline the organization, objectives, intended data uses, and QA/QC activities to perform in order to achieve the desired DQOs for maintaining defensibility of the data. Project DQOs were established in accordance with USEPA Region 5 guidance. Requirements for sample collection, handling, analysis criteria, target analytes, laboratory criteria, and data verification criteria for the RI are consistent with USEPA and U.S. Department of Defense (DoD) requirements. DQOs for this project include analytical precision, accuracy, representativeness, completeness, comparability, and sensitivity for the measurement data. Appendix C presents an assessment of the analytical program objectives.

4.4.2 Quality Assurance and Quality Control

Samples were properly packaged for shipment and transferred by courier to the laboratory for analysis. A signed chain-of-custody record (included in Appendix D) with sample numbers and locations was enclosed with each shipment. When transferring possession of samples, the individuals relinquishing and receiving the samples signed, dated, and noted the time on the record. All shipments were in compliance with applicable U.S. Department of Transportation regulations for environmental samples.

QA/QC samples for this project included field blanks, trip blanks, QC field duplicates, QA split samples, laboratory method blanks, laboratory control samples, laboratory duplicates, and matrix spike/matrix spike duplicate samples. Table 4-5 presents a summary of QA/QC samples utilized during the PBA08 RI and how each sample type was used to support the quality of the analytical data. An evaluation of QA/QC samples and their contribution to documenting project data quality is provided in Appendix C.

4.4.3 Field Analyses

No field laboratory analyses (i.e., field explosives testing or ISM processing) were conducted for the PBA08 RI. Field screening for organic vapors was not used to guide sampling or analytical efforts. Organic vapors were monitored in the breathing zone during drilling for health and safety purposes at each subsurface soil boring location.

4.4.4 Laboratory Analyses

Samples collected during the PBA08 RI were analyzed by TestAmerica Laboratories, Inc. (herein referred to as TestAmerica) of North Canton, Ohio and West Sacramento, California, as a subcontractor to White Water Associates, Inc., of Amasa, Michigan. Collected QA split samples were analyzed by USACE's contracted QA laboratory, RTI Laboratories, Inc., of Livonia, Michigan. TestAmerica and RTI Laboratories, Inc. are accredited by the DoD Environmental Laboratory Accreditation Program.

Table 4-5. Summary of PBA08 RI QA/QC Samples

Sample Type	Rationale
Field Blank	Analyzed to determine contamination in source material that may contribute to sample contamination.
Trip Blank	Analyzed to assess the potential for cross contamination of samples due to contaminant interference during sample shipment and storage.
Field Duplicate	Analyzed to determine sample heterogeneity and sampling methodology reproducibility.
Equipment Rinsate	Analyzed to assess the adequacy of the equipment decontamination processes for non-dedicated sampling equipment.
Laboratory Method Blanks	Analyzed to assess the contamination level in the laboratory preparation and analysis process.
Laboratory Duplicate Samples	Analyzed to assist in determining the analytical reproducibility and precision of the analysis for samples of interest and provide information about the effect of the sample matrix on the measurement methodology.
Matrix Spike/Matrix Spike Duplicate	
Laboratory Control Sample	Analyzed to determine the accuracy and precision of the analytical method implemented by the laboratory and to monitor the laboratory's analytical process control.
QA Split	Analyzed to provide independent verification of the accuracy and precision of the principal analytical laboratory.

QA = Quality assurance.

All analytical procedures were completed in accordance with applicable professional standards, USEPA requirements, government regulations and guidelines, DoD Quality Systems Manual Version 3, USACE Louisville District analytical QA guidelines, and specific project goals and requirements. In addition to these standards, the analytical laboratories were required to strictly adhere to the requirements set forth in the FWSAP and PBA08 SAP so that conditions adverse to data quality would not arise. Preparation and analyses for chemical parameters were performed according to the methods listed in Table 4-6. Additionally, soil geotechnical analysis for porosity, bulk density, moisture content, grain size fraction, and permeability were performed in compliance with American Society for Testing and Materials (ASTM) test methods.

Table 4-6. Summary of PBA08 RI Sample Preparation and Analytical Procedures

Parameter	Preparation	Analysis
Soil		
Inorganic Chemicals	SW-846 3050B	SW-846 6020
Mercury	--	SW-846 7471A
Explosives	--	SW-846 8330B
SVOCs and PAHs	SW-846 3540C	SW-846 8270C
Propellants:		
Nitrocellulose	--	353.2 Modified
Nitroguanidine	SW-846 3550A	SW-846 8330M
VOCs	SW-846 5030B	SW-846 8260B
Pesticides	SW-846 3540C	SW-846 8081A
PCBs	SW-846 3540C	SW-846 8082
Hexavalent Chromium	SW-846 3060A	SW-846 7196A

PAH = Polycyclic Aromatic Hydrocarbon.
PCB = Polychlorinated Biphenyl.
SVOC = Semi-volatile Organic Compound.
VOC = Volatile Organic Compound.
-- = Preparation steps included in analytical method.

Leidos is the custodian of the project files and will maintain the contents of the files for this investigation, including all relevant records, reports, logs, field notebooks, photographs, subcontractor reports, correspondence, and sample custody forms. These files will remain in a secure area under the custody of the Leidos project manager until they are transferred to USACE, Louisville District and U.S. Army at the end of the PBA08 project.

Analytical data reports from the project laboratory were forwarded to the USACE Louisville District laboratory data validation contractor for validation review and QA comparison. White Water Associates, Inc. and TestAmerica will retain all original raw data (hard copy and electronic) in a secure area under the custody of the laboratory project manager for a minimum of seven years.

4.4.5 Data Review, Verification, and Quality Assessment

Data were produced, reviewed, and reported by the laboratory in accordance with specifications in the PBA08 SAP, the Louisville District analytical QA guidelines, and the laboratory's QA manual.

TestAmerica performed in-house analytical data reduction under the direction of the laboratory project manager and QA officer. These individuals were responsible for assessing data quality and informing Leidos and USACE of any data considered "unacceptable" or requiring caution by the data user in terms of its reliability.

Final reports were generated by the laboratory project manager. Data were then delivered to Leidos for verification. TestAmerica prepared and retained full analytical and QC documentation for the project in paper copy and electronic storage media (e.g., compact disk), as directed by the analytical methodologies employed. Laboratory reports included documentation verifying analytical holding time compliance.

Leidos performed a systematic process utilizing automated data review (ADR) software for data verification to ensure the precision and accuracy of the analytical data were adequate for their intended use. The ADR outlier reports are included as Attachment 1 to Appendix C. This verification attempted to minimize the potential of using false-positive or false-negative results in the decision-making process (i.e., to ensure accurate identification of detected versus non-detected chemicals). This approach was consistent with DQOs for the project and with the analytical methods used for determining COCs and calculating risk. "Definitive Data" were reported consistent with the deliverables identified in the project sampling and analysis plan (SAP). These definitive data were then verified through the review process outlined in the project SAP and are presented in Appendix C. A few inorganic chemical, SVOC, and pesticide samples required dilution due to elevated analyte concentrations or difficult matrices. All reporting limits and/or method detection limits (MDLs) for undetected analytes remained below FWCUGs, with the exception of thallium in one sample and aldrin and n-nitrosodi-n-propylamine in four samples. Data that have been rejected were relegated to non-detected antimony results in four samples. Rejected data constituted 0.05% of the Atlas Scrap Yard data. The completeness goal for analytical data is 90%, as defined in Tables 3-1 and 3-2 of the Facility-Wide Quality Assurance Project Plan (FWQAPP). The project achieved this goal by collecting all samples presented in the PBA08 SAP and producing usable results for 99.95% of all samples performed. In addition to the Leidos data review, USACE performed a 10% validation of all data to evaluate data usability. Results of USACE's Chemical Data Usability Report are presented in Appendix C.

4.5 ORDNANCE AND EXPLOSIVES AVOIDANCE AND FIELD RECONNAISSANCE

All samples were collected within the MRS, so MEC avoidance subcontractor support staff were present during sampling at Atlas Scrap Yard. The MEC Team Leader led an initial safety briefing on MEC to train all field personnel to recognize and stay away from propellants and MEC. Daily tailgate safety briefings included reminders regarding MEC avoidance. Documentation of these safety meetings and daily activities are included in Appendix I. Prior to beginning sampling activities, sample locations were assessed for potential MEC using visual surveys and hand-held magnetometers. Once subsurface sampling began, the Foster Ferex MK 26 Ordnance Detector was lowered into the borehole to identify areas void of anomalies. No anomalies were noted during the collection of surface and subsurface soil samples during the investigation. The ordnance and explosives (OE) technician remained on site while sampling was performed to visually examine soil for any unusual material indicative of potential OE. No MEC were identified during the visual examination of soil during this investigation.

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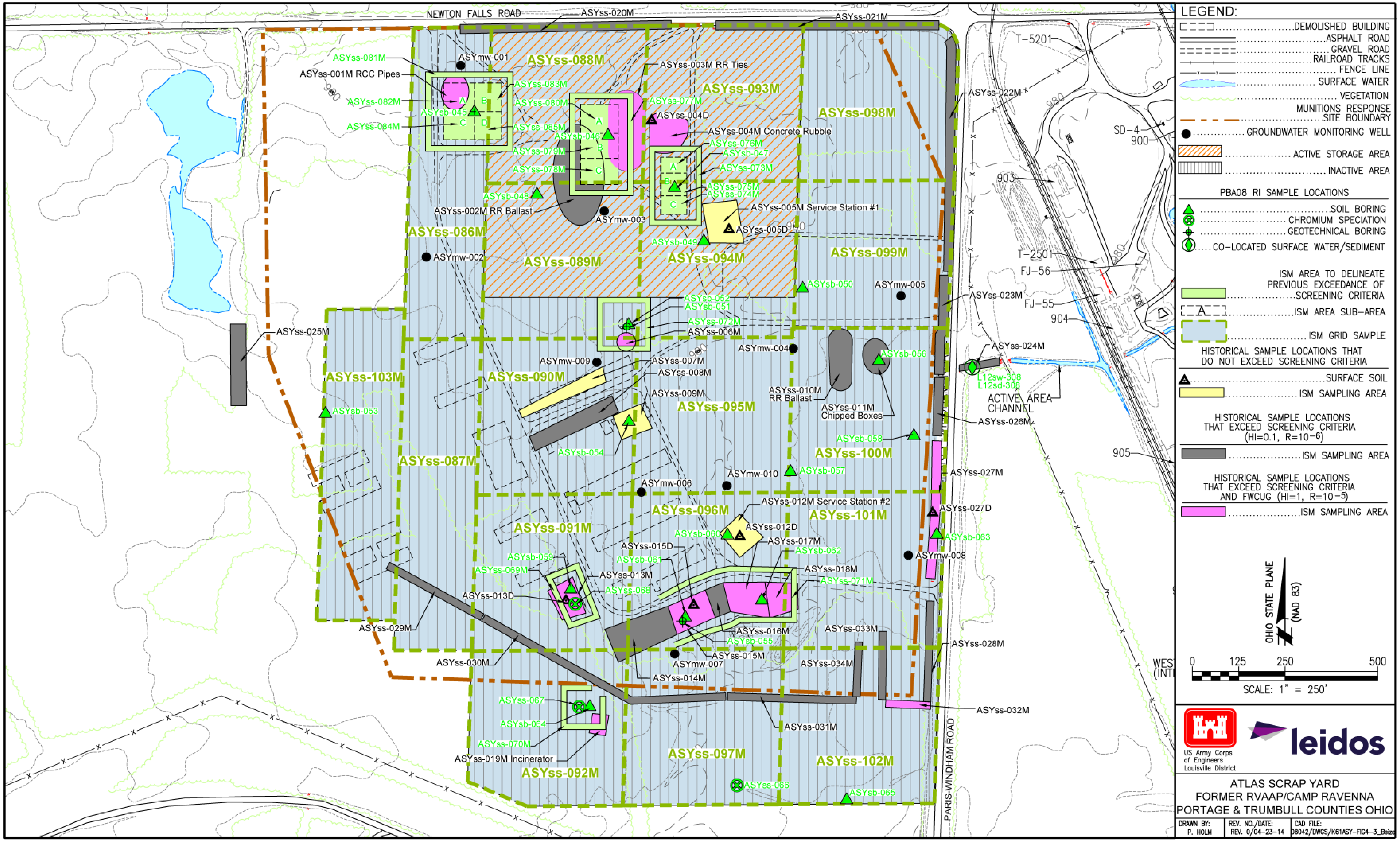

Figure 4-3. PBA08 RI and Historical Sample Locations

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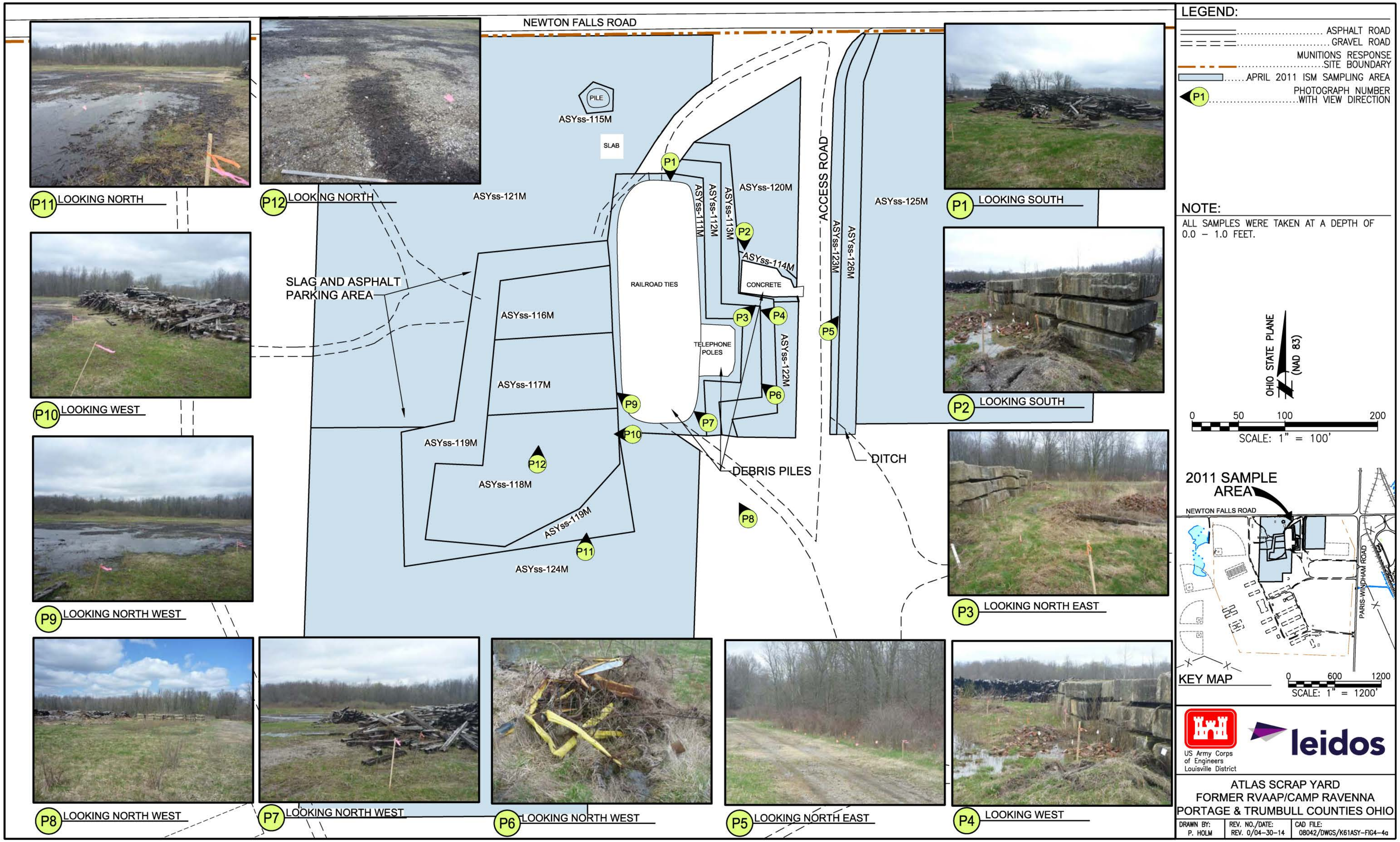

Figure 4-4. April 2011 Active Storage Area Sample Locations

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5.0 NATURE AND EXTENT OF CONTAMINATION

This section presents analytical data results obtained during the PBA08 RI and Characterization of 14 AOCs investigation; the data screening process to identify SRCs; and the evaluation of nature and extent of SRCs in environmental media at Atlas Scrap Yard.

Section 5.1 presents the statistical methods and screening processes used to distinguish constituents present at ambient concentrations (background concentrations) from those present at concentrations that indicate potential impacts related to historical operations within Atlas Scrap Yard. Section 5.1.1 presents data aggregates based on environmental media, AOC characteristics, and spatial distribution of samples. The nature and extent of contamination in all sampled environmental media (surface soil, subsurface soil, sediment, and surface water) are presented in Sections 5.2.1 through 5.2.6. Each section contains data tables that present results of the PBA08 RI and identified SRCs (utilizing historical and current datasets) and summarizes the nature and extent of SRCs within each environmental medium and spatial data aggregate. Summary analytical results are presented in graphical or tabular formats at the end of this section. All validated Atlas Scrap Yard data from historical investigations and the PBA08 RI are included in Appendix D. Complete laboratory analytical data packages from the PBA08 RI are also included in Appendix D.

5.1 DATA EVALUATION METHOD

Data evaluation methods for Atlas Scrap Yard are consistent with those established in the FWCUG Report and specified in the PBA08 SAP. The processes used to evaluate the analytical data involved three general steps: (1) defining data aggregates; (2) data verification, reduction, and screening; and (3) data presentation.

5.1.1 Definition of Aggregates

Atlas Scrap Yard data were aggregated in four ways for evaluating contaminant nature and extent. The initial basic aggregation of data was by environmental medium: surface soil, subsurface soil, sediment, and surface water. For each medium-specific aggregate, an evaluation was conducted to determine if further aggregation was warranted with respect to AOC characteristics, historical operations, ecological habitat, and potential future remedial strategy and land use (e.g., spatial aggregates). Data for soil were further aggregated based on depth and sample type for consistency with human health risk guidance established in the FWHHRAM and FWCUG Report. Data aggregates for evaluating the nature and extent of contamination at Atlas Scrap Yard are as follows:

- Surface Soil (0-1 ft bgs): This medium was evaluated as an AOC-wide aggregate with additional consideration for the ASA and IA.
- Subsurface Soil (> 1 ft bgs) includes data from sample intervals 1-4, 4-7, and 7-13 ft bgs: This medium was evaluated as an AOC-wide aggregate with additional consideration for the ASA and IA.

- Surface Water: Perennial surface water is not present within Atlas Scrap Yard. Surface water only occurs intermittently as storm water runoff. The nature and extent evaluation for Atlas Scrap Yard includes L12-308, which is downstream from the surface water discharge point, adjacent to Load Line 12. This sample location was evaluated as one data aggregate for to evaluate nature and extent of contamination in this report and is included in the HHRA in the *Phase III Remedial Investigation Report for Sediment and Surface Water at the RVAAP-12 Load Line 12* (USACE 2010c).
- Sediment: Sediment is not present as an aggregate at Atlas Scrap Yard, as surface water only occurs intermittently, and dry sediment is classified as soil in this report. As with surface water, the nature and extent evaluation for sediment associated with the drainage ditch from Atlas Scrap Yard includes L12-308, which is downstream from the surface water discharge point, adjacent to Load Line 12. This sample location is included in the HHRA in the *Phase III Remedial Investigation Report for Sediment and Surface Water at the RVAAP-12 Load Line 12* (USACE 2010c). In addition, the nature and extent evaluation included ISM sample ASYsd-024M-SD collected from the same reach of the drainage ditch during the Characterization of 14 AOCs.

The soil data aggregates are further subdivided for the HHRA and ERAs as discussed in Section 7.1.1.

5.1.2 Data Verification, Reduction, and Screening

5.1.2.1 Data Verification

Data verification was performed on 128 surface soil, subsurface soil, sediment, and surface water samples (including QC duplicates) collected during the PBA08 RI in 2010 and 2011. Historical data were verified and completed as presented in the historical reports. Analytical results were reported by the laboratory in electronic format and loaded into the Ravenna Environmental Information Management System (REIMS) database. As discussed in Section 4.4.5, data verification was performed to ensure all requested data were received and complete. Data qualifiers were assigned to each result based on the laboratory QA review and verification criteria. Results were qualified as follows:

"U"	not detected;
"UJ"	not detected, reporting limit estimated;
"J"	indicates the analyte was positively identified, but the associated numerical value is an approximate concentration of the analyte in the sample; and
"R"	result not usable.

In addition to assigning qualifiers, the verification process also selected the appropriate result to use when performing re-analyses or dilutions. Where laboratory surrogate recovery data or laboratory QC samples were outside of analytical method specifications, the verification chemist determined whether laboratory re-analysis should be used in place of an original reported result. If the laboratory reported results for diluted and undiluted samples, diluted sample results were used for analytes that exceeded the calibration range of the undiluted sample. A complete discussion of verification process results is contained in the data QC summary report (Appendix C). The data QC summary report also includes a summary table of the assigned data qualifiers and the accompanying rationale. Independent, third-party validation of 10% of the RI data and 100% of the USACE QA laboratory data was performed by a subcontractor to the USACE, Louisville District.

5.1.2.2 <u>Data Reduction</u>

Calculating data summary statistics was the initial step in the data reduction process to identify SRCs. Eligible historical and current AOC data were extracted from the database. Results from QC splits and field duplicates, as well as rejected results, were excluded from the data screening process. All analytes having at least one detected value were included in the data reduction process.

Summary statistics calculated for each data aggregate included the minimum, maximum, and average (mean) values and the proportion of detected results to the total number of samples included in the data screening process. For calculating mean values, non-detected results were addressed by using one-half of the reported detection limit as a surrogate value during calculation of the mean result for each compound (USEPA 1989).

Non-detected results with elevated detection limits (more than five times the contract-required detection limit) were excluded from the summary statistics in order to avoid skewing the mean value calculations.

5.1.2.3 <u>Data Screening</u>

After reduction, the data were screened to identify SRCs using the processes outlined below. Additional screening of identified SRCs was conducted: (1) in the fate and transport evaluation (Section 6.0) to identify CMCOPCs; (2) in the HHRA to identify human health COPCs and COCs (Section 7.2); and (3) in the ERA to evaluate COPECs (Section 7.3). Figure 5-1 illustrates the screening process to identify SRCs and COPCs at Atlas Scrap Yard in accordance with the FWCUG Report. The steps involved in the SRC screening process are summarized below. All chemicals that were not eliminated during the screening steps were retained as SRCs.

- Data Quality Assessment: Discussed previously in Section 4.4.5.
- Background Screening: The maximum detected concentration (MDC) of inorganic chemicals was compared to RVAAP background screening values (BSVs). If background concentrations were exceeded, the respective inorganic chemicals were retained as SRCs. No BSVs were established for organic chemicals. As such, all detected organic chemicals were retained as SRCs.
- Screening of Essential Human Nutrients: Chemicals that are considered essential nutrients (e.g., calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) are an integral part of the human food supply and are often added to foods as

supplements. USEPA recommends these chemicals not be evaluated unless they are grossly elevated relative to background concentrations or would exhibit toxicity at the observed concentrations at an AOC (USEPA 1989). Recommended dietary allowance (RDA) and recommended daily intake (RDI) values are available for all of these chemicals (Table 5-1). Screening values were calculated for receptors ingesting 100 mg of soil per day or 1 liter of groundwater per day to meet their RDA/RDI. In the case of calcium, magnesium, phosphorous, potassium, and sodium, a receptor ingesting 100 mg of soil per day would receive less than the RDA/RDI value, even if the soil consisted of the pure mineral (i.e., soil concentrations at 1,000,000 mg/kg). Essential nutrients detected at or below their RDA/RDI-based screening levels were eliminated as SRCs.

- Frequency of Detection/WOE Screening: Chemicals that were never detected in a given medium were eliminated as SRCs. For subsurface chemicals with at least 20 discrete samples and a frequency of detection of less than 5%, a WOE approach was used to determine if the chemical is AOC-related. This screening was applied to all organic and inorganic chemicals with the exception of explosives and propellants; all detected explosives and propellants were considered as SRCs regardless of frequency of detection. At Atlas Scrap Yard, 20 discrete subsurface soil samples were available for frequency of detection/WOE screening; however, no SRCs were screened out on this basis. The frequency of detection/WOE screening was not applied to ISM samples.

Table 5-1. Recommended Dietary Allowances/Reference Daily Intake Values

Essential Human Nutrient	**USDA RDA/RDI[a] Value**
Calcium	1000 mg/d
Chloride[b]	3400 mg/d
Iodine	150 µg/d
Iron	8 mg/d
Magnesium	400 mg/d
Potassium[b]	4700 mg/d
Phosphorous	700 mg/d
Sodium[b]	2300 mg/d

[a] Dietary reference intakes vary by gender and age, values present are for life stage group: Males 19-30 years.
[b] Adequate Intake Value.
mg/d = Milligram per day.
RDA= Recommended Dietary Allowance.
RDI= Reference Daily Intake.
µg/d = Micrograms per day.
USDA = U.S. Department of Agriculture.
Source= Values were obtained from http://fnic.nal.usda.gov charts.

5.1.3 Data Presentation

Data summary statistics and screening results for SRCs in surface soil, subsurface soil, sediment, and surface water at Atlas Scrap Yard are presented for each medium and spatial aggregate. Analytical results for SRCs are presented by sample location on Figures 5-2 through 5-15. Analytical results for SRCs are also presented in data summary tables.

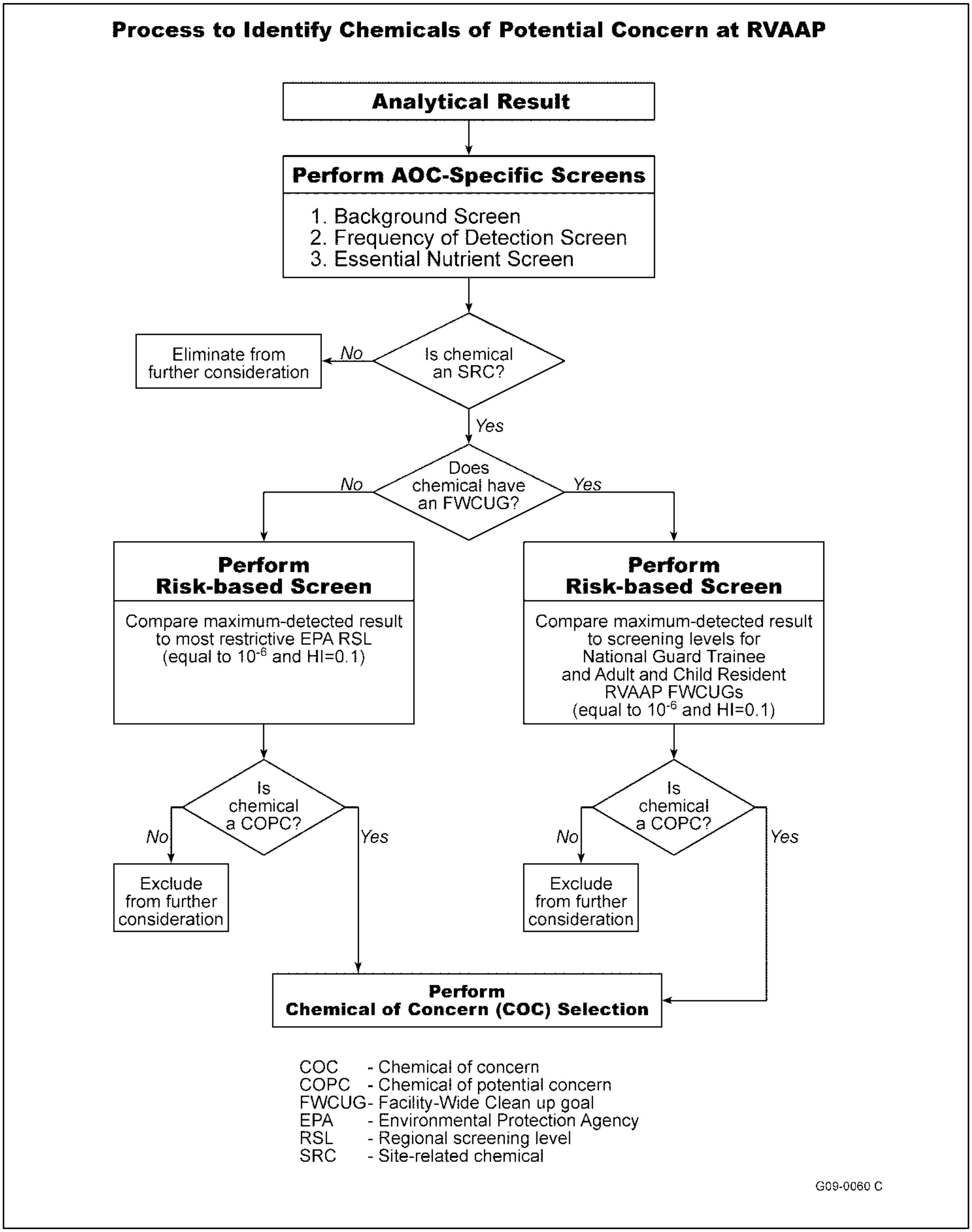


Figure 5-1. Process to Identify RVAAP COPCs in the Human Health Risk Assessment (USACE 2010a)

The complete laboratory analytical data packages are included in Appendix D. In order to maximize efficiency for laboratory reporting and data management activities, all samples received at the laboratory on a given day were reported in a single data package. Therefore, results may be present in the data packages that are associated with different AOCs. All samples for Atlas Scrap Yard have sample IDs beginning with "ASY."

The tables in Appendix D present the analytical results for samples collected during the PBA08 RI and Characterization of 14 AOCs (MKM 2007). Analytical results are grouped by media (e.g., surface soil, surface water) and class of analytes (e.g., explosives, inorganic chemicals) for ease of reference.

5.1.4 Data Evaluation

As discussed in Section 2.2.2, surface soil and sediment samples were collected during the Characterization of 14 AOCs. Because surface water occurs only intermittently as storm water runoff, the previously classified sediment samples within the Atlas Scrap Yard boundary are classified as soil. The nature and extent evaluation for Atlas Scrap Yard includes an evaluation of L12-308, which is immediately downstream of the surface water discharge point and adjacent to Load Line 12. Surface soil and subsurface soil samples at Atlas Scrap Yard were collected during the PBA08 RI. Additionally, four subsurface soil samples (two from both soil borings) were collected during the PBA08 RI for geotechnical analysis only. All available sample data were evaluated to determine suitability for use in the RI under two primary considerations: (1) representativeness with respect to current AOC conditions; and (2) sample collection methods (e.g., discrete vs. ISM). Table 5-2 presents the designated use for all available Atlas Scrap Yard samples as well as their aggregate assignments.

Samples from the 2004 dataset (Characterization of 14 AOCs) were evaluated to determine if conditions had changed substantively between earlier characterization efforts and the PBA08 RI activities. No historical surface samples were eliminated from evaluation on the basis of changed conditions at the AOC. However, surface soil samples at ASYss-001M, ASYss-003M, ASYss-004M and ASYss-004D were not included in the SRC screening dataset, as these ISM locations were re-sampled in 2010 under the PBA08 RI, and the more recent data were used for SRC screening.

In April 2011, an additional sampling event was conducted to refine contaminated areas in surface soil at the ASA, specifically grid ISM locations ASYss-088M, ASYss-089M, ASYss-093M and ASYss-094M. The sixteen samples collected during this sampling event were included in the SRC screening dataset.

Since no subsurface soil samples were collected historically, the SRC dataset is comprised only of PBA08 RI samples. Sediment and surface water samples collected from the sanitary sewer system are not included in the evaluation within this report, as those samples are evaluated as part of the Facility-Wide Sewers AOC (designated as RVAAP-67). One co-located set of sediment and surface water samples (L12sd-308 and L12sw-308) were collected in the ditch east of Atlas Scrap Yard along

Paris-Windham Road under the PBA08 RI for Load Line 12. These samples were incorporated into the Atlas Scrap Yard nature and extent evaluation to represent the potential exit point for runoff or surface drainage from the AOC.

Historical surface soil and sediment samples were collected using ISM sample methods only. Under the PBA08 RI, surface soil was sampled using discrete (i.e., chromium speciation and soil boring samples) and ISM methods. As presented in Table 5-2, only ISM sample locations were used in the SRC screening process for surface soil. All subsurface soil samples collected under the PBA08 RI were collected as discrete soil borings and screened for SRCs. One historical sediment sample was collected east (downstream) of the AOC via ISM methods at the western boundary of Load Line 12 along the drainage ditch beneath Paris-Windham Road, and one PBA08 RI sample was collected at the same location via discrete sampling methods. The two sediment samples (i.e., ISM and discrete) were screened for SRCs separately due to the difference in collection methodologies. A co-located surface water sample was also collected using discrete methods under the PBA08 RI and was the only surface water sample available for use in the SRC screening process. Table 5-2 presents the classification for all Atlas Scrap Yard samples.

5.2 CONTAMINANT NATURE AND EXTENT

This section evaluates the analytical results of previous and current investigations at Atlas Scrap Yard and identifies SRCs associated with surface soil, subsurface soil, sediment and surface water. SRC screening tables for each medium are presented at the end of Section 5 (Tables 5-6 through 5-10). The detected results of the subsequently collected PBA08 RI samples are also included at the end of Section 5 (Tables 5-11 through 5-15). Contaminant nature and extent is presented below for each medium and class of analytes.

5.2.1 Surface Soil Discrete Sample Results for Chromium Speciation

During the PBA08 RI, surface soil samples were collected from three discrete sample locations and analyzed for hexavalent chromium and total chromium. Samples were collected from the three sampling areas having the highest, mid-point, and lowest total historical chromium results. This sampling was accomplished to determine the contribution of hexavalent chromium to total chromium in soil at Atlas Scrap Yard for use in the HHRA (Section 7.2). Chromium speciation results are shown in Table 5-3. All three samples had a total chromium concentration below the BSV of 17.4 mg/kg.

Table 5-2. Data Summary

Sample ID	Date	Sample Type	Use Type	Comments
Surface Soil (0-1 ft)				
ASYsb-045-5660-SO	4/5/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-045-6221-FD	4/5/2010	D	FD	QC sample limits use to nature and extent
ASYsb-046-5664-SO	4/5/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-047-5668-SO	4/5/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-048-5672-SO	4/5/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-048-6222-FD	4/5/2010	D	FD	QC sample limits use to nature and extent
ASYsb-049-5676-SO	4/5/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-050-5680-SO	4/7/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-052-5688-SO	4/6/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-053-5692-SO	4/7/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-054-5696-SO	4/6/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-056-5702-SO	4/7/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-057-5706-SO	4/7/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-058-5710-SO	4/7/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-059-5714-SO	3/30/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-060-5718-SO	3/30/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-061-5722-SO	3/30/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-062-5726-SO	3/30/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening

Table 5-2. Data Summary (continued)

Sample ID	Date	Sample Type	Use Type	Comments
Surface Soil (0-1 ft), continued				
ASYsb-063-5730-SO	4/7/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-064-5734-SO	3/30/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYsb-065-5738-SO	4/7/2010	D	N	Sample used for nature and extent evaluation only, as ISM data is used for surface soil screening
ASYss-001M-SO	11/4/2004	ISM	N	Since this ISM area was re-sampled in 2010, data from 2004 used for nature and extent evaluation only
ASYss-002M-SO	11/4/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-003M-SO	11/4/2004	ISM	N	Since this ISM area was re-sampled in 2010, data from 2004 used for nature and extent evaluation only
ASYss-004D-SO	11/4/2004	ISM	N	Since this ISM area was re-sampled in 2010, data from 2004 used for nature and extent evaluation only
ASYss-004M-SO	11/4/2004	ISM	N	Since this ISM area was re-sampled in 2010, data from 2004 used for nature and extent evaluation only
ASYss-005D-SO	11/4/2004	ISM	S	Discrete sample collected for determining VOCs in ISM area; used for screening with ISM surface soil samples
ASYss-005M-SO	11/4/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-006M-SO	11/4/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-007M-DUP	11/4/2004	ISM	FD	QC sample limits use to nature and extent
ASYss-007M-SO	11/4/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-008M-SO	11/4/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-009M-SO	11/4/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-010M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-011M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-012D-QA	11/4/2004	ISM	FD	QC sample limits use to nature and extent
ASYss-012D-SO	11/4/2004	ISM	S	Discrete sample collected for determining VOCs in ISM area; used for screening with ISM surface soil samples
ASYss-012M-QA	11/4/2004	ISM	FD	QC sample limits use to nature and extent
ASYss-012M-SO	11/4/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-013D-SO	11/3/2004	ISM	S	Discrete sample collected for determining VOCs in ISM area; used for screening with ISM surface soil samples
ASYss-013M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-014M-SO	11/4/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening

Table 5-2. Data Summary (continued)

Sample ID	Date	Sample Type	Use Type	Comments
Surface Soil (0-1 ft), continued				
ASYss-015D-SO	11/4/2004	ISM	S	Discrete sample collected for determining VOCs in ISM area; used for screening with ISM surface soil samples
ASYss-015M-SO	11/4/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-016M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-017M-DUP	11/3/2004	ISM	FD	QC sample limits use to nature and extent
ASYss-017M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-018M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-019M-SO	11/10/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-020M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-021M-DUP	11/3/2004	ISM	FD	QC sample limits use to nature and extent
ASYss-021M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-022M-QA	11/11/2004	ISM	FD	QC sample limits use to nature and extent
ASYss-022M-SO	11/12/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-023M-SO	11/11/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-025M-SO	11/11/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-026M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-027D-DUP	11/3/2004	ISM	FD	QC sample limits use to nature and extent
ASYss-027D-SO	11/3/2004	ISM	S	Discrete sample collected for determining VOCs in ISM area; used for screening with ISM surface soil samples
ASYss-027M-DUP	11/3/2004	ISM	FD	QC sample limits use to nature and extent
ASYss-027M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-028M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-029M-SO	11/11/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-030M-SO	11/10/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-031M-SO	11/10/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-032M-SO	11/2/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-033M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-034M-SO	11/3/2004	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-066-5778-SO	4/7/2010	D	C	Sample used for chromium speciation, and nature and extent evaluation
ASYss-067-5779-SO	4/7/2010	D	C	Sample used for chromium speciation, and nature and extent evaluation
ASYss-069M-5743-SO	4/7/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-070M-5744-SO	4/5/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-070M-6209-FD	4/5/2010	ISM	FD	QC sample limits use to nature and extent
ASYss-071M-5745-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening

Table 5-2. Data Summary (continued)

Sample ID	Date	Sample Type	Use Type	Comments
Surface Soil (0-1 ft), continued				
ASYss-072M-5746-SO	4/7/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-073M-5747-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-074M-5748-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-075M-5749-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-076M-5750-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-076M-6211-FD	4/6/2010	ISM	FD	QC sample limits use to nature and extent
ASYss-077M-5751-SO	4/7/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-078M-5752-SO	4/7/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-079M-5753-SO	4/7/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-080M-5754-SO	4/7/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-081M-5755-SO	4/2/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-082M-5756-SO	4/2/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-083M-5757-SO	4/2/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-084M-5758-SO	4/2/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-085M-5759-SO	4/2/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-086M-5760-SO	4/2/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-087M-5761-SO	4/2/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-088M-5756-SO	4/5/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-089M-5763-SO	4/5/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-090M-5764-SO	4/5/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-091M-5765-SO	4/5/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-092M-5766-SO	4/5/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-093M-5767-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-094M-5768-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-095M-5769-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-096M-5770-SO	4/5/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-097M-5771-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-098M-5772-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-099M-5773-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-100M-5774-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-101M-5775-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-102M-5776-SO	4/6/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-103M-5777-SO	4/5/2010	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-103M-6213-FD	4/5/2010	ISM	FD	QC sample limits use to nature and extent

Table 5-2. Data Summary (continued)

Sample ID	Date	Sample Type	Use Type	Comments
Surface Soil (0-1 ft), continued				
ASYss-111M-5835-SO	4/20/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-112M-5836-SO	4/20/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-113M-5837-SO	4/20/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-114M-5838-SO	4/20/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-115M-5839-SO	4/20/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-116M-5840-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-117M-5841-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-118M-5842-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-119M-5843-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-120M-5844-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-121M-5845-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-122M-5846-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-123M-5847-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-124M-5848-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-125M-5849-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-125M-6238-FD	4/21/2011	ISM	FD	QC sample limits use to nature and extent
Subsurface Soil (>1 ft)				
ASYss-126M-5850-SO	4/21/2011	ISM	S	Sample used for nature and extent evaluation and surface soil screening
ASYss-126M-6239-FD	4/21/2011	ISM	FD	QC sample limits use to nature and extent
ASYsb-045-5661-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-046-5665-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-047-5669-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-048-5673-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-049-5677-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-050-5681-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-052-5689-SO	4/6/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-053-5693-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-054-5697-SO	4/6/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-056-5703-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-057-5707-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-058-5711-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-059-5715-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-060-5719-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-061-5723-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)

Table 5-2. Data Summary (continued)

Sample ID	Date	Sample Type	Use Type	Comments
Subsurface Soil (>1 ft), continued				
ASYsb-062-5727-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-062-6218-FD	3/30/2010	D	FD	QC sample limits use to nature and extent
ASYsb-063-5731-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-064-5735-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-064-6219-FD	3/30/2010	D	FD	QC sample limits use to nature and extent
ASYsb-065-5739-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (1-4 ft interval)
ASYsb-045-5662-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-046-5666-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-047-5670-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-047-6223-FD	4/5/2010	D	FD	QC sample limits use to nature and extent
ASYsb-048-5674-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-049-5678-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-050-5682-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-052-5690-SO	4/6/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-053-5694-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-054-5698-SO	4/6/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-056-5704-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-057-5708-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-058-5712-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-059-5716-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-059-6220-FD	3/30/2010	D	FD	QC sample limits use to nature and extent
ASYsb-060-5720-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-061-5724-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-062-5728-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-063-5732-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-064-5736-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-065-5740-SO	4/7/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (4-7 ft interval)
ASYsb-045-5663-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (7-13 ft interval)
ASYsb-049-5679-SO	4/5/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (7-13 ft interval)
ASYsb-049-5686-SO	4/6/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (7-13 ft interval)

Table 5-2. Data Summary (continued)

Sample ID	Date	Sample Type	Use Type	Comments
Subsurface Soil (>1 ft), continued				
ASYsb-059-5717-SO	3/30/2010	D	S	Sample used for nature and extent evaluation and subsurface soil screening (7-13 ft interval)
Sediment				
L12sd-308-5004-SD	2/15/2010	D	S	Sample used for nature and extent evaluation and discrete sediment screening. This sample was associated with Load Line 12, and was collected in the drainage ditch immediately east of Atlas Scrap Yard along Paris-Windham Road.
ASYsd-024M-SD	11/11/2004	ISM	S	Sample collected in the drainage ditch immediately east of Atlas Scrap Yard along Paris-Windham Road used for nature and extent evaluation and ISM sediment screening
Surface Water				
L12sw-308-5005-SW	2/15/2010	D	S	Sample used for nature and extent evaluation and SRC/COPC screening. This sample was associated with Load Line 12, and was collected in the drainage ditch immediately east of Atlas Scrap Yard along Paris-Windham Road.

C = Chromium speciation sample.
COPC = Chemical of potential concern.
D = Discrete.
FD = Field duplicate.
ft = Feet.
ID = Identification.
ISM = Incremental Sampling Method.
N = Nature and extent use only.
QC = Quality control.
S= Nature and extent, SRC and COPC screen, and sample point by sample point risk assessment.
SRC = Site-related contaminant.
VOC = volatile organic chemicals.

Table 5-3. Chromium Speciation Results

Sample location	Hexavalent Chromium Concentration (mg/kg)	Total Chromium Concentration[a] (mg/kg)	Percent Hexavalent Chromium (%)
ASYss-066	0.97 J	13.5 J	7.2
ASYss-067	1 J	15.5 J	6.5
ASYss-068	<1.1 U	10.7 J	NA

[a] Background screening value for total chromium = 17.4 mg/kg. No BSV is available for hexavalent chromium.
J = estimated value less than reporting limits.
mg/kg = Milligrams per kilogram.
NA = Not applicable; hexavalent chromium not detected in sample.
U= non-detectable concentration.

5.2.2 Contaminant Nature and Extent in Surface Soil

Data from all eligible historical and PBA08 RI surface soil ISM samples were combined and screened, as discussed in Section 5.1.2, to identify SRCs representing current conditions at Atlas Scrap Yard. Table 5-6 presents the results of the SRC screening for ISM surface soil at the AOC. As shown in Table 5-2, the surface soil aggregate SRC screening dataset included 35 ISM samples collected in 2004 under the Characterization of 14 AOCs, 35 ISM samples collected in 2010 during the PBA08 RI, and an additional 16 ISM samples collected in 2011 under a subsequent PBA08 RI sampling event. The following subsections discuss the concentration and distribution of ISM surface soil results.

All 2010 PBA08 RI ISM samples were analyzed for TAL metals, explosives, and PAHs; five samples were analyzed for RVAAP full-suite analytes (TAL metals, explosives, propellants, SVOCs, VOCs, PCBs, and pesticides). All 2011 PBA08 RI ISM samples were analyzed for TAL metals and PAHs. Tables 5-11 and 5-12 present the results for all detected analytes in the surface soil samples collected during the PBA08 RI using ISM and discrete methods, respectively.

The results for all the surface soil samples used in this RI, including the 2004 Characterization of 14 AOCs, are presented in Appendix D along with complete copies of all laboratory analytical data packages for the PBA08 RI samples.

Figures 5-2 through 5-11 illustrate the distribution and concentrations of inorganic and organic SRCs that occur at each surface soil sample location, which include discrete and ISM samples. Due to the number of surface soil samples, the AOC was subdivided into multiple views (i.e., northern, central, and southern portions) in the figures for clarity of data presentation. In addition, the samples collected in April 2011 at the ASA are presented separately on Figures 5-10 and 5-11. To illustrate the extent and magnitude of contaminants on Figures 5-2 through 5-11, those SRCs that exceeded the most restrictive FWCUGs at a TR of 10^{-5} and a hazard index (HI)=1.0 (or background concentrations) are highlighted yellow.

5.2.2.1 Explosives and Propellants

As shown in Table 5-6, eight explosives and one propellant (nitrocellulose) were identified as SRCs, as there are no associated background concentrations for these chemicals. The distribution of explosives and propellants in Atlas Scrap Yard surface soil is shown in Figures 5-5 through 5-7. Explosive and propellant SRCs for the grid ISM areas are shown in Figure 5-9. Explosive detections at Atlas Scrap Yard were limited in frequency. Of the eight explosives identified as SRCs, 4-amino-2,6-dinitrotoluene (DNT) exhibited the highest detection frequency at 6 out of 65 samples in the screening dataset. The greatest number of explosive detections generally occurred in the center of the ASA immediately south of the eastern entrance on Newton Falls Road. Four explosives were detected in PBA08 RI locations ASYss-080M and ASYss-093M. Nitrocellulose was detected in five of the six surface soil samples with three detects in the ASA, including the maximum concentration observed in grid ISM location ASYss-088M.

5.2.2.2 Inorganic Chemicals

As shown on Table 5-6, 16 inorganic chemicals were identified as SRCs in surface soil. Inorganic chemical concentrations detected above background concentrations were observed in surface soil throughout Atlas Scrap Yard, and all 81 samples used in the SRC surface soil screening dataset exhibited multiple inorganic chemicals above background concentrations. Due to the ubiquity of detections above background concentrations, no apparent spatial trend is evident in the distribution of inorganic chemicals throughout the AOC. A total of 11 of the 16 inorganic chemicals identified as SRCs were detected in all 81 surface soil samples in the SRC dataset (aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, lead, manganese, nickel, and zinc).

The highest number of inorganic SRCs detected at their maximum concentration (cadmium, chromium, lead, mercury, and zinc) were observed at historical sample location ASYss-019M, located in the footprint of the former incinerator at the southern portion of Atlas Scrap Yard. ASYss-019M had a lead concentration of 1,200 mg/kg, which was delineated by PBA08 RI sample ASYss-070M that had a lead concentration of 312J mg/kg. None of the inorganic SRCs were detected at their maximum concentrations at the grid ISM locations. Observations regarding select individual inorganic SRCs in Atlas Scrap Yard surface soil are presented below:

- Barium was detected above its screening level (88.4 mg/kg) in 58 samples, with a maximum concentration of 325 mg/kg detected at PBA08 RI sample locations ASYss-079M and ASYss-084M.
- Cadmium was detected above its screening level (0 mg/kg) in 74 samples, with a maximum concentration of 9.5 mg/kg detected at historical sample location ASYss-019M located in the vicinity of the former incinerator.
- Chromium was detected above its screening level (17.4 mg/kg) in 61 samples, with a MDC of 64 mg/kg observed at historical sample location ASYss-019M located in the vicinity of the former incinerator.

- Lead was detected above its screening level (26.1 mg/kg) in 28 samples, with a MDC of 1200 mg/kg observed at historical sample location ASYss-019M located in the vicinity of the former incinerator.
- Mercury was detected above its background concentration of 0.036 mg/kg in 56 samples, with a maximum detection of 0.64 mg/kg at historical sample location ASYss-019M located in the vicinity of the former incinerator.
- Silver was detected above its screening level (0 mg/kg) in 46 samples, with a maximum detection of 5.2 mg/kg observed at historical sample location ASYss-018M.
- Thallium was detected above its screening level (0 mg/kg) in 53 samples, with a maximum detection for the SRC screening dataset of 0.35 mg/kg at historical sample location ASYss-018M.
- Zinc was detected above its background concentration of 61.8 mg/kg in 42 samples, with a maximum detection of 1,800 mg/kg observed at historical sample location ASYss-019M located in the vicinity of the former incinerator.

The distribution of inorganic SRCs is presented in Figures 5-2 through 5-4, 5-8 (grid ISM areas), and 5-10 for samples collected in April 2011 at the ASA.

5.2.2.3 Semi-volatile Organic Compounds

A total of 26 SVOCs were identified as SRCs in surface soil, 16 of which were PAHs (Table 5-6). All detected concentrations were retained as SRCs since no site-specific background values exist for SVOCs. Since there are no background values for screening SVOCs, those SRCs that exceeded the most restrictive FWCUGs at a TR of 10^{-5} and HI=1.0 are highlighted yellow in Figures 5-5 through 5-7, 5-9 (grid ISM areas), and 5-11 for samples collected in April 2011 at the ASA to illustrate the distribution of SVOCs. Detections of PAH SRCs were widespread throughout the AOC, with the lowest frequency of detection noted at 46 of 54 samples for acenaphthene. Ten of the sixteen PAHs [benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene] were detected in all 54 samples in the SRC screening dataset.

Although SVOCs are widely distributed in surface soil, the highest concentrations of SRCs were observed in the ASA. Fourteen of the sixteen PAH SRCs were detected at their maximum concentrations at ISM location ASYss-126M. This sample was collected in April 2011 to characterize the ditch paralleling the access road in the ASA and was located within grid ISM location ASYss-093M collected in April 2010. The next highest concentrations of PAHs from the April 2011 sampling event were from the parking areas made up of slag and asphalt gravel immediately to the west of the railroad tie pile (locations ASY-116M, ASY-117M, ASY-118M, and ASY-119M). Another four SRCs (2-methylnaphthalene, carbazole, dibenzofuran, and naphthalene) were also detected in parking area at their maximum concentrations at ASYss-088M collected in April 2010.

5.2.2.4 Volatile Organic Compounds, Pesticides, and Polychlorinated Biphenyls

One VOC (acetone) and one PCB (PCB-1260) were identified as SRCs in surface soil, as there are no associated background concentrations for these chemicals (Table 5-6). Acetone was detected only at historical location ASYss-027D at a concentration of 0.022 mg/kg. PCB-1260 was detected in two surface soil samples in the SRC screening dataset at PBA08 RI locations ASYss-074M (0.019J mg/kg) and ASYss-076M (0.17 J mg/kg). PCB-1260 was detected in historical sample ASYss-004M at 0.054 mg/kg; however this location was not included in the SRC dataset because it was re-sampled under the PBA08 RI. The distribution of the detected VOCs and PCBs in surface soil is presented in Figures 5-5 through 5-7. Grid ISM surface soil samples are presented in Figure 5-9. No pesticides were detected during the PBA08 RI.

5.2.3 Contaminant Nature and Extent in Subsurface Soil

Data from subsurface soil samples were screened, as discussed in Section 5.1.2, to identify SRCs representing subsurface conditions at Atlas Scrap Yard. Since subsurface soil samples were not collected during the historical investigations at the AOC, the SRC screening dataset was comprised of 42 discrete samples collected during the PBA08 RI activities. All 1-4 ft bgs and 4-7 ft bgs subsurface samples were analyzed for TAL metals, explosives, and PAHs; seven samples were analyzed for RVAAP full-suite analytes (TAL metals, explosives, propellants, SVOCs, VOCs, PCBs, pesticides). As discussed in Section 4.1.2, there were no exceedances of preliminary screening criteria in the 4-7 ft bgs samples, and the vertical nature and extent of contamination was delineated at that interval. In accordance with the DQOs of the PBA08 SAP, no 7-13 ft bgs samples were analyzed for purposes of evaluating nature and extent. Table 5-7 presents the results of the SRC screening for subsurface soil samples at Atlas Scrap Yard.

Table 5-13 summarizes the analytical results for all detected analytes in the PBA08 RI subsurface soil samples at Atlas Scrap Yard. Complete copies of the laboratory analytical packages are presented in Appendix D. Figures 5-12 through 5-14 illustrate the distribution of inorganic and organic SRCs in subsurface soil.

5.2.3.1 Explosives and Propellants

Two explosives [3-nitrotoluene and octahydro-1,3,5,7-tetranitroi-1,3,5,7-tetrazocane (HMX)] and one propellant (nitrocellulose) were identified as SRCs for subsurface soil (Table 5-7). All detected concentrations of these explosive SRCs in subsurface soil samples were less than the laboratory reporting limit. The explosive 3-nitrotoluene was detected in the 1-4 ft bgs interval at location ASYsb-061 at a concentration of 0.021J mg/kg but was not observed in the 4-7 ft bgs interval. HMX was detected at a concentration of 0.014J mg/kg in the 1-4 ft bgs interval only at soil boring location ASYsb-063. Nitrocellulose was detected at a concentration of 2J mg/kg in the 1-4 ft bgs interval at location ASYsb-046 but was not detected in the underlying 4-7 ft bgs interval. The locations of explosives and propellants in subsurface soil are shown in Figures 5-12 through 5-14.

5.2.3.2 Inorganic Chemicals

Seven inorganic chemicals were identified as SRCs in subsurface soil (Table 5-7): arsenic, beryllium, cadmium, cobalt, lead, selenium, and silver. The distribution of inorganic SRCs in subsurface soil is presented in Figures 5-12 through 5-14. Those SRCs that exceeded the most restrictive FWCUGs at a TR of 10^{-5} and HI=1.0 (or background concentrations) are highlighted yellow on the figures.

Cadmium and silver were observed above screening criteria (0 mg/kg) in 39 and 21 out of 41 samples, respectively. The remaining inorganic SRCs were detected above their respective screening criteria only sporadically. The inorganic chemical with the next highest frequency of detection above screening criteria was selenium, which was detected above its background concentration of 1.5 mg/kg in 5 of the 41 samples collected with a maximum of 1.8 mg/kg observed at ASYsb-058 in the 1-4 ft bgs interval. Three of the seven inorganic SRCs were detected at their maximum concentrations in the 1-4 ft bgs interval at ASYsb-059: arsenic (25.2 mg/kg versus the screening criteria of 19.8 mg/kg), beryllium (1.2 mg/kg versus the screening criteria of 0.88 mg/kg), and cobalt (33.7 mg/kg versus the screening criteria of 23.2 mg/kg). Lead was only detected above background (19.1 mg/kg) at ASYsb-064 (33 mg/kg) located in the vicinity of the former incinerator.

All inorganic SRCs identified for subsurface soil were also identified as SRCs for surface soil. No real trends of increasing or decreasing concentrations with depth were observed with the inorganic SRCs.

5.2.3.3 Semi-volatile Organic Compounds

Seventeen SVOCs were identified as SRCs in subsurface soil, as shown in Table 5-7. The distribution of SVOCs in subsurface soil is shown in Figures 5-12 through 5-14. Sixteen of the seventeen SVOCs were PAHs except bis(2-ethylhexyl)phthalate. SVOCs were detected in a maximum of 4 of 42 samples in the SRC screening dataset.

The sample with the greatest number and highest concentrations of PAH SRCs was the 1-4 ft bgs interval at location ASYsb-063. All 16 PAH SRCs were detected at ASYsb-063, with 15 observed at their maximum concentrations in the 1-4 ft bgs sample. Seven PAHs were detected in the 4-7 ft bgs interval at ASYsb-063 at concentrations typically an order of magnitude lower than those observed in the shallower subsurface soil interval. PAH concentrations in the 1-4 ft interval (Figure 5-13) were similar to those observed in the associated ISM surface soil sample ASYss-027M (Figure 5-6). Locations ASYss-027M and ASYsb-063 are located within a drainage ditch east of Atlas Scrap Yard and alongside Paris-Windham Road. The PAHs observed at these locations are likely sourced from road runoff.

Twelve PAHs were detected in the 1-4 ft bgs interval at ASYsb-048, including naphthalene at its maximum concentration. No PAHs were detected in the underlying 4-7 ft bgs sample at this location. PAH concentrations at ASYsb-048 in the 1-4 ft bgs interval (Figure 5-12) were approximately two orders of magnitude lower than those observed in the associated grid ISM surface soil sample ASYss-089M (Figure 5-9).

All SVOC SRCs identified for subsurface soil were also identified as SRCs for the surface soil. No real trends of increasing or decreasing concentrations with depth were observed for organic SRCs. Additionally, no CERCLA-release related sources of PAHs were identified for this AOC.

5.2.3.4 Volatile Organic Compounds, Pesticides, and Polychlorinated Biphenyls

Three VOCs (2-butanone, carbon disulfide, and toluene) were identified as SRCs in subsurface soil, as summarized in Table 5-7. No pesticides or PCBs were detected in subsurface soil. The distribution of VOCs in subsurface soil is shown in Figures 5-12 through 5-14.

The VOC 2-butanone was detected only in the 1-4 ft bgs interval at location ASYsb-046, with a concentration of 0.0098J mg/kg. Carbon disulfide was detected in three samples, including the 1-4 and 4-7 ft bgs interval at soil boring location ASYsb-062 with concentrations of 0.0011J mg/kg and 0.0014J mg/kg (MDC), respectively. Toluene was detected at only ASYsb-062 in the 4-7 ft bgs interval at a concentration of 0.00037J mg/kg.

No VOC SRCs identified for subsurface soil were identified as SRCs for surface soil. No trends of increasing or decreasing concentrations with depth were observed with the organic SRCs.

5.2.4 Geotechnical Subsurface Soil Samples

Two soil borings were completed at Atlas Scrap Yard for the purposes of obtaining geotechnical parameters to support vadose zone soil leaching and groundwater transport modeling. Four undisturbed samples were collected from two subsurface soil borings, including ASYsb-051 from the 4.0-5.6 and 8.5-10.0 ft bgs intervals and ASYsb-055 from the 4.0-5.5 and 9.0-10.5 ft bgs intervals. Groundwater was encountered at depths of 10.3 and 11.1 ft bgs at soil boring locations ASYsb-051 and ASYsb-055, respectively. Both borings were advanced to a total depth of 13.0 ft bgs, and bedrock was not encountered at either location. Table 5-4 summarizes the results of the geotechnical characteristics of Atlas Scrap Yard soil. Laboratory analytical data package results are presented in Appendix D.

Table 5-4. Summary of Geotechnical Parameters

Sample ID: Parameters	ASYsb-051-5684-SO	ASYsb-051-5685-SO	ASYsb-055-5700-SO	ASYsb-055-5701-SO
Depth	4.0-5.6 ft bgs	8.5-10.0 ft bgs	4.0-5.5 ft bgs	9.0-10.5 ft bgs
Porosity	36.7%	38.6%	38.3%	30.1%
Density	1.73 g/cm^3	1.68 g/cm^3	1.69 g/cm^3	1.91 g/cm^3
Moisture content	21.5%	21.3%	19.7%	15.7%
Total organic carbon	2,200 mg/kg	5,100 mg/kg	2,200 mg/kg	2,000 mg/kg
Size fraction analysis	16.1% sand, 43.1% silt, 40.7% clay	0.6% gravel, 2.7% sand, 34.8 % silt, 61.9 % clay	6.1% sand, 56.2% silt, 37.7% clay	6.2% gravel, 25.6% sand, 36.4% silt, 31.8% clay
Permeability (K)	1.1E-07 cm/sec	2.3E-08 cm/sec	3.6E-08 cm/sec	4.7E-08 cm/sec

cm/sec = Centimeters per second.
ft bgs = Feet below ground surface.
g/cm^3 = Grams per cubic centimeter.
ID = Identification.
mg/kg = Milligrams per kilogram.

5.2.5 Contaminant Nature and Extent in Sediment

Sediment collected within the AOC as part of the Characterization of 14 AOCs was considered dry sediment, as surface water only occurs intermittently as storm water runoff at Atlas Scrap Yard. As discussed in Section 1.2, dry sediment is classified as soil in this report. Two sediment samples were collected in the ditch east of Atlas Scrap Yard along Paris-Windham Road adjacent to Load Line 12: one ISM sample was collected during the Characterization of 14 AOCs (ASYsd-024M-SD), and one discrete sample was collected during the PBA08 RI (L12sd-308). The *Phase III Remedial Investigation Report for Sediment and Surface Water at the RVAAP-12 Load Line 12* (USACE 2010c) contains details of sample collection. These sediment samples were incorporated into the Atlas Scrap Yard evaluation to represent the potential exit point for runoff or surface drainage from the AOC. The results of the SRC screening for the discrete and ISM datasets are presented in Tables 5-9 and 5-8, respectively. The results of the detected analytes for the PBA08 RI sediment samples are summarized in Table 5-14. Complete copies of the laboratory analytical packages are presented in Appendix D. Figure 5-15 presents the location and concentrations of SRCs identified in sediment.

5.2.5.1 Explosives and Propellants

As shown in Table 5-8, one explosive (2-amino-4,6-DNT) was identified as an SRC for the ISM sediment dataset, as it was detected at a concentration of 0.08J mg/kg in historical ISM sample ASYsd-024M (Figure 5-15). Explosives were not detected or identified as SRCs for the discrete sediment dataset (Table 5-9).

Propellants were not analyzed in discrete or ISM sediment samples, as these locations were not RVAAP full-suite sample locations.

5.2.5.2 Inorganic Chemicals

As shown in Table 5-9, five inorganic chemicals were identified as SRCs in discrete sediment. The majority of inorganic SRC detections at PBA08 RI discrete location L12sd-308 occurred at levels less than twice their respective background concentrations.

Ten inorganic chemicals were identified as SRCs in the ISM screening dataset for sediment (Table 5-8). The inorganic SRCs observed at historical sediment sample ASYsd-024M occurred at concentrations only marginally above their respective screening levels (i.e., within the same order of magnitude and less than twice their respective background concentrations). The distribution of inorganic chemicals in sediment is shown in Figure 5-15.

5.2.5.3 Semi-volatile Organic Compounds

Seventeen SVOCs, all of which were PAHs, were identified as SRCs in the discrete sediment dataset, as shown in Table 5-9. SVOC analysis was not performed on the historical ISM sediment sample ASYsd-024M. The surface soil grid ISM area (ASYss-100M, shown in Figure 5-15), immediately adjacent to the drainage ditch along the west side of Paris-Windham Road where discrete sediment sample L12sd-308 was located, exhibited similar concentrations of PAHs to those observed in sediment.

5.2.5.4 Volatile Organic Compounds, Pesticides, and Polychlorinated Biphenyls

No PCBs were detected or identified as SRCs for sediment in the discrete dataset for Atlas Scrap Yard; these analyses were not performed on the historical ISM sediment sample. VOCs and pesticides analyses were not performed on either the discrete or ISM sediment datasets.

5.2.6 Contaminant Nature and Extent in Surface Water

Surface water was not collected within the AOC during the PBA08 RI, as surface water only occurs intermittently as storm water runoff at Atlas Scrap Yard. One surface water sample (L12sw-308) was collected in the ditch east of Atlas Scrap Yard along Paris-Windham Road under the PBA08 RI for Load Line 12. The *Phase III Remedial Investigation Report for Sediment and Surface Water at the RVAAP-12 Load Line 12* (USACE 2010c) contains details of sample collection. This surface water sample was incorporated into the Atlas Scrap Yard evaluation to represent the potential exit point for runoff or surface drainage from the AOC. This sample was analyzed for RVAAP full-suite analytes. Table 5-10 presents the results of the SRC screening for surface water. The results of the detected analytes for the PBA08 RI surface water samples are summarized in Table 5-15. Complete copies of the laboratory analytical packages are presented in Appendix D. The field measurements recorded during surface water sample collection are summarized in Table 5-5. Figure 5-15 presents the location and concentrations of SRCs identified in surface water.

5.2.6.1 Explosives and Propellants

No propellants or explosives were detected or identified as SRCs in surface water at L12-308.

5.2.6.2 Inorganic Chemicals

Seventeen inorganic chemicals (16 metals and one nitrate) were identified as SRCs in surface water at L12-308, as shown in Table 5-10. Only five inorganic chemicals were identified as SRCs in the co-located PBA08 RI sediment sample L12sd-308, with only three (beryllium, cadmium, and nickel) corresponding to surface water SRCs. Six of the inorganic chemicals (aluminum, arsenic, barium, copper, manganese, and zinc) observed in surface water sample L12sw-308 had concentrations that were on average an order of magnitude higher than their respective background concentrations.

5.2.6.3 Semi-volatile Organic Compounds

Seven SVOCs [all of which were PAHs with the exception of bis(2-ethylhexyl)phthalate] were identified as SRCs for surface water, as shown in Table 5-10. With the exception of bis(2-ethylhexyl)phthalate, all SVOC SRCs detected at surface water location L12sw-308 were also detected in the co-located PBA08 RI sediment sample at this location (L12sd-308).

5.2.6.4 Volatile Organic Compounds, Pesticides, and Polychlorinated Biphenyls

As shown in Table 5-10, the pesticide delta-hexachlorobenzene (BHC) was identified as an SRC in surface water. Delta-BHC was detected at 0.00001J mg/kg at L12sw-308 (Figure 5-15). No VOCs or PCBs were detected in surface water.

Table 5-5. Surface Water Field Measurements

Location	Temperature (°C)	pH (S.U.)	Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)
L12sw-308	7.63	7.33	0.187	11.21	5.22

°C = Degrees Celsius.
mg/L = Milligrams per liter.
mS/cm = Milli-siemens per centimeter.
NTU = Nephelometric turbidity units.
S.U. = Standard unit.

5.3 SUMMARY OF CONTAMINANT NATURE AND EXTENT

Data from the 2004 Characterization of 14 AOCs, 2010 PBA08 RI, and 2011 PBA08 RI subsequent sampling event provide effective characterization of the nature and extent of the contamination at the AOC, and no further sampling is required. The predominant SRCs in surface and subsurface soil at Atlas Scrap Yard were PAHs, which were observed in all surface soil samples analyzed across the entire AOC. The highest levels of PAHs were identified during the PBA08 RI within the parking areas made up of slag and asphalt gravel used for vehicle traffic and equipment and material staging within the ASA and the ditch paralleling an access road (sample ASYss-126M). Inorganic chemicals were observed in surface soil at concentrations above their respective background concentrations throughout the AOC.

A limited number of SRCs were observed in subsurface soil, sediment, and surface water, relative to surface soil. Detections of explosives, propellants, VOCs, pesticides, and PCBs were limited in frequency at the AOC. A summary of observations for each medium is presented below.

5.3.1 Surface Soil

The predominant SRCs for surface soil at Atlas Scrap Yard were inorganic chemicals and SVOCs, the majority of which were PAHs. Of the 53 SRCs identified in surface soil, 26 were SVOCs (16 were PAHs). Although SVOCs are widely distributed in surface soil, the highest concentrations of SRCs were observed in the north-central portion of the AOC in the vicinity of the ASA. As indicated by the April 2011 sampling event, the highest concentrations of PAHs are from the parking areas made up of slag and asphalt gravel (locations ASY-116M, ASY-117M, ASY-118M, and ASY-119M) and in the ditch adjacent to an access road (locations ASY-123M and ASY-126M). The lower PAH concentrations from the April 2011 sampling event were from the sample areas encircling the existing railroad tie pile.

Sixteen inorganic chemicals were identified as SRCs in surface soil, with the highest number of inorganic SRCs detected at their maximum concentration at historical sample location ASYss-019M located in the vicinity of the former incinerator. Eight explosives, one propellant (nitrocellulose), one VOC (acetone), and one PCB (PCB-1260) were also identified as SRCs. No pesticides were detected or identified as SRCs in surface soil.

5.3.2 Subsurface Soil

Thirty SRCs were identified in subsurface soil. Seventeen SVOCs were identified as SRCs, 16 of which were PAHs. The sample with the greatest number and highest concentrations of PAH SRCs was the 1-4 ft bgs interval at ASYsb-063, located within a drainage ditch east of Atlas Scrap Yard and along the west side of Paris-Windham Road. All 16 PAH SRCs were detected at ASYsb-063, with 15 observed at their maximum concentrations in the 1-4 ft bgs sample, and likely sourced from road runoff. Seven inorganic chemicals were identified as SRCs in subsurface soil. Detections of inorganic chemicals above background concentrations were generally sporadic across the AOC and occurred within a narrow range of concentration. Two explosives (3-nitrotoluene and HMX), one propellant (nitrocellulose), and three VOCs (2-butanone, carbon disulfide, and toluene) were also identified as SRCs in subsurface soil. No pesticides or PCBs were identified as SRCs for subsurface soil. As there were no exceedances of the preliminary screening criteria defined in the PBA08 SAP in the samples collected from 4-7 ft bgs, the vertical nature and extent of contamination is considered defined by the 4-7 ft bgs interval.

5.3.3 Sediment

Two sediment samples (one ISM and one discrete) were collected in the ditch east of Atlas Scrap Yard along Paris-Windham Road adjacent to Load Line 12. These sediment samples were incorporated into the Atlas Scrap Yard evaluation to represent the potential exit point for runoff or surface drainage from the AOC. ISM and discrete samples collected were screened separately for SRCs due to the use of different sampling methodologies.

Twenty-two SRCs were identified for the discrete sample dataset; 11 SRCs were identified for the ISM screening dataset. Seventeen SVOCs were identified as SRCs in the discrete sediment dataset. SVOCs were not analyzed in the historical ISM sediment sample. Five inorganic chemicals were identified as SRCs in discrete sediment; 10 inorganic SRCs were identified for the ISM sediment dataset. Explosives were not detected or identified as SRCs for the discrete sediment sample, and the explosive 2-amino-4,6-DNT was identified as an SRC for the ISM sediment dataset only. No PCBs were detected or identified as SRCs for the discrete dataset for Atlas Scrap Yard; these analyses were not performed on the historical ISM sample.

5.3.4 Surface Water

One surface water sample (L12sw-308) was collected in the ditch east of Atlas Scrap Yard along Paris-Windham Road under the PBA08 RI for Load Line 12. This surface water sample was incorporated into the Atlas Scrap Yard evaluation to represent the potential exit point for runoff or surface drainage from the AOC.

Twenty-five SRCs were identified in surface water for Atlas Scrap Yard: 17 inorganic chemicals (16 metals and nitrate), seven SVOCs (six PAHs), and one pesticide (delta-BHC). Six of the inorganic chemicals observed in surface water sample L12sw-308 (aluminum, arsenic, barium, copper, manganese, and zinc) had concentrations that were on average an order of magnitude higher than their respective background concentrations. With the exception of bis(2-ethylhexyl)phthalate, all SVOC SRCs detected at surface water location L12sw-308 were also detected in the co-located PBA08 RI sediment sample at this location (L12sd-308). No propellants, explosives, PCBs, or VOCs were detected in surface water for Atlas Scrap Yard.

Table 5-6. SRC Screening Summary for Surface Soil

Analyte	CAS Number	Frequency of Detect	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Average Result (mg/kg)	Background Criteria[a] (mg/kg)	SRC? (yes/no)	SRC Justification
Inorganic Chemicals								
Aluminum	**7429-90-5**	**81/ 81**	**8100**	**32100**	**14200**	**17700**	**Yes**	**Exceeds background**
Antimony	7440-36-0	51/ 78	0.072	0.65	0.354	0.96	No	Below background
Arsenic	**7440-38-2**	**81/ 81**	**3.7**	**41**	**9.31**	**15.4**	**Yes**	**Exceeds background**
Barium	**7440-39-3**	**81/ 81**	**51**	**325**	**132**	**88.4**	**Yes**	**Exceeds background**
Beryllium	**7440-41-7**	**81/ 81**	**0.38**	**6.3**	**1.56**	**0.88**	**Yes**	**Exceeds background**
Cadmium	**7440-43-9**	**74/ 81**	**0.09**	**9.5**	**0.455**	**0**	**Yes**	**Exceeds background**
Calcium	7440-70-2	81/ 81	910	178000	38700	15800	No	Essential Nutrient
Chromium	**7440-47-3**	**81/ 81**	**11.5**	**64**	**23.9**	**17.4**	**Yes**	**Exceeds background**
Cobalt	**7440-48-4**	**81/ 81**	**1.5**	**19**	**6.24**	**10.4**	**Yes**	**Exceeds background**
Copper	**7440-50-8**	**81/ 81**	**7.2**	**250**	**20.7**	**17.7**	**Yes**	**Exceeds background**
Iron	7439-89-6	81/ 81	8190	42100	18800	23100	No	Essential Nutrient
Lead	**7439-92-1**	**81/ 81**	**11.1**	**1200**	**50.4**	**26.1**	**Yes**	**Exceeds background**
Magnesium	7439-95-4	81/ 81	1390	27100	6150	3030	No	Essential Nutrient
Manganese	**7439-96-5**	**81/ 81**	**95**	**3600**	**1100**	**1450**	**Yes**	**Exceeds background**
Mercury	**7439-97-6**	**72/ 81**	**0.018**	**0.64**	**0.069**	**0.036**	**Yes**	**Exceeds background**
Nickel	**7440-02-0**	**81/ 81**	**7.2**	**31**	**17**	**21.1**	**Yes**	**Exceeds background**
Potassium	7440-09-7	81/ 81	577	1980	1190	927	No	Essential Nutrient
Selenium	**7782-49-2**	**73/ 81**	**0.46**	**2.9**	**1.14**	**1.4**	**Yes**	**Exceeds background**
Silver	**7440-22-4**	**46/ 81**	**0.024**	**5.2**	**0.398**	**0**	**Yes**	**Exceeds background**
Sodium	7440-23-5	81/ 81	37.1	2430	361	123	No	Essential Nutrient
Thallium	**7440-28-0**	**53/ 81**	**0.066**	**0.35**	**0.199**	**0**	**Yes**	**Exceeds background**
Vanadium	7440-62-2	81/ 81	4.5	26	16.6	31.1	No	Below background
Zinc	**7440-66-6**	**81/ 81**	**28.3**	**1800**	**104**	**61.8**	**Yes**	**Exceeds background**

Table 5-6. SRC Screening Summary for Surface Soil (continued)

Analyte	CAS Number	Frequency of Detect	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Average Result (mg/kg)	Background Criteria[a] (mg/kg)	SRC? (yes/no)	SRC Justification
Explosives/Propellants								
1,3,5-Trinitrobenzene	**99-35-4**	**4/ 65**	**0.014**	**0.16**	**0.0929**	**None**	**Yes**	**Detected organic**
2,6-Dinitrotoluene	**606-20-2**	**1/ 65**	**0.13**	**0.13**	**0.124**	**None**	**Yes**	**Detected organic**
2-Amino-4,6-Dinitrotoluene	**35572-78-2**	**2/ 65**	**0.09**	**0.1**	**0.124**	**None**	**Yes**	**Detected organic**
2-Nitrotoluene	**88-72-2**	**2/ 65**	**0.24**	**0.43**	**0.131**	**None**	**Yes**	**Detected organic**
3-Nitrotoluene	**99-08-1**	**4/ 65**	**0.053**	**0.12**	**0.123**	**None**	**Yes**	**Detected organic**
4-Amino-2,6-Dinitrotoluene	**19406-51-0**	**6/ 65**	**0.029**	**0.21**	**0.149**	**None**	**Yes**	**Detected organic**
HMX	**2691-41-0**	**1/ 65**	**0.016**	**0.016**	**0.123**	**None**	**Yes**	**Detected organic**
Nitrocellulose	**9004-70-0**	**5/ 6**	**1**	**4.2**	**1.98**	**None**	**Yes**	**Detected organic**
Tetryl	**479-45-8**	**4/ 65**	**0.04**	**0.14**	**0.181**	**None**	**Yes**	**Detected organic**
Semi-volatile Organic Compounds								
2-Methylnaphthalene	**91-57-6**	**7/ 7**	**0.012**	**2.2**	**0.553**	**None**	**Yes**	**Detected organic**
4-Methylphenol	**106-44-5**	**1/ 3**	**0.015**	**0.015**	**0.0277**	**None**	**Yes**	**Detected organic**
Acenaphthene	**83-32-9**	**46/ 54**	**0.0054**	**10**	**0.371**	**None**	**Yes**	**Detected organic**
Acenaphthylene	**208-96-8**	**51/ 54**	**0.0098**	**2.5**	**0.426**	**None**	**Yes**	**Detected organic**
Anthracene	**120-12-7**	**53/ 54**	**0.0069**	**23**	**1.55**	**None**	**Yes**	**Detected organic**
Benz(a)anthracene	**56-55-3**	**54/ 54**	**0.015**	**51**	**3.97**	**None**	**Yes**	**Detected organic**
Benzenemethanol	**100-51-6**	**1/ 7**	**0.25**	**0.25**	**0.882**	**None**	**Yes**	**Detected organic**
Benzo(a)pyrene	**50-32-8**	**54/ 54**	**0.015**	**50**	**4.11**	**None**	**Yes**	**Detected organic**
Benzo(b)fluoranthene	**205-99-2**	**54/ 54**	**0.035**	**51**	**6.51**	**None**	**Yes**	**Detected organic**
Benzo(ghi)perylene	**191-24-2**	**54/ 54**	**0.014**	**29**	**2.73**	**None**	**Yes**	**Detected organic**
Benzo(k)fluoranthene	**207-08-9**	**54/ 54**	**0.013**	**37**	**3.05**	**None**	**Yes**	**Detected organic**
Bis(2-ethylhexyl)phthalate	**117-81-7**	**3/ 7**	**0.024**	**1.5**	**0.96**	**None**	**Yes**	**Detected organic**
Butyl benzyl phthalate	**85-68-7**	**1/ 7**	**0.24**	**0.24**	**0.79**	**None**	**Yes**	**Detected organic**
Carbazole	**86-74-8**	**4/ 7**	**0.043**	**0.44**	**0.213**	**None**	**Yes**	**Detected organic**
Chrysene	**218-01-9**	**54/ 54**	**0.029**	**49**	**5.17**	**None**	**Yes**	**Detected organic**
Di-n-butyl phthalate	**84-74-2**	**1/ 7**	**0.027**	**0.027**	**0.762**	**None**	**Yes**	**Detected organic**
Dibenz(a,h)anthracene	**53-70-3**	**51/ 54**	**0.0078**	**7.7**	**0.843**	**None**	**Yes**	**Detected organic**
Dibenzofuran	**132-64-9**	**6/ 7**	**0.011**	**0.51**	**0.166**	**None**	**Yes**	**Detected organic**
Diethyl phthalate	**84-66-2**	**1/ 7**	**0.023**	**0.023**	**0.74**	**None**	**Yes**	**Detected organic**

Table 5-6. SRC Screening Summary for Surface Soil (continued)

Analyte	CAS Number	Freq of Detect	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Average Result (mg/kg)	Background Criteria[a] (mg/kg)	SRC? (yes/no)	SRC Justification
Semi-volatile Organic Compounds, continued								
Fluoranthene	**206-44-0**	**54/ 54**	**0.041**	**130**	**7**	**None**	**Yes**	**Detected organic**
Fluorene	**86-73-7**	**51/ 54**	**0.0084**	**8.5**	**0.35**	**None**	**Yes**	**Detected organic**
Indeno(1,2,3-cd)pyrene	**193-39-5**	**54/ 54**	**0.0072**	**26**	**2.54**	**None**	**Yes**	**Detected organic**
Naphthalene	**91-20-3**	**52/ 54**	**0.013**	**1.4**	**0.228**	**None**	**Yes**	**Detected organic**
Phenanthrene	**85-01-8**	**54/ 54**	**0.033**	**53**	**2.3**	**None**	**Yes**	**Detected organic**
Phenol	**108-95-2**	**2/ 7**	**0.0083**	**0.031**	**0.763**	**None**	**Yes**	**Detected organic**
Pyrene	**129-00-0**	**54/ 54**	**0.027**	**94**	**5.93**	**None**	**Yes**	**Detected organic**
Pesticides and PCBs								
PCB-1260	**11096-82-5**	**2/ 6**	**0.019**	**0.17**	**0.0428**	**None**	**Yes**	**Detected organic**
Volatile Organic Compounds								
Acetone	**67-64-1**	**1/ 9**	**0.022**	**0.022**	**0.0131**	**None**	**Yes**	**Detected organic**

[a] Background concentrations are published in the Phase II Remedial Investigation Report for Winklepeck Burning Grounds (USACE 2001b).
SRC screening tables include all available and appropriate data as presented in Section 5.1.4.
CAS = Chemical Abstract Service.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
mg/kg = Milligrams per kilogram.
PCB = Polychlorinated Biphenyl.
SRC = Site-related Contaminant.
Bold indicates analyte identified as an SRC.

Table 5-7. SRC Screening Summary for Subsurface Soil

Analyte	CAS Number	Freq of Detect	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Average Result (mg/kg)	Background Criteria[a] (mg/kg)	SRC? (yes/no)	SRC Justification
Inorganic Chemicals								
Arsenic	7440-38-2	41/ 41	3.8	25.2	14.1	19.8	Yes	Exceeds background
Beryllium	7440-41-7	41/ 41	0.31	1.2	0.659	0.88	Yes	Exceeds background
Cadmium	7440-43-9	39/ 41	0.027	0.32	0.0731	0	Yes	Exceeds background
Cobalt	7440-48-4	41/ 41	3.9	33.7	12.9	23.2	Yes	Exceeds background
Lead	7439-92-1	41/ 41	8.4	33	13.1	19.1	Yes	Exceeds background
Selenium	7782-49-2	41/ 41	0.67	1.8	1.2	1.5	Yes	Exceeds background
Silver	7440-22-4	21/ 41	0.0089	0.13	0.0221	0	Yes	Exceeds background
Explosives/Propellants								
3-Nitrotoluene	99-08-1	1/ 41	0.021	0.021	0.12	None	Yes	Detected organic
HMX	2691-41-0	1/ 41	0.014	0.014	0.12	None	Yes	Detected organic
Nitrocellulose	9004-70-0	1/ 6	2	2	2.83	None	Yes	Detected organic
Semi-volatile Organic Compounds								
Acenaphthene	83-32-9	1/ 42	0.015	0.015	0.0087	None	Yes	Detected organic
Acenaphthylene	208-96-8	1/ 42	0.03	0.03	0.00905	None	Yes	Detected organic
Anthracene	120-12-7	3/ 42	0.011	0.075	0.0105	None	Yes	Detected organic
Benz(a)anthracene	56-55-3	3/ 42	0.011	0.35	0.0178	None	Yes	Detected organic
Benzo(a)pyrene	50-32-8	3/ 42	0.011	0.43	0.0196	None	Yes	Detected organic
Benzo(b)fluoranthene	205-99-2	3/ 42	0.021	0.62	0.0252	None	Yes	Detected organic
Benzo(ghi)perylene	191-24-2	4/ 42	0.0097	0.29	0.0165	None	Yes	Detected organic
Benzo(k)fluoranthene	207-08-9	2/ 42	0.024	0.28	0.0155	None	Yes	Detected organic
Bis(2-ethylhexyl)phthalate	117-81-7	1/ 7	0.036	0.036	0.174	None	Yes	Detected organic
Chrysene	218-01-9	4/ 42	0.012	0.47	0.0211	None	Yes	Detected organic
Dibenz(a,h)anthracene	53-70-3	1/ 42	0.074	0.074	0.0101	None	Yes	Detected organic
Fluoranthene	206-44-0	4/ 42	0.019	0.82	0.0295	None	Yes	Detected organic
Fluorene	86-73-7	1/ 42	0.021	0.021	0.00884	None	Yes	Detected organic
Indeno(1,2,3-cd)pyrene	193-39-5	2/ 42	0.027	0.27	0.0153	None	Yes	Detected organic
Naphthalene	91-20-3	3/ 42	0.018	0.11	0.012	None	Yes	Detected organic
Phenanthrene	85-01-8	3/ 42	0.014	0.23	0.0158	None	Yes	Detected organic
Pyrene	129-00-0	5/ 42	0.0082	0.66	0.0257	None	Yes	Detected organic

Table 5-7. SRC Screening Summary for Subsurface Soil (continued)

Analyte	CAS Number	Freq of Detect	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Average Result (mg/kg)	Background Criteria[a] (mg/kg)	SRC? (yes/no)	SRC Justification
Volatile Organic Compounds								
2-Butanone	78-93-3	1/ 7	0.0098	0.0098	0.0116	None	Yes	Detected organic
Carbon disulfide	75-15-0	3/ 7	0.00062	0.0014	0.00218	None	Yes	Detected organic
Toluene	108-88-3	1/ 7	0.00037	0.00037	0.00265	None	Yes	Detected organic

[a] Background concentrations are published in the Phase II Remedial Investigation Report for Winklepeck Burning Grounds (USACE 2001b).
SRC screening tables include all available and appropriate data as presented in Section 5.1.4.
CAS = Chemical Abstract Service.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
mg/kg = Milligrams per kilogram.
SRC = Site-related Contaminant.

Table 5-8. SRC Screening Summary for ISM Sediment

Analyte	CAS Number	Freq of Detect	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Average Result (mg/kg)	Background Criteria[a] (mg/kg)	SRC? (yes/no)	SRC Justification
Inorganic Chemicals								
Aluminum	**7429-90-5**	**1/ 1**	**15000**	**15000**	**15000**	**13900**	**Yes**	**Exceeds background**
Arsenic	7440-38-2	1/ 1	10	10	10	19.5	No	Below background
Barium	**7440-39-3**	**1/ 1**	**140**	**140**	**140**	**123**	**Yes**	**Exceeds background**
Beryllium	**7440-41-7**	**1/ 1**	**1.2**	**1.2**	**1.2**	**0.38**	**Yes**	**Exceeds background**
Cadmium	**7440-43-9**	**1/ 1**	**1.8**	**1.8**	**1.8**	**0**	**Yes**	**Exceeds background**
Calcium	7440-70-2	1/ 1	5500	5500	5500	5510	No	Essential Nutrient
Chromium	**7440-47-3**	**1/ 1**	**20**	**20**	**20**	**18.1**	**Yes**	**Exceeds background**
Cobalt	7440-48-4	1/ 1	7.3	7.3	7.3	9.1	No	Below background
Copper	**7440-50-8**	**1/ 1**	**31**	**31**	**31**	**27.6**	**Yes**	**Exceeds background**
Iron	7439-89-6	1/ 1	17000	17000	17000	28200	No	Essential Nutrient
Lead	**7439-92-1**	**1/ 1**	**37**	**37**	**37**	**27.4**	**Yes**	**Exceeds background**
Magnesium	7439-95-4	1/ 1	2100	2100	2100	2760	No	Essential Nutrient
Manganese	7439-96-5	1/ 1	420	420	420	1950	No	Below background
Mercury	**7439-97-6**	**1/ 1**	**0.14**	**0.14**	**0.14**	**0.059**	**Yes**	**Exceeds background**
Nickel	**7440-02-0**	**1/ 1**	**20**	**20**	**20**	**17.7**	**Yes**	**Exceeds background**
Potassium	7440-09-7	1/ 1	1400	1400	1400	1950	No	Essential Nutrient
Selenium	**7782-49-2**	**1/ 1**	**2.7**	**2.7**	**2.7**	**1.7**	**Yes**	**Exceeds background**
Sodium	7440-23-5	1/ 1	450	450	450	112	No	Essential Nutrient
Vanadium	7440-62-2	1/ 1	24	24	24	26.1	No	Below background
Zinc	7440-66-6	1/ 1	310	310	310	532	No	Below background
Explosives/Propellants								
2-Amino-4,6-Dinitrotoluene	**35572-78-2**	**1/ 1**	**0.08**	**0.08**	**0.08**	**None**	**Yes**	**Detected organic**

[a] Background concentrations are published in the Phase II Remedial Investigation Report for Winklepeck Burning Grounds (USACE 2001b).

SRC screening tables include all available and appropriate data as presented in Section 5.1.4.

CAS = Chemical Abstract Service.

mg/kg = miligrams per kilogram.

SRC = Site-related Contaminant.

Bold indicates analyte identified as an SRC.

Table 5-9. SRC Screening Summary for Discrete Sediment

Analyte	CAS Number	Freq of Detect	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Average Result (mg/kg)	Background Criteria[a] (mg/kg)	SRC? (yes/no)	SRC Justification
Inorganic Chemicals								
Aluminum	7429-90-5	1/ 1	13000	13000	13000	13900	No	Below background
Arsenic	7440-38-2	1/ 1	6.8	6.8	6.8	19.5	No	Below background
Barium	7440-39-3	1/ 1	95.3	95.3	95.3	123	No	Below background
Beryllium	**7440-41-7**	**1/ 1**	**0.74**	**0.74**	**0.74**	**0.38**	**Yes**	**Exceeds background**
Cadmium	**7440-43-9**	**1/ 1**	**0.51**	**0.51**	**0.51**	**0**	**Yes**	**Exceeds background**
Calcium	7440-70-2	1/ 1	3580	3580	3580	5510	No	Essential Nutrient
Chromium	7440-47-3	1/ 1	16.4	16.4	16.4	18.1	No	Below background
Cobalt	7440-48-4	1/ 1	6.7	6.7	6.7	9.1	No	Below background
Copper	7440-50-8	1/ 1	17	17	17	27.6	No	Below background
Iron	7439-89-6	1/ 1	18200	18200	18200	28200	No	Essential Nutrient
Lead	7439-92-1	1/ 1	20.6	20.6	20.6	27.4	No	Below background
Magnesium	7439-95-4	1/ 1	2020	2020	2020	2760	No	Essential Nutrient
Manganese	7439-96-5	1/ 1	173	173	173	1950	No	Below background
Mercury	**7439-97-6**	**1/ 1**	**0.062**	**0.062**	**0.062**	**0.059**	**Yes**	**Exceeds background**
Nickel	**7440-02-0**	**1/ 1**	**18.2**	**18.2**	**18.2**	**17.7**	**Yes**	**Exceeds background**
Potassium	7440-09-7	1/ 1	1150	1150	1150	1950	No	Essential Nutrient
Selenium	7782-49-2	1/ 1	1.5	1.5	1.5	1.7	No	Below background
Silver	**7440-22-4**	**1/ 1**	**0.078**	**0.078**	**0.078**	**0**	**Yes**	**Exceeds background**
Sodium	7440-23-5	1/ 1	1290	1290	1290	112	No	Essential Nutrient
Thallium	7440-28-0	1/ 1	0.19	0.19	0.19	0.89	No	Below background
Semi-volatile Organic Compounds								
2-Methylnaphthalene	**91-57-6**	**1/ 1**	**0.041**	**0.041**	**0.041**	**None**	**Yes**	**Detected organic**
Acenaphthene	**83-32-9**	**1/ 1**	**0.03**	**0.03**	**0.03**	**None**	**Yes**	**Detected organic**
Acenaphthylene	**208-96-8**	**1/ 1**	**0.061**	**0.061**	**0.061**	**None**	**Yes**	**Detected organic**
Anthracene	**120-12-7**	**1/ 1**	**0.078**	**0.078**	**0.078**	**None**	**Yes**	**Detected organic**
Benz(a)anthracene	**56-55-3**	**1/ 1**	**0.35**	**0.35**	**0.35**	**None**	**Yes**	**Detected organic**
Benzo(a)pyrene	**50-32-8**	**1/ 1**	**0.41**	**0.41**	**0.41**	**None**	**Yes**	**Detected organic**
Benzo(b)fluoranthene	**205-99-2**	**1/ 1**	**0.68**	**0.68**	**0.68**	**None**	**Yes**	**Detected organic**
Benzo(ghi)perylene	**191-24-2**	**1/ 1**	**0.34**	**0.34**	**0.34**	**None**	**Yes**	**Detected organic**

Table 5-9. SRC Screening Summary for Discrete Sediment (continued)

Analyte	CAS Number	Freq of Detect	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Average Result (mg/kg)	Background Criteria[a] (mg/kg)	SRC? (yes/no)	SRC Justification
Semi-volatile Organic Compounds, continued								
Benzo(k)fluoranthene	**207-08-9**	**1/ 1**	**0.28**	**0.28**	**0.28**	**None**	**Yes**	**Detected organic**
Chrysene	**218-01-9**	**1/ 1**	**0.46**	**0.46**	**0.46**	**None**	**Yes**	**Detected organic**
Dibenz(a,h)anthracene	**53-70-3**	**1/ 1**	**0.085**	**0.085**	**0.085**	**None**	**Yes**	**Detected organic**
Fluoranthene	**206-44-0**	**1/ 1**	**0.68**	**0.68**	**0.68**	**None**	**Yes**	**Detected organic**
Fluorene	**86-73-7**	**1/ 1**	**0.024**	**0.024**	**0.024**	**None**	**Yes**	**Detected organic**
Indeno(1,2,3-cd)pyrene	**193-39-5**	**1/ 1**	**0.31**	**0.31**	**0.31**	**None**	**Yes**	**Detected organic**
Naphthalene	**91-20-3**	**1/ 1**	**0.033**	**0.033**	**0.033**	**None**	**Yes**	**Detected organic**
Phenanthrene	**85-01-8**	**1/ 1**	**0.23**	**0.23**	**0.23**	**None**	**Yes**	**Detected organic**
Pyrene	**129-00-0**	**1/ 1**	**0.54**	**0.54**	**0.54**	**None**	**Yes**	**Detected organic**

[a] Background concentrations are published in the Phase II Remedial Investigation Report for Winklepeck Burning Grounds (USACE 2001b).
SRC screening tables include all available and appropriate data as presented in Section 5.1.4. CAS = Chemical Abstract Service.
mg/kg = Miligrams per kilogram.
SRC = Site-related Contaminant.
Bold indicates analyte identified as an SRC.

Table 5-10. SRC Screening for Surface Water

Analyte	CAS Number	Freq of Detect	Minimum Detect (mg/L)	Maximum Detect (mg/L)	Average Result (mg/L)	Background Criteria[a] (mg/L)	SRC? (yes/no)	SRC Justification
Inorganic Chemicals								
Aluminum	**7429-90-5**	**1/ 1**	**21.3**	**21.3**	**21.3**	**3.37**	**Yes**	**Exceeds background**
Antimony	**7440-36-0**	**1/ 1**	**0.00051**	**0.00051**	**0.00051**	**0**	**Yes**	**Exceeds background**
Arsenic	**7440-38-2**	**1/ 1**	**0.0144**	**0.0144**	**0.0144**	**0.0032**	**Yes**	**Exceeds background**
Barium	**7440-39-3**	**1/ 1**	**0.187**	**0.187**	**0.187**	**0.0475**	**Yes**	**Exceeds background**
Beryllium	**7440-41-7**	**1/ 1**	**0.0012**	**0.0012**	**0.0012**	**0**	**Yes**	**Exceeds background**
Cadmium	**7440-43-9**	**1/ 1**	**0.0012**	**0.0012**	**0.0012**	**0**	**Yes**	**Exceeds background**
Calcium	7440-70-2	1/ 1	55.3	55.3	55.3	41.4	No	Essential Nutrient
Chromium	**7440-47-3**	**1/ 1**	**0.0231**	**0.0231**	**0.0231**	**0**	**Yes**	**Exceeds background**
Cobalt	**7440-48-4**	**1/ 1**	**0.0109**	**0.0109**	**0.0109**	**0**	**Yes**	**Exceeds background**
Copper	**7440-50-8**	**1/ 1**	**0.0249**	**0.0249**	**0.0249**	**0.0079**	**Yes**	**Exceeds background**
Iron	**7439-89-6**	**1/ 1**	**27.4**	**27.4**	**27.4**	**2.56**	**Yes**	**Exceeds background**
Lead	**7439-92-1**	**1/ 1**	**0.0365**	**0.0365**	**0.0365**	**0**	**Yes**	**Exceeds background**
Magnesium	7439-95-4	1/ 1	9.2	9.2	9.2	10.8	No	Essential Nutrient
Manganese	**7439-96-5**	**1/ 1**	**1.18**	**1.18**	**1.18**	**0.391**	**Yes**	**Exceeds background**
Nickel	**7440-02-0**	**1/ 1**	**0.0244**	**0.0244**	**0.0244**	**0**	**Yes**	**Exceeds background**
Potassium	7440-09-7	1/ 1	5.12	5.12	5.12	3.17	No	Essential Nutrient
Selenium	**7782-49-2**	**1/ 1**	**0.0019**	**0.0019**	**0.0019**	**0**	**Yes**	**Exceeds background**
Sodium	7440-23-5	1/ 1	3.11	3.11	3.11	21.3	No	Essential Nutrient
Vanadium	**7440-62-2**	**1/ 1**	**0.0367**	**0.0367**	**0.0367**	**0**	**Yes**	**Exceeds background**
Zinc	**7440-66-6**	**1/ 1**	**0.346**	**0.346**	**0.346**	**0.042**	**Yes**	**Exceeds background**
Nitrate	**14797-55-8**	**1/ 1**	**0.1**	**0.1**	**0.1**	**None**	**Yes**	**Exceeds background**

Table 5-10. SRC Screening for Surface Water (continued)

Analyte	CAS Number	Freq of Detect	Minimum Detect (mg/L)	Maximum Detect (mg/L)	Average Result (mg/L)	Background Criteria[a] (mg/L)	SRC? (yes/no)	SRC Justification
Semi-volatile Organic Compounds								
Benz(a)anthracene	**56-55-3**	**1/ 1**	**0.00024**	**0.00024**	**0.00024**	**None**	**Yes**	**Detected organic**
Benzo(a)pyrene	**50-32-8**	**1/ 1**	**0.00022**	**0.00022**	**0.00022**	**None**	**Yes**	**Detected organic**
Benzo(b)fluoranthene	**205-99-2**	**1/ 1**	**0.00032**	**0.00032**	**0.00032**	**None**	**Yes**	**Detected organic**
Bis(2-ethylhexyl)phthalate	**117-81-7**	**1/ 1**	**0.0011**	**0.0011**	**0.0011**	**None**	**Yes**	**Detected organic**
Chrysene	**218-01-9**	**1/ 1**	**0.00022**	**0.00022**	**0.00022**	**None**	**Yes**	**Detected organic**
Fluoranthene	**206-44-0**	**1/ 1**	**0.00046**	**0.00046**	**0.00046**	**None**	**Yes**	**Detected organic**
Pyrene	**129-00-0**	**1/ 1**	**0.00033**	**0.00033**	**0.00033**	**None**	**Yes**	**Detected organic**
Pesticides/PCBs								
delta-BHC	**319-86-8**	**1/ 1**	**0.000014**	**0.000014**	**0.000014**	**None**	**Yes**	**Detected organic**

[a] Background concentrations are published in the Phase II Remedial Investigation Report for Winklepeck Burning Grounds (USACE 2001b).
SRC screening tables include all available and appropriate data as presented in Section 5.1.4. BHC = Hexachlorobenzene.
CAS = Chemical Abstract Service.
mg/L = Miligrams per liter.
SRC = Site-related Contaminant.
PCB = Polychlorinated Biphenyl.
Bold indicates analyte identified as an SRC.

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples

Location		**ASYss-069M**	**ASYss-070M**	**ASYss-070M**	**ASYss-071M**	**ASYss-072M**
Sample ID		**ASYss-069M-5743-SO**	**ASYss-070M-6209-FD**	**ASYss-070M-5744-SO**	**ASYss-071M-5745-SO**	**ASYss-072M-5746-SO**
Date		**04/07/10**	**04/05/10**	**04/05/10**	**04/06/10**	**04/07/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed[a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria[b]**					
Inorganic Chemicals						
Aluminum	17700	16100	10200	10300	12800	12200
Antimony	0.96	0.21 J	0.48 J	0.33 J	0.24 J	0.15 J
Arsenic	15.4	12.2 J	9.3 J	10 J	8	7.2 J
Barium	88.4	**193 ***	**95.9 ***	**91.3 ***	**118 ***	75.3
Beryllium	0.88	**2 ***	0.39 J	0.38 J	**1.2 ***	0.81
Cadmium	0	**0.46 ***	**1.3 J***	**3 J***	**0.36 ***	**0.21 ***
Calcium	15800	**58200 ***	1240	1260	**34000 J***	**20600 ***
Chromium	17.4	**23.4 J***	**20 J***	**27.4 J***	**22.7 J***	**22.5 J***
Cobalt	10.4	7.1 J	5.4 J	4.9 J	6.7	4.1 J
Copper	17.7	14.9	**33.8 J***	**38.5 J***	13.6 J	8.1
Iron	23100	21900	22500	**24700 ***	18200	15400
Lead	26.1	**61.1 ***	**240 J***	**312 J***	**39.8 J***	**79 ***
Magnesium	3030	**8080 J***	1470	1450	**5830 ***	**4090 J ***
Manganese	1450	**1600 ***	275	258	1000	630
Mercury	0.036	**0.049 J***	**0.16 ***	**0.36 ***	**0.063 J***	**0.047 J***
Nickel	21.1	15.7	9.9 J	10.7 J	17.7	12.7
Potassium	927	**1140 ***	654 J	609 J	**1080 ***	731
Selenium	1.4	**1.5 J***	0.84 J	0.83 J	1 J	0.88 J
Silver	0	**0.072 J***	**0.23 J***	**0.19 J***	**2.4 ***	**0.049 J***
Sodium	123	**319 ***	59.9 J	51.7 J	**238 ***	**136 ***
Thallium	0	**0.23 ***	**0.17 J***	**0.18 J***	**0.14 J***	**0.14 J***
Vanadium	31.1	16 J	18.2 J	18.3 J	15.5 J	16.2 J
Zinc	61.8	**71.2 ***	**628 ***	**205 ***	**70.8 J***	61
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.24 U	<0.25 U	<0.25 U	<0.24 U	<0.25 U
2,6-Dinitrotoluene	None	<0.24 U	<0.25 U	<0.25 U	<0.24 U	<0.25 U
3-Nitrotoluene	None	<0.24 U	<0.25 U	<0.25 U	<0.24 U	<0.25 U
4-Amino-2,6-	None	**0.062 J***	<0.25 U	<0.25 U	**0.065 J***	<0.25 U
HMX	None	<0.24 U	<0.25 U	<0.25 U	<0.24 U	<0.25 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Tetryl	None	<0.24 U	<0.25 U	<0.25 U	<0.24 U	<0.25 U
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	NR	NR	NR	NR
Acenaphthene	None	**0.33 ***	<0.0068 U	**0.0054 J***	**0.35 ***	**0.01 ***
Acenaphthylene	None	**0.12 ***	<0.0068 U	<0.0068 U	**0.26 ***	**0.012 ***
Anthracene	None	**0.81 ***	<0.0068 U	<0.0068 U	**1.4 ***	**0.03 ***
Benz(a)anthracene	None	**2.1 ***	**0.013 ***	**0.015 ***	**4.3 ***	**0.13 ***
Benzo(a)pyrene	None	**1.7 ***	**0.017 ***	**0.015 ***	**4.4 ***	**0.13 J***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location	**Background Criteria**[b]	**ASYss-069M**	**ASYss-070M**	**ASYss-070M**	**ASYss-071M**	**ASYss-072M**
Sample ID		**ASYss-069M-5743-SO**	**ASYss-070M-6209-FD**	**ASYss-070M-5744-SO**	**ASYss-071M-5745-SO**	**ASYss-072M-5746-SO**
Date		**04/07/10**	**04/05/10**	**04/05/10**	**04/06/10**	**04/07/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Benzo(b)fluoranthene	None	**2.6 ***	**0.046 ***	**0.035 ***	**5.9 ***	**0.19 ***
Benzo(ghi)perylene	None	**1.1 ***	**0.014 ***	**0.014 ***	**3 ***	**0.092 ***
Benzo(k)fluoranthene	None	**1.1 ***	**0.018 ***	**0.013 ***	**3.3 ***	**0.1 ***
Bis(2-ethylhexyl) phthalate	None	NR	NR	NR	NR	NR
Carbazole	None	NR	NR	NR	NR	NR
Chrysene	None	**2.2 ***	**0.038 ***	**0.029 ***	**4.9 ***	**0.14 J***
Di-n-butyl phthalate	None	NR	NR	NR	NR	NR
Dibenz(a,h) anthracene	None	**0.31 ***	<0.0068 U	<0.0068 U	**0.88 ***	**0.028 ***
Dibenzofuran	None	NR	NR	NR	NR	NR
Diethyl phthalate	None	NR	NR	NR	NR	NR
Fluoranthene	None	**5.4 ***	**0.075 ***	**0.041 ***	**8.9 ***	**0.22 ***
Fluorene	None	**0.33 ***	<0.0068 U	<0.0068 U	**0.35 ***	**0.011 ***
Indeno(1,2,3-cd)pyrene	None	**1.1 ***	**0.013 ***	**0.014 ***	**2.8 ***	**0.083 ***
Naphthalene	None	**0.67 ***	**0.023 ***	**0.033 ***	**0.29 ***	**0.031 ***
Phenanthrene	None	**4 ***	**0.044 ***	**0.033 ***	**3.7 ***	**0.1 ***
Pyrene	None	**3.8 ***	**0.044 ***	**0.027 ***	**7.1 ***	**0.18 ***
Pesticides/PCBs						
PCB-1260	None	NR	NR	NR	NR	NR
Volatile Organic Compounds						
Acetone	None	NR	NR	NR	NR	NR

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-073M**	**ASYss-074M**	**ASYss-075M**	**ASYss-076M**	**ASYss-076M**
Sample ID		**ASYss-073M-5747-SO**	**ASYss-074M-5748-SO**	**ASYss-075M-5749-SO**	**ASYss-076M-6211-FD**	**ASYss-076M-5750-SO**
Date		**04/06/10**	**04/06/10**	**04/06/10**	**04/06/10**	**04/06/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**RVAAP Full Suite**
Analyte (mg/kg)						
Inorganic Chemicals						
Aluminum	17700	14500	11600	13300	16700	15500
Antimony	0.96	0.1 J	0.098 J	0.11 J	0.18 J	0.15 J
Arsenic	15.4	8.4	8.3	8.8	9.5	8.6
Barium	88.4	**129 ***	**96.5 ***	**110 ***	**171 ***	**156 ***
Beryllium	0.88	**1.4 ***	**1.1 ***	**1.2 ***	**1.8 ***	**1.7 ***
Cadmium	0	**0.19 J***	**0.13 J***	**0.15 J***	**0.38 ***	**0.33 ***
Calcium	15800	**50500 J***	**29700 J***	**35200 J***	**77200 J***	**75300 J***
Chromium	17.4	17.1 J	14.6 J	17.4 J	**28.5 J***	**23.5 J***
Cobalt	10.4	5.7	7	6.9	5	4.5
Copper	17.7	13.3 J	13.9 J	16.3 J	**51.2 J***	**51.2 J***
Iron	23100	16800	17300	17700	16100	15600
Lead	26.1	20.1 J	17.8 J	18.4 J	**39.8 J***	**40.4 J***
Magnesium	3030	**6980 ***	**5840 ***	**6400 ***	**8770 ***	**8610 ***
Manganese	1450	1210	817	898	**1510 ***	1400
Mercury	0.036	0.034 J	0.022 J	0.031 J	**0.066 J***	**0.074 J***
Nickel	21.1	14.6	16.9	17.9	19.1	17.5
Potassium	927	**1050 ***	**1080 ***	**1080 ***	**1400 ***	**1130 ***
Selenium	1.4	1.1 J	0.86 J	0.99 J	**1.5 J***	**1.4 J***
Silver	0	**0.035 J***	**0.031 J***	**0.033 J***	**0.07 J***	**0.073 J***
Sodium	123	**245 ***	**167 ***	**180 ***	**307 ***	**295 ***
Thallium	0	**0.11 J***	**0.11 J***	**0.11 J***	**0.11 J***	**0.1 J***
Vanadium	31.1	12.8 J	12.5 J	13.8 J	15.5 J	13.7 J
Zinc	61.8	48.6 J	46.3 J	48.9 J	**76.9 J***	**75.1 J***
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.25 U	<0.24 U	<0.24 U	**0.033 J***	<0.24 U
2,6-Dinitrotoluene	None	<0.25 U	<0.24 U	<0.24 U	<0.24 U	**0.13 J***
3-Nitrotoluene	None	<0.25 U	<0.24 U	<0.24 U	<0.24 U	<0.24 U
4-Amino-2,6-Dinitrotoluene	None	**0.045 J***	**0.029 J***	**0.051 J***	<0.24 U	<0.24 U
HMX	None	<0.25 U	<0.24 U	<0.24 U	<0.24 U	<0.24 U
Nitrocellulose	None	NR	**1 J***	NR	**3.1 J***	**2.6 J***
Tetryl	None	<0.25 U	<0.24 U	<0.24 U	**0.11 J***	<0.24 U
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	**0.12 J***	NR	**1.2 J***	**1.4 J***
Acenaphthene	None	**0.17 ***	**0.18 J***	**0.14 ***	**0.32 J***	**0.32 J***
Acenaphthylene	None	**0.3 ***	**0.15 J***	**0.42 ***	**0.15 J***	**0.16 J***
Anthracene	None	**0.88 ***	**2 ***	**1.2 ***	**0.99 ***	**0.87 ***
Benz(a)anthracene	None	**2.6 ***	**3.1 ***	**3.3 ***	**6.4 ***	**6.5 ***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-073M**	**ASYss-074M**	**ASYss-075M**	**ASYss-076M**	**ASYss-076M**
Sample ID		**ASYss-073M-5747-SO**	**ASYss-074M-5748-SO**	**ASYss-075M-5749-SO**	**ASYss-076M-6211-FD**	**ASYss-076M-5750-SO**
Date		**04/06/10**	**04/06/10**	**04/06/10**	**04/06/10**	**04/06/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**RVAAP Full Suite**
Analyte (mg/kg)						
		Semi-volatile Organic Compounds, continued				
Benzo(a)pyrene	None	**2.5 ***	**3.3 ***	**3.1 ***	**6.9 ***	**7.3 ***
Benzo(b)fluoranthene	None	**4 ***	**5.6 ***	**5.4 ***	**11 ***	**12 ***
Benzo(ghi)perylene	None	**2 ***	**2.5 ***	**2.3 ***	**5.4 ***	**5.5 ***
Benzo(k)fluoranthene	None	**2 ***	**1.8 ***	**2.1 ***	**3.9 ***	**4 ***
Bis(2-ethylhexyl) phthalate	None	NR	<1.7 U	NR	<4.2 U	<4.2 U
Carbazole	None	NR	**0.36 ***	NR	<0.64 U	<0.64 U
Chrysene	None	**3 ***	**3.7 ***	**4 ***	**6.6 ***	**7.7 ***
Di-n-butyl phthalate	None	NR	<1.7 U	NR	<4.2 U	<4.2 U
Dibenz(a,h) anthracene	None	**0.43 ***	**0.63 ***	**0.49 ***	**1.3 ***	**1.5 ***
Dibenzofuran	None	NR	**0.12 J***	NR	**0.37 J***	**0.42 J***
Diethyl phthalate	None	NR	<1.7 U	NR	<4.2 U	<4.2 U
Fluoranthene	None	**5 ***	**5.7 ***	**6.1 ***	**12 ***	**12 ***
Fluorene	None	**0.16 ***	**0.31 ***	**0.12 ***	**0.22 J***	**0.2 J***
Indeno(1,2,3-cd)pyrene	None	**1.7 ***	**2.1 ***	**2.1 ***	**4.5 ***	**4.7 ***
Naphthalene	None	**0.2 ***	**0.1 J***	**0.18 ***	**0.75 ***	**0.97 ***
Phenanthrene	None	**1.7 ***	**1.5 ***	**1.6 ***	**2.5 ***	**2.2 ***
Pyrene	None	**4 ***	**4.8 ***	**5 ***	**9.9 ***	**11 ***
		Pesticides/PCBs				
PCB-1260	None	NR	**0.019 J***	NR	**0.096 J***	**0.17 J***
		Volatile Organic Compounds				
Acetone	None	NR	<0.026 UJ	NR	<0.025 U	<0.028 UJ

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-077M**	**ASYss-078M**	**ASYss-079M**	**ASYss-080M**	**ASYss-081M**
Sample ID		**ASYss-077M-5751-SO**	**ASYss-078M-5752-SO**	**ASYss-079M-5753-SO**	**ASYss-080M-5754-SO**	**ASYss-081M-5755-SO**
Date		**04/07/10**	**04/07/10**	**04/07/10**	**04/07/10**	**04/02/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria[b]**					
Inorganic Chemicals						
Aluminum	17700	16800	**30400 ***	**32100 ***	**21100 ***	15700 J
Antimony	0.96	0.13 J	0.099 J	0.076 J	0.11 J	0.13 J
Arsenic	15.4	9.7 J	4.1 J	4 J	7.4 J	8 J
Barium	88.4	**155 ***	**322 ***	**325 ***	**201 ***	**161 ***
Beryllium	0.88	**2 ***	**6.3 ***	**5.3 ***	**3.9 ***	**1.9 J***
Cadmium	0	**0.15 J***	**0.16 J***	**0.18 J***	**0.15 J***	**0.2 J***
Calcium	15800	**57500 ***	**167000 ***	**178000 ***	**100000 ***	**56200 ***
Chromium	17.4	**33.1 J***	**36.1 J***	**35.8 J***	**45.1 J***	**35.2 J***
Cobalt	10.4	7.5 J	2 J	1.5 J	5.1 J	4.9 J
Copper	17.7	15	16.3	9.1	13.8	9.8 J
Iron	23100	23000	12800	9710	19400	16700
Lead	26.1	16	15.7	13.1	15.6	24.5 J
Magnesium	3030	**8500 J***	**27100 J***	**23200 J***	**16700 J***	**8960 ***
Manganese	1450	1390	**3330 ***	**3180 ***	**1930 ***	**1790 ***
Mercury	0.036	0.018 J	0.018 J	<0.1 U	0.021 J	**0.048 J***
Nickel	21.1	**24.6 ***	13	12	**24.5 ***	17.9 J
Potassium	927	**1310 ***	**1840 ***	**1980 ***	**1680 ***	**1040 J***
Selenium	1.4	1.2 J	**2.5 J***	**2.7 J***	**1.8 J***	**1.7 J***
Silver	0	**0.059 J***	**0.17 J***	**0.11 J***	**0.089 J***	**0.054 J***
Sodium	123	**375 ***	**1130 ***	**1120 ***	**743 ***	**293 J***
Thallium	0	**0.16 J***	**0.092 J***	**0.08 J***	**0.11 J***	**0.12 J***
Vanadium	31.1	16.3 J	13 J	11.9 J	14.2 J	18 J
Zinc	61.8	45.4	37.3	30.7	39.8	56
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	**0.067 J***	**0.16 J***	<0.24 U	**0.098 J***	<0.25 U
2,6-Dinitrotoluene	None	<0.24 U	<0.24 U	<0.24 U	<0.24 U	<0.25 U
3-Nitrotoluene	None	<0.24 U	**0.053 J***	<0.24 U	**0.091 J***	<0.25 U
4-Amino-2,6-Dinitrotoluene	None	<0.24 U	<0.24 U	<0.24 U	**0.21 J***	<0.25 U
HMX	None	<0.24 U	<0.24 U	<0.24 U	<0.24 U	<0.25 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Tetryl	None	<0.24 U	**0.14 J***	**0.04 J***	**0.13 J***	<0.25 U
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	NR	NR	NR	NR
Acenaphthene	None	**0.16 ***	**0.25 ***	**0.035 ***	<0.17 U	**0.033 ***
Acenaphthylene	None	**1.2 ***	**0.89 ***	**0.56 ***	**2.5 ***	**0.081 ***
Anthracene	None	**4.4 ***	**4.5 ***	**0.88 ***	**5.4 ***	**0.14 ***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location	**Background Criteria**[b]	**ASYss-077M**	**ASYss-078M**	**ASYss-079M**	**ASYss-080M**	**ASYss-081M**
Sample ID		**ASYss-077M-5751-SO**	**ASYss-078M-5752-SO**	**ASYss-079M-5753-SO**	**ASYss-080M-5754-SO**	**ASYss-081M-5755-SO**
Date		**04/07/10**	**04/07/10**	**04/07/10**	**04/07/10**	**04/02/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed[a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Benz(a)anthracene	None	**12 ***	**17 ***	**2.6 ***	**17 ***	**0.49 ***
Benzo(a)pyrene	None	**12 ***	**19 ***	**2.5 ***	**20 ***	**0.51 ***
Benzo(b)fluoranthene	None	**23 ***	**37 ***	**4.9 ***	**37 ***	**0.89 ***
Benzo(ghi)perylene	None	**8.7 ***	**12 ***	**2.1 ***	**14 ***	**0.4 ***
Benzo(k)fluoranthene	None	**12 ***	**14 ***	**2.3 ***	**15 ***	**0.36 ***
Bis(2-ethylhexyl) phthalate	None	NR	NR	NR	NR	NR
Carbazole	None	NR	NR	NR	NR	NR
Chrysene	None	**20 ***	**30 ***	**3.5 ***	**28 ***	**0.58 ***
Di-n-butyl phthalate	None	NR	NR	NR	NR	NR
Dibenz(a,h) anthracene	None	**2.7 ***	**4.2 ***	**0.78 ***	**5.1 ***	**0.11 ***
Dibenzofuran	None	NR	NR	NR	NR	NR
Diethyl phthalate	None	NR	NR	NR	NR	NR
Fluoranthene	None	**14 ***	**19 ***	**2.8 ***	**18 ***	**1 ***
Fluorene	None	**0.39 ***	**0.4 ***	**0.056 ***	**0.3 ***	**0.037 ***
Indeno(1,2,3-cd)pyrene	None	**8.3 ***	**12 ***	**1.8 ***	**13 ***	**0.36 ***
Naphthalene	None	**0.29 ***	**0.18 ***	**0.23 ***	**0.33 ***	**0.12 ***
Phenanthrene	None	**1.9 ***	**2.5 ***	**0.51 ***	**1.7 ***	**0.48 ***
Pyrene	None	**15 ***	**22 ***	**3 ***	**19 ***	**0.82 ***
Pesticides/PCBs						
PCB-1260	None	NR	NR	NR	NR	NR
Volatile Organic Compounds						
Acetone	None	NR	NR	NR	NR	NR

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-082M**	**ASYss-083M**	**ASYss-084M**	**ASYss-085M**	**ASYss-086M**
Sample ID		**ASYss-082M-5756-SO**	**ASYss-083M-5757-SO**	**ASYss-084M-5758-SO**	**ASYss-085M-5759-SO**	**ASYss-086M-5760-SO**
Date		**04/02/10**	**04/02/10**	**04/02/10**	**04/02/10**	**04/02/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria**[b]					
Inorganic Chemicals						
Aluminum	17700	**19700 J***	8230 J	**23700 J***	8950 J	11100 J
Antimony	0.96	0.16 J	0.1 J	0.27 J	0.14 J	0.11 J
Arsenic	15.4	5.5 J	5 J	6.1 J	7.4 J	8.5 J
Barium	88.4	**232 ***	**94.6 ***	**325 ***	**101 ***	**98.4 ***
Beryllium	0.88	**3.1 J***	**1.3 J***	**4.2 J***	**1.2 J***	**0.9 J***
Cadmium	0	**0.39 J***	**0.28 J***	**0.69 J***	**0.21 J***	**0.16 J***
Calcium	15800	**89500 ***	**35500 ***	**115000 ***	**29300 ***	**19100 ***
Chromium	17.4	**19.5 J***	11.5 J	**59 J***	**21.6 J***	**19.6 J***
Cobalt	10.4	3.4 J	2.1 J	3.6 J	3.6 J	5.3 J
Copper	17.7	10.5 J	9.7 J	**20 J***	11.7 J	8.8 J
Iron	23100	12400	9160	**42100 ***	14100	16700
Lead	26.1	24.9 J	**29.8 J***	**110 J***	**58.5 J***	25.3 J
Magnesium	3030	**12100 ***	**6350 ***	**15300 ***	**5500 ***	**3560 ***
Manganese	1450	**2500 ***	914	**3600 ***	1010	837
Mercury	0.036	**0.05 J***	0.019 J	**0.18 ***	**0.037 J***	**0.052 J***
Nickel	21.1	10.6 J	8 J	**25.3 J***	12.8 J	13.1 J
Potassium	927	**1440 J***	608 J	**1790 J***	652 J	714 J
Selenium	1.4	**2.3 J***	1 J	**2.9 J***	1.2 J	1.2 J
Silver	0	**0.068 J***	**0.027 J***	**0.073 J***	**0.029 J***	**0.054 J***
Sodium	123	**447 J***	**200 J***	**616 J***	**178 J***	101 J
Thallium	0	**0.093 J***	<0.2 U	**0.072 J***	**0.066 J***	**0.15 J***
Vanadium	31.1	11 J	4.5 J	8.1 J	6.4 J	17.2 J
Zinc	61.8	**178 ***	**140 ***	**443 ***	**102 ***	49.3
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,6-Dinitrotoluene	None	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
3-Nitrotoluene	None	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
4-Amino-2,6-Dinitrotoluene	None	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
HMX	None	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Tetryl	None	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	NR	NR	NR	NR
Acenaphthene	None	**0.017 ***	**0.092 ***	**0.052 ***	**0.055 ***	**0.023 ***
Acenaphthylene	None	**0.075 ***	**0.085 ***	**0.23 ***	**0.066 ***	**0.17 ***
Anthracene	None	**0.076 ***	**0.39 ***	**0.22 ***	**0.14 ***	**0.11 ***
Benz(a)anthracene	None	**0.32 ***	**0.98 ***	**0.98 ***	**0.63 ***	**0.38 ***
Benzo(a)pyrene	None	**0.35 ***	**0.87 ***	**1.1 ***	**0.58 ***	**0.42 ***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-082M**	**ASYss-083M**	**ASYss-084M**	**ASYss-085M**	**ASYss-086M**
Sample ID		**ASYss-082M-5756-SO**	**ASYss-083M-5757-SO**	**ASYss-084M-5758-SO**	**ASYss-085M-5759-SO**	**ASYss-086M-5760-SO**
Date		**04/02/10**	**04/02/10**	**04/02/10**	**04/02/10**	**04/02/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria[b]**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Benzo(b)fluoranthene	None	**0.55 ***	**1.3 ***	**2.7 ***	**1.6 ***	**0.75 ***
Benzo(ghi)perylene	None	**0.24 ***	**0.48 ***	**1.1 ***	**0.88 ***	**0.38 ***
Benzo(k)fluoranthene	None	**0.27 ***	**0.58 ***	**1.1 ***	**0.74 ***	**0.33 ***
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Carbazole	None	NR	NR	NR	NR	NR
Chrysene	None	**0.37 ***	**0.99 ***	**1.5 ***	**0.97 ***	**0.45 ***
Di-n-butyl phthalate	None	NR	NR	NR	NR	NR
Dibenz(a,h)anthracene	None	**0.084 ***	**0.15 ***	**0.32 ***	**0.2 ***	**0.12 ***
Dibenzofuran	None	NR	NR	NR	NR	NR
Diethyl phthalate	None	NR	NR	NR	NR	NR
Fluoranthene	None	**0.66 ***	**2.1 ***	**2.1 ***	**1.3 ***	**0.67 ***
Fluorene	None	**0.026 ***	**0.11 ***	**0.052 ***	**0.046 ***	**0.024 ***
Indeno(1,2,3-cd)pyrene	None	**0.24 ***	**0.49 ***	**1.1 ***	**0.74 ***	**0.37 ***
Naphthalene	None	**0.13 ***	**0.051 ***	**0.17 ***	**0.058 ***	**0.098 ***
Phenanthrene	None	**0.28 ***	**1.2 ***	**0.59 ***	**0.5 ***	**0.24 ***
Pyrene	None	**0.5 ***	**1.5 ***	**1.7 ***	**1 ***	**0.51 ***
Pesticides/PCBs						
PCB-1260	None	NR	NR	NR	NR	NR
Volatile Organic Compounds						
Acetone	None	NR	NR	NR	NR	NR

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-087M**	**ASYss-088M**	**ASYss-089M**	**ASYss-090M**	**ASYss-091M**
Sample ID		**ASYss-087M-5761-SO**	**ASYss-088M-5756-SO**	**ASYss-089M-5763-SO**	**ASYss-090M-5764-SO**	**ASYss-091M-5765-SO**
Date		**04/02/10**	**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Inorganic Chemicals						
Aluminum	17700	11300 J	14400	13400	10300	10200
Antimony	0.96	0.1 J	0.25 J	0.26 J	0.65 J	0.16 J
Arsenic	15.4	8.5 J	10.1 J	8.9 J	7.7 J	9.1 J
Barium	88.4	80.3	**171 ***	**120 ***	**95.8 ***	81.5
Beryllium	0.88	0.71 J	**2.2 J***	**1.5 J***	0.87 J	0.7 J
Cadmium	0	**0.17 J***	**0.35 J***	**0.27 J***	**0.3 J***	**0.2 J***
Calcium	15800	12700	**68300 ***	**39000 ***	**28400 ***	9480
Chromium	17.4	**18.8 J***	**25.9 J***	**23.9 J***	**19.1 J***	15.3 J
Cobalt	10.4	5.1 J	4.8 J	4.7 J	5.3 J	7 J
Copper	17.7	9 J	16 J	11.2 J	11.4 J	12.3 J
Iron	23100	17700	17400	17700	15500	17900
Lead	26.1	21 J	23.8 J	22.5 J	25.6 J	**26.5 J***
Magnesium	3030	2950	**10200 ***	**6630 ***	**5490 ***	**2770**
Manganese	1450	594	**1610 ***	1010	658	714
Mercury	0.036	**0.051 J***	**0.056 J***	**0.063 J***	**0.048 J***	**0.055 J***
Nickel	21.1	13.2 J	19.3 J	15.8 J	13.6 J	13.7 J
Potassium	927	765	**1250 J***	**958 J***	830 J	810 J
Selenium	1.4	1 J	**1.9 J***	**1.5 J***	1.1 J	1.1 J
Silver	0	**0.048 J***	**0.11 J***	**0.33 J***	**0.17 J***	**0.045 J***
Sodium	123	82.9 J	**346 J***	**205 J***	123 J	67.8 J
Thallium	0	**0.17 J***	**0.16 J***	**0.13 J***	**0.13 J***	**0.15 J***
Vanadium	31.1	17.9 J	12.3 J	14.7 J	14.8 J	17.6 J
Zinc	61.8	44.5	**75.6 ***	45.4	**88.7 ***	50.1
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
2,6-Dinitrotoluene	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
3-Nitrotoluene	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
4-Amino-2,6-Dinitrotoluene	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
HMX	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
Nitrocellulose	None	NR	**4.2 J***	NR	NR	NR
Tetryl	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	**2.2 J***	NR	NR	NR
Acenaphthene	None	<0.0068 U	**0.24 J***	**0.082 ***	**0.023 ***	**0.0085 ***
Acenaphthylene	None	**0.0098 ***	**1.7 ***	**0.98 ***	**0.021 ***	**0.019 ***
Anthracene	None	**0.0088 ***	**2.9 ***	**1.7 ***	**0.075 ***	**0.024 ***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-087M**	**ASYss-088M**	**ASYss-089M**	**ASYss-090M**	**ASYss-091M**
Sample ID		**ASYss-087M-5761-SO**	**ASYss-088M-5756-SO**	**ASYss-089M-5763-SO**	**ASYss-090M-5764-SO**	**ASYss-091M-5765-SO**
Date		**04/02/10**	**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Benz(a)anthracene	None	**0.051 ***	**8.9 ***	**5 ***	**0.31 ***	**0.16 ***
Benzo(a)pyrene	None	**0.055 ***	**9 ***	**4.8 ***	**0.29 ***	**0.17 ***
Benzo(b)fluoranthene	None	**0.093 ***	**18 ***	**8.6 ***	**0.37 ***	**0.27 ***
Benzo(ghi)perylene	None	**0.039 ***	**6.1 ***	**3 ***	**0.19 ***	**0.11 ***
Benzo(k)fluoranthene	None	**0.03 ***	**6.2 ***	**3.6 ***	**0.27 ***	**0.13 ***
Bis(2-ethylhexyl)phthalate	None	NR	<4.2 U	NR	NR	NR
Carbazole	None	NR	**0.44 J***	NR	NR	NR
Chrysene	None	**0.059 ***	**14 ***	**6.3 ***	**0.31 ***	**0.18 ***
Di-n-butyl phthalate	None	NR	<4.2 U	NR	NR	NR
Dibenz(a,h) anthracene	None	**0.013 ***	**2.1 ***	**1.2 ***	**0.037 ***	**0.025 ***
Dibenzofuran	None	NR	**0.51 J***	NR	NR	NR
Diethyl phthalate	None	NR	<4.2 U	NR	NR	NR
Fluoranthene	None	**0.091 ***	**11 ***	**5.5 ***	**0.62 ***	**0.24 ***
Fluorene	None	**0.0084 ***	**0.3 J***	**0.14 ***	**0.028 ***	**0.014 ***
Indeno(1,2,3-cd)pyrene	None	**0.037 ***	**5.8 ***	**3.1 ***	**0.2 ***	**0.11 ***
Naphthalene	None	**0.044 ***	**1.4 ***	**0.38 ***	**0.1 ***	**0.065 ***
Phenanthrene	None	**0.055 ***	**2.1 ***	**1.2 ***	**0.37 ***	**0.094 ***
Pyrene	None	**0.067 ***	**11 ***	**4.8 ***	**0.45 ***	**0.21 ***
Pesticides/PCBs						
PCB-1260	None	NR	<0.034 U	NR	NR	NR
Volatile Organic Compounds						
Acetone	None	NR	<0.031 UJ	NR	NR	NR

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location	**Background Criteria**[b]	**ASYss-092M**	**ASYss-093M**	**ASYss-094M**	**ASYss-095M**	**ASYss-096M**
Sample ID		**ASYss-092M-5766-SO**	**ASYss-093M-5767-SO**	**ASYss-094M-5768-SO**	**ASYss-095M-5769-SO**	**ASYss-096M-5770-SO**
Date		**04/05/10**	**04/06/10**	**04/06/10**	**04/06/10**	**04/05/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
		Inorganic Chemicals				
Aluminum	17700	9330	12600	13000	11400	9050
Antimony	0.96	0.072 J	0.12 J	0.19 J	0.15 J	0.15 J
Arsenic	15.4	8.3 J	8.6	9.2	9.9	7.9 J
Barium	88.4	57	**90.7 ***	**98.2 ***	**91.9 ***	70.5
Beryllium	0.88	0.38 J	0.82	0.8	0.8	0.66 J
Cadmium	0	**0.12 J***	**0.15 J***	**0.17 J***	**0.18 J***	**0.19 J***
Calcium	15800	2320	**17800 J***	14400 J	14800 J	9900
Chromium	17.4	13.2 J	16.5 J	**19.5 J***	**21.4 J***	17.2 J
Cobalt	10.4	6.5 J	6.1	6.3	9.5	4.9 J
Copper	17.7	7.5 J	9.6 J	16.2 J	11.1 J	9.5 J
Iron	23100	17100	19000	21400	**23600 ***	18200
Lead	26.1	22.6 J	22.5 J	24.3 J	25.1 J	19.4 J
Magnesium	3030	1730	**3530 ***	**3210 ***	**3250 ***	2780
Manganese	1450	510	846	891	901	455
Mercury	0.036	**0.06 J***	**0.054 J***	**0.048 J***	**0.048 J***	**0.049 J***
Nickel	21.1	11.1 J	11.5	13.8	15.2	12.9 J
Potassium	927	577 J	866	906	848	761 J
Selenium	1.4	0.85 J	0.82 J	0.91 J	0.76 J	0.95 J
Silver	0	**0.059 J***	**0.052 J***	**0.047 J***	**0.081 J***	**0.055 J***
Sodium	123	37.1 J	122	112	117	78.1 J
Thallium	0	**0.16 J***	**0.14 J***	**0.15 J***	**0.15 J***	**0.12 J***
Vanadium	31.1	15.9 J	18.9 J	20.6 J	19.7 J	15.7 J
Zinc	61.8	39.1	47.3 J	51.8 J	54.9 J	50.3
		Explosives/Propellants				
1,3,5-Trinitrobenzene	None	<0.25 U	**0.014 J***	<0.25 U	<0.24 U	<0.24 U
2,6-Dinitrotoluene	None	<0.25 U	<0.24 U	<0.25 U	<0.24 U	<0.24 U
3-Nitrotoluene	None	<0.25 U	**0.12 J***	<0.25 U	<0.24 U	<0.24 U
4-Amino-2,6-Dinitrotoluene	None	<0.25 U	<0.24 U	<0.25 U	<0.24 U	<0.24 U
HMX	None	<0.25 U	**0.016 J***	<0.25 U	<0.24 U	<0.24 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Tetryl	None	<0.25 U	**0.071 J***	<0.25 U	<0.24 U	<0.24 U
		Semi-volatile Organic Compounds				
2-Methylnaphthalene	None	NR	NR	NR	NR	NR
Acenaphthene	None	<0.0068 U	**5.3 ***	**0.012 ***	**0.11 ***	**0.012 ***
Acenaphthylene	None	<0.0068 U	**0.68 ***	**0.026 ***	**0.081 ***	**0.022 ***
Anthracene	None	**0.0069 ***	**9.7 ***	**0.035 ***	**0.25 ***	**0.041 ***
Benz(a)anthracene	None	**0.031 ***	**17 ***	**0.11 ***	**0.81 ***	**0.21 ***
Benzo(a)pyrene	None	**0.033 ***	**18 ***	**0.078 ***	**0.83 ***	**0.22 ***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-092M**	**ASYss-093M**	**ASYss-094M**	**ASYss-095M**	**ASYss-096M**
Sample ID		**ASYss-092M-5766-SO**	**ASYss-093M-5767-SO**	**ASYss-094M-5768-SO**	**ASYss-095M-5769-SO**	**ASYss-096M-5770-SO**
Date		**04/05/10**	**04/06/10**	**04/06/10**	**04/06/10**	**04/05/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria[b]**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Benzo(b)fluoranthene	None	**0.065** *	**21** *	**0.17** *	**1.2** *	**0.35** *
Benzo(ghi)perylene	None	**0.028** *	**11** *	**0.075** *	**0.58** *	**0.17** *
Benzo(k)fluoranthene	None	**0.024** *	**11** *	**0.06** *	**0.51** *	**0.13** *
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Carbazole	None	NR	NR	NR	NR	NR
Chrysene	None	**0.041** *	**18** *	**0.12** *	**0.9** *	**0.21** *
Di-n-butyl phthalate	None	NR	NR	NR	NR	NR
Dibenz(a,h) anthracene	None	**0.0078** *	**2.8** *	<0.0068 U	**0.11** *	**0.046** *
Dibenzofuran	None	NR	NR	NR	NR	NR
Diethyl phthalate	None	NR	NR	NR	NR	NR
Fluoranthene	None	**0.063** *	**43** *	**0.2** *	**2.1** *	**0.38** *
Fluorene	None	**0.0087** *	**4.3** *	**0.016** *	**0.1** *	**0.016** *
Indeno(1,2,3-cd)pyrene	None	**0.026** *	**10** *	**0.0072** *	**0.5** *	**0.16** *
Naphthalene	None	**0.028** *	<0.34 U	**0.1** *	**0.088** *	**0.051** *
Phenanthrene	None	**0.04** *	**21** *	**0.13** *	**1** *	**0.15** *
Pyrene	None	**0.046** *	**33** *	**0.15** *	**1.5** *	**0.28** *
Pesticides/PCBs						
PCB-1260	None	NR	NR	NR	NR	NR
Volatile Organic Compounds						
Acetone	None	NR	NR	NR	NR	NR

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-097M**	**ASYss-098M**	**ASYss-099M**	**ASYss-100M**	**ASYss-101M**
Sample ID		**ASYss-097M-5771-SO**	**ASYss-098M-5772-SO**	**ASYss-099M-5773-SO**	**ASYss-100M-5774-SO**	**ASYss-101M-5775-SO**
Date		**04/06/10**	**04/06/10**	**04/06/10**	**04/06/10**	**04/06/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria[b]**					
Inorganic Chemicals						
Aluminum	17700	9350	10800	11600	12200	11300
Antimony	0.96	0.13 J	0.12 J	0.099 J	0.12 J	0.12 J
Arsenic	15.4	8.2	8.4	8.6	6.6	6.3
Barium	88.4	75.1	67.8	70.3	75.7	83.4
Beryllium	0.88	0.55	0.42	0.51	0.72	0.74
Cadmium	0	**0.25 ***	**0.15 J***	**0.11 J***	**0.21 ***	**0.23 ***
Calcium	15800	2170 J	1800 J	5090 J	12300 J	10900 J
Chromium	17.4	**18.3 J***	17.3 J	17 J	17.3 J	16.3 J
Cobalt	10.4	10	5.8	6.6	6.1	5.5
Copper	17.7	11.2 J	15.9 J	10.3 J	8.4 J	8.8 J
Iron	23100	17600	18700	20300	15900	16400
Lead	26.1	24.8 J	**39.2 J***	15.3 J	18.5 J	21.2 J
Magnesium	3030	1470	1700	2280	3020	2710
Manganese	1450	723	415	662	487	476
Mercury	0.036	**0.074 J***	**0.098 J***	**0.042 J***	**0.058 J***	**0.052 J***
Nickel	21.1	14	12.6	14.1	13.8	12.9
Potassium	927	610	711 J	743 J	797	861
Selenium	1.4	0.83 J	0.65 J	0.73 J	0.81 J	0.99 J
Silver	0	**0.072 J***	**0.073 J***	**0.046 J***	**1 ***	**0.5 J***
Sodium	123	39.6 J	39.2 J	55.1 J	101 J	85.9 J
Thallium	0	**0.16 J***	**0.16 J***	**0.15 J***	**0.14 J***	**0.15 J***
Vanadium	31.1	18.2 J	19.6 J	20.4 J	16.7 J	16.6 J
Zinc	61.8	60.2 J	**62 J***	42.7 J	60.5 J	**69.4 J***
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.24 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
2,6-Dinitrotoluene	None	<0.24 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
3-Nitrotoluene	None	<0.24 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
4-Amino-2,6-	None	<0.24 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
HMX	None	<0.24 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
Nitrocellulose	None	**2.1 J***	NR	NR	NR	NR
Tetryl	None	<0.24 U	<0.25 U	<0.24 U	<0.25 U	<0.24 U
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	**0.074 J***	NR	NR	NR	NR
Acenaphthene	None	**0.023 J***	**0.023 ***	**0.02 ***	**0.033 ***	**0.21 ***
Acenaphthylene	None	**0.014 J***	**0.14 ***	**0.13 ***	**0.036 ***	**0.15 ***
Anthracene	None	**0.061 ***	**0.1 ***	**0.17 ***	**0.085 ***	**0.9 J***
Benz(a)anthracene	None	**0.22 ***	**0.31 ***	**0.51 ***	**0.4 ***	**1.7 J***
Benzo(a)pyrene	None	**0.22 ***	**0.34 ***	**0.47 ***	**0.4 ***	**1.4 J***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-097M**	**ASYss-098M**	**ASYss-099M**	**ASYss-100M**	**ASYss-101M**
Sample ID		**ASYss-097M-5771-SO**	**ASYss-098M-5772-SO**	**ASYss-099M-5773-SO**	**ASYss-100M-5774-SO**	**ASYss-101M-5775-SO**
Date		**04/06/10**	**04/06/10**	**04/06/10**	**04/06/10**	**04/06/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]			**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria**[b]	**RVAAP Full Suite**				
Semi-volatile Organic Compounds, continued						
Benzo(b)fluoranthene	None	**0.33 ***	**0.52 ***	**0.78 ***	**0.57 ***	**1.9 J***
Benzo(ghi)perylene	None	**0.16 ***	**0.26 ***	**0.3 ***	**0.29 ***	**0.9 ***
Benzo(k)fluoranthene	None	**0.13 ***	**0.23 ***	**0.3 ***	**0.25 ***	**0.93 ***
Bis(2-ethylhexyl)phthalate	None	**0.024 J***	NR	NR	NR	NR
Carbazole	None	**0.043 J***	NR	NR	NR	NR
Chrysene	None	**0.23 ***	**0.32 ***	**0.54 ***	**0.41 ***	**1.7 J***
Di-n-butyl phthalate	None	**0.027 J***	NR	NR	NR	NR
Dibenz(a,h) anthracene	None	**0.046 J***	**0.062 ***	**0.088 ***	**0.073 ***	**0.26 ***
Dibenzofuran	None	**0.026 J***	NR	NR	NR	NR
Diethyl phthalate	None	**0.023 J***	NR	NR	NR	NR
Fluoranthene	None	**0.55 ***	**0.55 ***	**0.91 ***	**0.89 ***	**4.4 J***
Fluorene	None	**0.031 J***	**0.012 ***	**0.029 ***	**0.035 ***	**0.35 ***
Indeno(1,2,3-cd)pyrene	None	**0.15 ***	**0.25 ***	**0.3 ***	**0.28 ***	**0.83 ***
Naphthalene	None	**0.059 ***	**0.04 ***	**0.032 ***	**0.055 ***	**0.076 ***
Phenanthrene	None	**0.27 ***	**0.15 ***	**0.3 ***	**0.38 ***	**3 J***
Pyrene	None	**0.41 ***	**0.4 ***	**0.69 ***	**0.66 ***	**3 J***
Pesticides/PCBs						
PCB-1260	None	<0.034 U	NR	NR	NR	NR
Volatile Organic Compounds						
Acetone	None	<0.029 UJ	NR	NR	NR	NR

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-102M**	**ASYss-103M**	**ASYss-103M**	**ASYss-111M**	**ASYss-112M**
Sample ID		**ASYss-102M-5776-SO**	**ASYss-103M-6213-FD**	**ASYss-103M-5777-SO**	**ASYss-111M-5835-SO**	**ASYss-112M-5836-SO**
Date		**04/06/10**	**04/05/10**	**04/05/10**	**04/20/11**	**04/20/11**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**
Analyte (mg/kg)	**Background Criteria**[b]					
Inorganic Chemicals						
Aluminum	17700	10400	10400	11000	12000 J	11100 J
Antimony	0.96	0.078 J	0.14 J	0.14 J	NR	NR
Arsenic	15.4	4.6	10.7 J	9.8 J	NR	NR
Barium	88.4	52.9	66.3	74.6	**118 ***	**104 ***
Beryllium	0.88	0.39	0.55 J	0.66 J	**1.4 J***	**1 J***
Cadmium	0	**0.16 J***	**0.16 J***	**0.16 J***	**0.19 ***	**0.12 J***
Calcium	15800	2220 J	4190	8500	NR	NR
Chromium	17.4	12.3 J	16.1 J	16.7 J	**30.2 ***	**19.9 ***
Cobalt	10.4	3.4	6.2 J	5.6 J	9.1	9.8
Copper	17.7	7.2 J	16.2 J	11.1 J	**18.4 ***	17.4
Iron	23100	12400	20200	19900	NR	NR
Lead	26.1	16.2 J	21.9 J	23.6 J	15	14.8
Magnesium	3030	1390	2480	2900	NR	NR
Manganese	1450	178	265	314	1250	924
Mercury	0.036	**0.065 J***	**0.098 J***	**0.12 ***	**0.046 J***	<0.1 U
Nickel	21.1	9.9	14.8 J	14.5 J	**24.1 J***	**22.4 J***
Potassium	927	612	759 J	742 J	NR	NR
Selenium	1.4	0.71 J	0.91 J	0.97 J	1.1	1.1
Silver	0	**0.06 J***	**0.066 J***	**0.092 J***	**0.034 J***	**0.024 J***
Sodium	123	38.4 J	42.7 J	62.7 J	NR	NR
Thallium	0	**0.15 J***	**0.17 J***	**0.16 J***	**0.14 J***	**0.13 J***
Vanadium	31.1	16 J	19.2 J	18.1 J	NR	NR
Zinc	61.8	42.4 J	49.4	49	61.8	54
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.24 U	<0.24 U	<0.24 U	NR	NR
2,6-Dinitrotoluene	None	<0.24 U	<0.24 U	<0.24 U	NR	NR
3-Nitrotoluene	None	<0.24 U	<0.24 U	<0.24 U	NR	NR
4-Amino-2,6-Dinitrotoluene	None	<0.24 U	<0.24 U	<0.24 U	NR	NR
HMX	None	<0.24 U	<0.24 U	<0.24 U	NR	NR
Nitrocellulose	None	NR	NR	NR	NR	NR
Tetryl	None	<0.24 U	<0.24 U	<0.24 U	NR	NR
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	NR	NR	NR	NR
Acenaphthene	None	**0.023 ***	<0.0068 U	<0.0068 U	**0.026 ***	**0.015 ***
Acenaphthylene	None	**0.018 ***	**0.029 ***	**0.018 ***	**0.29 ***	**0.12 ***
Anthracene	None	**0.066 ***	**0.042 ***	**0.025 ***	**0.56 ***	**0.22 ***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-102M**	**ASYss-103M**	**ASYss-103M**	**ASYss-111M**	**ASYss-112M**
Sample ID		**ASYss-102M-5776-SO**	**ASYss-103M-6213-FD**	**ASYss-103M-5777-SO**	**ASYss-111M-5835-SO**	**ASYss-112M-5836-SO**
Date		**04/06/10**	**04/05/10**	**04/05/10**	**04/20/11**	**04/20/11**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **PAHs**	**TAL Metals** **PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Benz(a)anthracene	None	**0.25 ***	**0.19 ***	**0.15 ***	**1.5 ***	**0.66 ***
Benzo(a)pyrene	None	**0.24 ***	**0.17 ***	**0.13 ***	**1.4 ***	**0.72 ***
Benzo(b)fluoranthene	None	**0.38 ***	**0.27 ***	**0.21 ***	**3.2 ***	**1.4 ***
Benzo(ghi)perylene	None	**0.16 ***	**0.11 ***	**0.091 ***	**1 ***	**0.56 ***
Benzo(k)fluoranthene	None	**0.14 ***	**0.14 ***	**0.097 ***	**0.98 ***	**0.59 ***
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Carbazole	None	NR	NR	NR	NR	NR
Chrysene	None	**0.26 ***	**0.21 ***	**0.16 ***	**1.9 ***	**0.93 ***
Di-n-butyl phthalate	None	NR	NR	NR	NR	NR
Dibenz(a,h)anthracene	None	**0.035 ***	**0.036 ***	**0.03 ***	**0.37 ***	**0.19 ***
Dibenzofuran	None	NR	NR	NR	NR	NR
Diethyl phthalate	None	NR	NR	NR	NR	NR
Fluoranthene	None	**0.65 ***	**0.38 ***	**0.3 ***	**1.8 ***	**0.91 ***
Fluorene	None	**0.028 ***	**0.014 ***	**0.01 ***	**0.036 ***	**0.019 ***
Indeno(1,2,3-cd)pyrene	None	**0.15 ***	**0.12 ***	**0.09 ***	**0.98 ***	**0.53 ***
Naphthalene	None	**0.027 ***	**0.05 ***	**0.042 ***	**0.11 ***	**0.053 ***
Phenanthrene	None	**0.32 ***	**0.12 ***	**0.1 ***	**0.29 ***	**0.18 ***
Pyrene	None	**0.46 ***	**0.25 ***	**0.2 ***	**1.6 ***	**0.8 ***
Pesticides/PCBs						
PCB-1260	None	NR	NR	NR	NR	NR
Volatile Organic Compounds						
Acetone	None	NR	NR	NR	NR	NR

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location	**Background Criteria[b]**	**ASYss-118M**	**ASYss-119M**	**ASYss-120M**	**ASYss-121M**	**ASYss-122M**
Sample ID		**ASYss-118M-5842-SO**	**ASYss-119M-5843-SO**	**ASYss-120M-5844-SO**	**ASYss-121M-5845-SO**	**ASYss-122M-5846-SO**
Date		**04/21/11**	**04/21/11**	**04/21/11**	**04/21/11**	**04/21/11**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed[a]		**TAL Metals PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**
Analyte (mg/kg)						
Inorganic Chemicals						
Aluminum	17700	16400 J	14000 J	16900 J	19600 J*	16200 J
Antimony	0.96	NR	NR	NR	NR	NR
Arsenic	15.4	NR	NR	NR	NR	NR
Barium	88.4	**194 ***	**127 ***	**187 ***	**235 ***	**157 ***
Beryllium	0.88	**2.3 J***	**1.6 J***	**2 J***	**2.9 J***	**1.9 J***
Cadmium	0	**0.23 ***	**0.15 J***	**0.25 ***	**0.25 ***	**0.2 ***
Calcium	15800	NR	NR	NR	NR	NR
Chromium	17.4	**42.3 ***	**41.5 ***	**25.3 ***	**41.5 ***	**31 ***
Cobalt	10.4	5.8	7.8	7.4	4.3	5.2
Copper	17.7	12.6	15.7	**250 ***	13.7	**27.1 ***
Iron	23100	NR	NR	NR	NR	NR
Lead	26.1	15.9	17.5	**32.9 ***	25.4	23.9
Magnesium	3030	NR	NR	NR	NR	NR
Manganese	1450	**1760 ***	1170	**1950 ***	**2420 ***	**1480 ***
Mercury	0.036	**0.038 J***	0.019 J	**0.046 J***	0.029 J	0.032 J
Nickel	21.1	**26.3 J***	**29.1 J***	21 J	**21.8 J***	20.8 J
Potassium	927	NR	NR	NR	NR	NR
Selenium	1.4	**1.5 ***	1.2	**1.7 ***	**1.9 ***	**1.4 ***
Silver	0	<0.21 UJ	<0.085 UJ	<0.091 UJ	<0.15 UJ	<0.051 UJ
Sodium	123	NR	NR	NR	NR	NR
Thallium	0	**0.2 ***	**0.15 J***	**0.13 J***	**0.28 ***	**0.086 J***
Vanadium	31.1	NR	NR	NR	NR	NR
Zinc	61.8	47.6	48.9	**101 ***	42	49.8
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	NR	NR	NR	NR	NR
2,6-Dinitrotoluene	None	NR	NR	NR	NR	NR
3-Nitrotoluene	None	NR	NR	NR	NR	NR
4-Amino-2,6-Dinitrotoluene	None	NR	NR	NR	NR	NR
HMX	None	NR	NR	NR	NR	NR
Nitrocellulose	None	NR	NR	NR	NR	NR
Tetryl	None	NR	NR	NR	NR	NR
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	NR	NR	NR	NR
Acenaphthene	None	**0.23 J***	**0.15 J***	**0.053 J***	**0.068 J***	**0.18 J***
Acenaphthylene	None	**2.4 J***	**1.3 J***	**0.35 J***	**0.87 J***	**0.26 J***
Anthracene	None	**5.9 J***	**2.1 J***	**0.57 J***	**1.3 J***	**0.89 J***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-118M**	**ASYss-119M**	**ASYss-120M**	**ASYss-121M**	**ASYss-122M**
Sample ID		**ASYss-118M-5842-SO**	**ASYss-119M-5843-SO**	**ASYss-120M-5844-SO**	**ASYss-121M-5845-SO**	**ASYss-122M-5846-SO**
Date		**04/21/11**	**04/21/11**	**04/21/11**	**04/21/11**	**04/21/11**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria[b]**	**TAL Metals PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Benz(a)anthracene	None	**13 J***	**5 J***	**1.8 J***	**3.1 J***	**3.3 J***
Benzo(a)pyrene	None	**14 J***	**5.4 J***	**1.7 J***	**3.1 J***	**3.5 J***
Benzo(b)fluoranthene	None	**26 J***	**10 J***	**3.6 J***	**6.8 J***	**4.7 J***
Benzo(ghi)perylene	None	**9.3 J***	**3.8 J***	**1.3 J***	**2.2 J***	**2.3 J***
Benzo(k)fluoranthene	None	**9.3 J***	**4.5 J***	**1.4 J***	**2.2 J***	**3.1 J***
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Carbazole	None	NR	NR	NR	NR	NR
Chrysene	None	**19 J***	**7.2 J***	**2.2 J***	**3.7 J***	**3.6 J***
Di-n-butyl phthalate	None	NR	NR	NR	NR	NR
Dibenz(a,h)anthracene	None	**3.3 J***	**1.4 J***	**0.5 J***	**0.7 J***	**0.72 J***
Dibenzofuran	None	NR	NR	NR	NR	NR
Diethyl phthalate	None	NR	NR	NR	NR	NR
Fluoranthene	None	**15 J***	**5.8 J***	**2.8 J***	**3.5 J***	**6.6 J***
Fluorene	None	**0.39 J***	**0.22 J***	**0.079 J***	**0.1 J***	**0.13 J***
Indeno(1,2,3-cd)pyrene	None	**8.7 J***	**3.6 J***	**1.2 J***	**2.2 J***	**2.2 J***
Naphthalene	None	**0.69 J***	**0.42 J***	**0.24 J***	**1.1 J***	**0.4 J***
Phenanthrene	None	**2.3 J***	**1.2 J***	**0.61 J***	**0.9 J***	**1.6 J***
Pyrene	None	**16 J***	**5.7 J***	**2.5 J***	**3.4 J***	**5.2 J***
Pesticides/PCBs						
PCB-1260	None	NR	NR	NR	NR	NR
Volatile Organic Compounds						
Acetone	None	NR	NR	NR	NR	NR

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-123M**	**ASYss-124M**	**ASYss-125M**	**ASYss-125M**	**ASYss-126M**
Sample ID		**ASYss-123M-5847-SO**	**ASYss-124M-5848-SO**	**ASYss-125M-6238-FD**	**ASYss-125M-5849-SO**	**ASYss-126M-6239-FD**
Date		**04/21/11**	**04/21/11**	**04/21/11**	**04/21/11**	**04/21/11**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**	**TAL Metals PAHs**
Analyte (mg/kg)	**Background Criteria**[b]					
Inorganic Chemicals						
Aluminum	17700	**23300 J***	17400 J	11000 J	11200 J	17700 J
Antimony	0.96	NR	NR	NR	NR	NR
Arsenic	15.4	NR	NR	NR	NR	NR
Barium	88.4	**301 ***	**164 ***	**82.9**	**87**	**154 ***
Beryllium	0.88	**3.8 J***	**1.9 J***	**0.66 J**	**0.67 J**	**1.8 J***
Cadmium	0	**0.23 ***	**0.24 ***	**0.23 ***	**0.24 ***	**0.24 ***
Calcium	15800	NR	NR	NR	NR	NR
Chromium	17.4	**25.7 ***	**22.9 ***	17.3	16.6	**20.7 ***
Cobalt	10.4	2	5.9	5.3	6.2	3.1
Copper	17.7	9	12.8	11.8	10.9	8.7
Iron	23100	NR	NR	NR	NR	NR
Lead	26.1	23.8	**26.8 ***	**39.2 ***	**42.7 ***	21.5
Magnesium	3030	NR	NR	NR	NR	NR
Manganese	1450	**3040 ***	**1610 ***	698	948	**1470 ***
Mercury	0.036	0.019 J	**0.046 J***	**0.055 J***	**0.046 J***	**0.038 J***
Nickel	21.1	13 J	15.6 J	11.8 J	11.7 J	11.5 J
Potassium	927	NR	NR	NR	NR	NR
Selenium	1.4	**2 ***	**1.5 ***	0.81	0.81	**1.5 ***
Silver	0	<0.031 UJ	<0.27 UJ	<0.061 UJ	<0.052 UJ	<0.04 UJ
Sodium	123	NR	NR	NR	NR	NR
Thallium	0	<0.21 U	**0.15 J***	**0.14 J***	**0.14 J***	**0.13 J***
Vanadium	31.1	NR	NR	NR	NR	NR
Zinc	61.8	30.4	52	**65 ***	**64.7 ***	58.3
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	NR	NR	NR	NR	NR
2,6-Dinitrotoluene	None	NR	NR	NR	NR	NR
3-Nitrotoluene	None	NR	NR	NR	NR	NR
4-Amino-2,6-Dinitrotoluene	None	NR	NR	NR	NR	NR
HMX	None	NR	NR	NR	NR	NR
Nitrocellulose	None	NR	NR	NR	NR	NR
Tetryl	None	NR	NR	NR	NR	NR
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	NR	NR	NR	NR
Acenaphthene	None	**0.39 J***	**0.14 J***	**0.0078 J***	**0.0071 J***	**8.8 J***
Acenaphthylene	None	**0.13 J***	**0.6 J***	**0.053 J***	**0.04 J***	**1.5 J***
Anthracene	None	**0.88 J***	**2 J***	**0.032 J***	**0.027 J***	**19 J***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		ASYss-123M	ASYss-124M	ASYss-125M	ASYss-125M	ASYss-126M
Sample ID		ASYss-123M-5847-SO	ASYss-124M-5848-SO	ASYss-125M-6238-FD	ASYss-125M-5849-SO	ASYss-126M-6239-FD
Date		04/21/11	04/21/11	04/21/11	04/21/11	04/21/11
Depth (ft)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Parameters Analyzed ^{a}	Background Criteria^{b}	TAL Metals PAHs	TAL Metals PAHs	TAL Metals PAHs	TAL Metals PAHs	TAL Metals PAHs
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Benz(a)anthracene	None	4.4 J*	3.6 J*	0.12 J*	0.11 J*	47 J*
Benzo(a)pyrene	None	4.5 J*	3.1 J*	0.14 J*	0.12 J*	43 J*
Benzo(b)fluoranthene	None	6.3 J*	5.1 J*	0.2 J*	0.2 J*	56 J*
Benzo(ghi)perylene	None	3.2 J*	1.9 J*	0.1 J*	0.093 J*	25 J*
Benzo(k)fluoranthene	None	3.3 J*	2.9 J*	0.14 J*	0.11 J*	26 J*
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Carbazole	None	NR	NR	NR	NR	NR
Chrysene	None	5 J*	4.7 J*	0.17 J*	0.14 J*	45 J*
Di-n-butyl phthalate	None	NR	NR	NR	NR	NR
Dibenz(a,h)anthracene	None	0.88 J*	0.5 J*	0.029 J*	0.024 J*	6.9 J*
Dibenzofuran	None	NR	NR	NR	NR	NR
Diethyl phthalate	None	NR	NR	NR	NR	NR
Fluoranthene	None	9 J*	5.5 J*	0.19 J*	0.17 J*	110 J*
Fluorene	None	0.28 J*	0.22 J*	0.0097 J*	0.0086 J*	7 J*
Indeno(1,2,3-cd)pyrene	None	2.8 J*	1.8 J*	0.099 J*	0.089 J*	23 J*
Naphthalene	None	0.18 J*	0.5 J*	0.069 J*	0.07 J*	<0.69 UJ
Phenanthrene	None	3.3 J*	1.4 J*	0.084 J*	0.08 J*	47 J*
Pyrene	None	7.4 J*	4.5 J*	0.16 J*	0.14 J*	86 J*
Pesticides/PCBs						
PCB-1260	None	NR	NR	NR	NR	NR
Volatile Organic Compounds						
Acetone	None	NR	NR	NR	NR	NR

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location	**Background Criteria**[b]	**ASYss-126M**
Sample ID		**ASYss-126M-5850-SO**
Date		**04/21/11**
Depth (ft)		**0.0 - 1.0**
Parameters Analyzed[a]		**TAL Metals PAHs**
Analyte (mg/kg)		
Inorganic Chemicals		
Aluminum	17700	16100 J
Antimony	0.96	NR
Arsenic	15.4	NR
Barium	88.4	**125 ***
Beryllium	0.88	**1.4 J***
Cadmium	0	**0.26 ***
Calcium	15800	NR
Chromium	17.4	**20.3 ***
Cobalt	10.4	3.4
Copper	17.7	8.7
Iron	23100	NR
Lead	26.1	19
Magnesium	3030	NR
Manganese	1450	1110
Mercury	0.036	**0.041 J***
Nickel	21.1	11.9 J
Potassium	927	NR
Selenium	1.4	1.3
Silver	0	<0.041 UJ
Sodium	123	NR
Thallium	0	**0.13 J***
Vanadium	31.1	NR
Zinc	61.8	**64.8 ***
Explosives/Propellants		
1,3,5-Trinitrobenzene	None	NR
2,6-Dinitrotoluene	None	NR
3-Nitrotoluene	None	NR
4-Amino-2,6-Dinitrotoluene	None	NR
HMX	None	NR
Nitrocellulose	None	NR
Tetryl	None	NR
Semi-volatile Organic Compounds		
2-Methylnaphthalene	None	NR
Acenaphthene	None	**10 J***
Acenaphthylene	None	**1.8 J***
Anthracene	None	**23 J***

Table 5-11. Analytes Detected in PBA08 RI ISM Surface Soil Samples (continued)

Location		**ASYss-126M**
Sample ID		**ASYss-126M-5850-SO**
Date		**04/21/11**
Depth (ft)		**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals PAHs**
Analyte (mg/kg)		
Semi-volatile Organic Compounds, continued		
Benz(a)anthracene	None	**51 J***
Benzo(a)pyrene	None	**50 J***
Benzo(b)fluoranthene	None	**51 J***
Benzo(ghi)perylene	None	**29 J***
Benzo(k)fluoranthene	None	**37 J***
Bis(2-ethylhexyl)phthalate	None	NR
Carbazole	None	NR
Chrysene	None	**49 J***
Di-n-butyl phthalate	None	NR
Dibenz(a,h)anthracene	None	**7.7 J***
Dibenzofuran	None	NR
Diethyl phthalate	None	NR
Fluoranthene	None	**130 J***
Fluorene	None	**8.5 J***
Indeno(1,2,3-cd)pyrene	None	**26 J***
Naphthalene	None	<1.4 UJ
Phenanthrene	None	**53 J***
Pyrene	None	**94 J***
Pesticides/PCBs		
PCB-1260	None	NR
Volatile Organic Compounds		
Acetone	None	NR

[a] Only detected analytes are presented in the table.

[b] Background concentrations are published in the *Phase II Remedial Investigation Report for Winklepeck Burning Grounds* (USACE 2001b).

ft = Feet.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
ID = Identification.
J = estimated value less than reporting limits.
mg/kg = Milligrams per kilogram.
NR = Not reported/not analyzed.
PAH = Polycyclic aromatic hydrocarbon.
PCB = Polychlorinated biphenyl.
RVAAP = Ravenna Army Ammunition Plant.
TAL = Target Analyte List.
U= Non-detectable concentration.
UJ= Non-detectable concentration, reporting limit estimated.
*** = Result exceeds background concentration.**
< = Less than.

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples

Location		**ASYsb-045**	**ASYsb-045**	**ASYsb-046**	**ASYsb-047**	**ASYsb-048**
Sample ID		**ASYsb-045-6221-FD**	**ASYsb-045-5660-SO**	**ASYsb-046-5664-SO**	**ASYsb-047-5668-SO**	**ASYsb-048-6222-FD**
Date		**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria**[b]					
Inorganic Chemicals						
Aluminum	17700	**28700 ***	**20200 ***	**29000 ***	16500	**18700 ***
Antimony	0.96	0.087 J	0.086 J	<0.61 R	0.11 J	0.18 J
Arsenic	15.4	5 J	6.6 J	1.7 J	5.6 J	14.4 J
Barium	88.4	**445 ***	**197 ***	**330 ***	**200 ***	**284 ***
Beryllium	0.88	**3.5 ***	**2.2 ***	**3.9 ***	**2.6 ***	**2.3 ***
Cadmium	0	**0.25 J***	**0.23 J***	**0.026 J***	**0.16 J***	**0.37 ***
Calcium	15800	**165000 J***	**68800 J***	**207000 J***	**69400 J***	**108000 J***
Chromium	17.4	20 *	10.7	11	9.2	10.4
Cobalt	10.4	4	7	0.28 J	3.3	3.4
Copper	17.7	6.3 J	6.1 J	2.2 J	9.5 J	11.1 J
Iron	23100	9390	13600	3580	10600	14000
Lead	26.1	**78.5 J***	21.3 J	2.2 J	21.3 J	**26.9 J***
Magnesium	3030	**20100 J***	**11200 J***	**35100 J***	**9370 J***	**12700 J***
Manganese	1450	**3420 ***	**1670 ***	**3410 ***	**1920 ***	**3200 ***
Mercury	0.036	0.032 J	**0.039 J***	<0.12 U	<0.13 U	<0.13 U
Nickel	21.1	4.2 J	7 J	0.95 J	7.3 J	10 J
Potassium	927	**1870 J***	**955 J***	**1320 J***	**1370 J***	**1390 J***
Selenium	1.4	**3.5 J***	**1.9 J***	**4.2 J***	**2 J***	**2.9 J***
Silver	0	**0.043 J***	**0.037 J***	**0.033 J***	**0.032 J***	**1.4 ***
Sodium	123	**662 ***	**328 ***	**902 ***	**377 ***	**494 ***
Thallium	0	**0.08 J***	**0.15 J***	<0.24 U	<0.26 U	**0.32 ***
Vanadium	31.1	10.1 J	18.7 J	6.6 J	11.1 J	8.8 J
Zinc	61.8	**82.8 ***	**72.9 ***	<4.5 UJ	34.6	**74.6 ***
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.25 U	<0.25 U	<0.24 U	**0.013 J***	<0.25 U
2,4-Dinitrotoluene	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	<0.25 U
2,6-Dinitrotoluene	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	**0.55 J***
3-Nitrotoluene	None	<0.25 U	<0.25 UJ	<0.24 UJ	<0.25 UJ	<0.25 U
4-Amino-2,6-Dinitrotoluene	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	<0.25 U
HMX	None	<0.25 U	<0.25 U	<0.24 U	<0.25 U	<0.25 U
Nitrocellulose	None	NR	NR	**1.2 J***	NR	NR
Nitroglycerin	None	<0.5 U	<0.5 U	<0.48 U	<0.5 U	**0.12 J***
PETN	None	<0.5 U	<0.5 U	<0.48 U	<0.5 U	<0.5 U
Tetryl	None	<0.25 U	<0.25 UJ	<0.24 UJ	<0.25 UJ	<0.25 U

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples (continued)

Location		**ASYsb-045**	**ASYsb-045**	**ASYsb-046**	**ASYsb-047**	**ASYsb-048**
Sample ID		**ASYsb-045-6221-FD**	**ASYsb-045-5660-SO**	**ASYsb-046-5664-SO**	**ASYsb-047-5668-SO**	**ASYsb-048-6222-FD**
Date		**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	NR	**0.032 J***	NR	NR
Acenaphthene	None	<0.0088 U	<0.0088 U	<0.061 U	**0.13 ***	**0.13 ***
Acenaphthylene	None	**0.015 ***	**0.013 ***	**0.0087 J***	**0.33 ***	**0.71 ***
Anthracene	None	**0.018 ***	**0.012 ***	**0.047 J***	**0.81 ***	**1.2 ***
Benz(a)anthracene	None	**0.062 ***	**0.04 ***	**0.2 ***	**2.5 ***	**3.6 ***
Benzo(a)pyrene	None	**0.079 ***	**0.046 ***	**0.28 ***	**2.5 ***	**3.8 ***
Benzo(b) fluoranthene	None	**0.13 ***	**0.092 ***	**0.59 ***	**4.9 ***	**8.5 ***
Benzo(ghi) perylene	None	**0.077 ***	**0.036 ***	**0.28 ***	**2.1 ***	**4.1 ***
Benzo(k) fluoranthene	None	**0.064 ***	**0.035 ***	**0.23 ***	**1.4 ***	**2.3 ***
Bis(2-ethylhexyl) phthalate	None	NR	NR	<0.4 UJ	NR	NR
Chrysene	None	**0.086 ***	**0.063 ***	**0.41 ***	**3.2 ***	**4.9 ***
Di-n-butyl phthalate	None	NR	NR	<0.4 UJ	NR	NR
Dibenz(a,h)anthracene	None	<0.0088 U	<0.0088 U	**0.07 ***	**0.66 ***	**1.3 ***
Fluoranthene	None	**0.12 ***	**0.076 ***	**0.29 ***	**4.6 ***	**4 ***
Fluorene	None	<0.0088 U	<0.0088 U	<0.061 U	**0.11 ***	**0.13 ***
Indeno(1,2,3-cd)pyrene	None	**0.059 ***	**0.032 ***	**0.24 ***	**1.8 ***	**3.2 ***
Naphthalene	None	**0.024 ***	**0.013 ***	**0.026 J***	**0.19 ***	**4.2 ***
Phenanthrene	None	**0.043 ***	**0.026 ***	**0.05 J***	**1.5 ***	**2.1 ***
Pyrene	None	**0.1 ***	**0.06 ***	**0.3 ***	**3.7 ***	**3.7 ***
Volatile Organic Compounds						
Carbon disulfide	None	NR	NR	**0.00099 J***	NR	NR
Toluene	None	NR	NR	<0.0061 U	NR	NR

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples (continued)

Location	**Background Criteria**[b]	**ASYsb-048**	**ASYsb-049**	**ASYsb-050**	**ASYsb-052**	**ASYsb-053**
Sample ID		**ASYsb-048-5672-SO**	**ASYsb-049-5676-SO**	**ASYsb-050-5680-SO**	**ASYsb-052-5688-SO**	**ASYsb-053-5692-SO**
Date		**04/05/10**	**04/05/10**	**04/07/10**	**04/06/10**	**04/07/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**
Analyte (mg/kg)						
Inorganic Chemicals						
Aluminum	17700	17700	**18900 ***	9140	11600	10000
Antimony	0.96	0.15 J	0.073 J	<0.65 UJ	0.13 J	0.11 J
Arsenic	15.4	14 J	5.1 J	5.5 J	13.4	9.8 J
Barium	88.4	**231 ***	**205 ***	64.3	79.4	49.1
Beryllium	0.88	**2.3 ***	**2 ***	0.48	0.56	0.44
Cadmium	0	**0.62 ***	**0.19 J***	**0.095 J***	**0.041 J***	**0.34 ***
Calcium	15800	**91600 J***	**90900 J***	2750	3340 J	1810
Chromium	17.4	9.4	8.4	11.3	15.5 J	13.2
Cobalt	10.4	4.7	3	5.2 J	5.3	5.4 J
Copper	17.7	11.3	6.6 J	5.3	15 J	11.7
Iron	23100	12000	10100	15400	**24700 ***	18800
Lead	26.1	24.7 J	20.7 J	13.3 J	12.7 J	15.7 J
Magnesium	3030	**12300 J***	**12300 J***	1490	1950	1920
Manganese	1450	**2460 ***	**1760 ***	232	106	115
Mercury	0.036	**0.05 J***	0.028 J	0.033 J	0.034 J	0.029 J
Nickel	21.1	10 J	5.8 J	9.8 J	14.4	13 J
Potassium	927	**1150 J***	**1120 J***	714 J	721	491 J
Selenium	1.4	**3.1 J***	**2 J***	0.92	0.79 J	1.2
Silver	0	**1.3 ***	**0.031 J***	**0.057 J***	**0.028 J***	**0.24 J***
Sodium	123	**475 ***	**391 ***	<42.3 UJ	35.7 J	<40.8 UJ
Thallium	0	**0.36 ***	**0.074 J***	**0.15 J***	**0.16 J***	**0.15 J***
Vanadium	31.1	7.4 J	11.6 J	16.3 J	23.3 J	18.2 J
Zinc	61.8	**71.1 ***	32.1	37.2	41.3 J	**90.6 ***
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.25 U	**0.015 J***	<0.25 U	<0.24 U	<0.25 U
2,4-Dinitrotoluene	None	<0.25 U	<0.25 U	<0.25 U	<0.24 U	<0.25 U
2,6-Dinitrotoluene	None	**0.56 J***	<0.25 U	<0.25 U	<0.24 U	<0.25 U
3-Nitrotoluene	None	**0.14 J***	<0.25 U	<0.25 U	<0.24 U	<0.25 U
4-Amino-2,6-Dinitrotoluene	None	<0.25 U	**0.059 J***	<0.25 U	<0.24 U	<0.25 U
HMX	None	<0.25 U	<0.25 U	<0.25 U	<0.24 U	<0.25 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Nitroglycerin	None	<0.5 U	<0.5 U	<0.5 U	<0.47 U	<0.5 U
PETN	None	<0.5 U	<0.5 U	<0.5 U	<0.47 U	<0.5 U
Tetryl	None	**0.051 J***	**0.045 J***	<0.25 U	<0.24 U	<0.25 U

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples (continued)

Location		**ASYsb-048**	**ASYsb-049**	**ASYsb-050**	**ASYsb-052**	**ASYsb-053**
Sample ID		**ASYsb-048-5672-SO**	**ASYsb-049-5676-SO**	**ASYsb-050-5680-SO**	**ASYsb-052-5688-SO**	**ASYsb-053-5692-SO**
Date		**04/05/10**	**04/05/10**	**04/07/10**	**04/06/10**	**04/07/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria[b]**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	NR	NR	NR	NR
Acenaphthene	None	**0.093 ***	**0.022 ***	<0.0087 U	<0.0085 U	<0.0091 U
Acenaphthylene	None	**0.75 ***	**0.065 ***	<0.0087 U	<0.0085 U	<0.0091 U
Anthracene	None	**1.2 ***	**0.079 ***	<0.0087 U	<0.0085 U	<0.0091 U
Benz(a)anthracene	None	**3.5 ***	**0.23 ***	<0.0087 U	**0.031 ***	**0.024 ***
Benzo(a)pyrene	None	**4.5 ***	**0.24 ***	<0.0087 U	**0.034 ***	**0.028 ***
Benzo(b)fluoranthene	None	**8.4 ***	**0.36 ***	<0.0087 U	**0.055 ***	**0.042 ***
Benzo(ghi)perylene	None	**4.3 ***	**0.19 ***	<0.0087 U	**0.019 ***	**0.019 ***
Benzo(k)fluoranthene	None	**3.4 ***	**0.13 ***	<0.0087 U	**0.027 ***	**0.017 ***
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Chrysene	None	**5.7 ***	**0.22 ***	<0.0087 U	**0.036 ***	**0.032 ***
Di-n-butyl phthalate	None	NR	NR	NR	NR	NR
Dibenz(a,h)anthracene	None	**1.2 ***	**0.042 ***	<0.0087 U	<0.0085 U	<0.0091 U
Fluoranthene	None	**4.6 ***	**0.45 ***	**0.0098 ***	**0.049 ***	**0.045 ***
Fluorene	None	**0.13 ***	**0.022 ***	<0.0087 U	<0.0085 U	<0.0091 U
Indeno(1,2,3-cd)pyrene	None	**3.6 ***	**0.17 ***	<0.0087 U	**0.019 ***	**0.018 ***
Naphthalene	None	**3 ***	**0.046 ***	<0.0087 U	<0.0085 U	**0.024 ***
Phenanthrene	None	**2 ***	**0.19 ***	<0.0087 U	**0.018 ***	**0.025 ***
Pyrene	None	**4 ***	**0.34 ***	<0.0087 U	**0.04 ***	**0.037 ***
Volatile Organic Compounds						
Carbon disulfide	None	NR	NR	NR	NR	NR
Toluene	None	NR	NR	NR	NR	NR

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples (continued)

Location		**ASYsb-054**	**ASYsb-056**	**ASYsb-057**	**ASYsb-058**	**ASYsb-059**
Sample ID		**ASYsb-054-5696-SO**	**ASYsb-056-5702-SO**	**ASYsb-057-5706-SO**	**ASYsb-058-5710-SO**	**ASYsb-059-5714-SO**
Date		**04/06/10**	**04/07/10**	**04/07/10**	**04/07/10**	**03/30/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]	**Background Criteria[b]**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Inorganic Chemicals						
Aluminum	17700	8800	17000	14600	10600	**28500 ***
Antimony	0.96	<0.63 UJ	0.25 J	0.091 J	0.087 J	0.27 J
Arsenic	15.4	10.1	4.9 J	8 J	6.8 J	4.4
Barium	88.4	40.2	**161 ***	**110 ***	53	**459 ***
Beryllium	0.88	0.3	**1.7 ***	**1.3 ***	0.47	**5.1 ***
Cadmium	0	**0.12 J***	**0.49 J***	**0.35 ***	**0.14 J***	**0.57 ***
Calcium	15800	2960 J	**49000 ***	**25200 ***	6090	**159000 ***
Chromium	17.4	11.4 J	16.2	11	10.7	11.4
Cobalt	10.4	3.7	4.3 J	**12.9 J***	3.7 J	2.1
Copper	17.7	7.7 J	12.7	6.2	6.6	14.3 J
Iron	23100	**28000 ***	14000	20700	16700	7980
Lead	26.1	13.1 J	**59.3 J***	21.4 J	13 J	**60.1 J***
Magnesium	3030	1360	**8670 ***	**5000 ***	2290	**16800 J***
Manganese	1450	201	1040	**1460 ***	110	**5480 ***
Mercury	0.036	<0.13 U	**4.5 ***	0.036 J	0.023 J	<0.12 U
Nickel	21.1	7.9	8.3 J	8.1 J	9.1 J	4.6 J
Potassium	927	542	**1250 J***	637 J	593 J	**2200 ***
Selenium	1.4	0.54 J	**2 ***	**1.6 ***	0.97	**3.3 ***
Silver	**0**	**0.036 J***	**0.93 J***	<0.048 UJ	**0.054 J***	**0.043 J***
Sodium	123	44.1 J	**280 ***	**167 ***	<79.2 UJ	**820 ***
Thallium	0	**0.14 J***	**0.14 J***	**0.16 J***	**0.15 J***	**0.12 J***
Vanadium	31.1	18.6 J	13.9 J	19.7 J	20.3 J	7.7
Zinc	61.8	**73.9 J***	**250 ***	46.5	37.5	53
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.23 U	<0.24 U	<0.25 U	<0.26 U	<0.25 U
2,4-Dinitrotoluene	None	<0.23 U	**0.022 J***	<0.25 U	<0.26 U	<0.25 U
2,6-Dinitrotoluene	None	<0.23 U	<0.24 U	<0.25 U	<0.26 U	<0.25 U
3-Nitrotoluene	None	<0.23 U	<0.24 U	<0.25 U	<0.26 U	<0.25 U
4-Amino-2,6-Dinitrotoluene	None	<0.23 U	<0.24 U	<0.25 U	<0.26 U	<0.25 U
HMX	None	<0.23 U	<0.24 U	<0.25 U	<0.26 U	<0.25 U
Nitrocellulose	None	<6.3 U	NR	NR	NR	NR
Nitroglycerin	None	<0.46 U	<0.48 U	<0.5 U	<0.52 U	<0.5 U
PETN	None	<0.46 U	<0.48 U	<0.5 U	<0.52 U	**0.065 J***
Tetryl	None	<0.23 U	<0.24 U	<0.25 U	<0.26 U	<0.25 U

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples (continued)

Location		**ASYsb-054**	**ASYsb-056**	**ASYsb-057**	**ASYsb-058**	**ASYsb-059**
Sample ID		**ASYsb-054-5696-SO**	**ASYsb-056-5702-SO**	**ASYsb-057-5706-SO**	**ASYsb-058-5710-SO**	**ASYsb-059-5714-SO**
Date		**04/06/10**	**04/07/10**	**04/07/10**	**04/07/10**	**03/30/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed ^{a}		**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria**^{b}					
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	<0.41 U	NR	NR	NR	NR
Acenaphthene	None	<0.063 U	<0.017 U	<0.0087 UJ	<0.0087 U	**0.034 ***
Acenaphthylene	None	<0.063 U	<0.017 U	<0.0087 UJ	<0.0087 U	**0.088 ***
Anthracene	None	<0.063 U	**0.019 ***	<0.0087 UJ	<0.0087 U	**0.22 ***
Benz(a)anthracene	None	**0.033 J***	**0.084 ***	**0.034 J***	**0.011 ***	**0.95 ***
Benzo(a)pyrene	None	**0.038 J***	**0.11 ***	**0.036 J***	<0.0087 U	**0.87 ***
Benzo(b)fluoranthene	None	**0.053 J***	**0.14 ***	**0.055 J***	**0.016 ***	**1.3 ***
Benzo(ghi)perylene	None	**0.019 J***	**0.083 ***	**0.028 J***	<0.0087 U	**0.54 ***
Benzo(k)fluoranthene	None	**0.025 J***	**0.04 ***	**0.02 J***	<0.0087 U	**0.69 ***
Bis(2-ethylhexyl)phthalate	None	**0.028 J***	NR	NR	NR	NR
Chrysene	None	**0.03 J***	**0.096 ***	**0.039 J***	<0.0087 U	**0.99 ***
Di-n-butyl phthalate	None	**0.026 J***	NR	NR	NR	NR
Dibenz(a,h)anthracene	None	<0.063 U	**0.021 ***	<0.0087 UJ	<0.0087 U	<0.016 U
Fluoranthene	None	**0.037 J***	**0.14 ***	**0.056 J***	**0.016 ***	**2.2 ***
Fluorene	None	<0.063 U	<0.017 U	<0.0087 UJ	<0.0087 U	**0.043 ***
Indeno(1,2,3-cd)pyrene	None	**0.018 J***	**0.078 ***	**0.022 J***	<0.0087 U	**0.48 ***
Naphthalene	None	<0.063 U	**0.02 ***	<0.0087 UJ	<0.0087 U	**0.34 ***
Phenanthrene	None	<0.063 U	**0.043 ***	**0.02 J***	<0.0087 U	**0.91 ***
Pyrene	None	**0.033 J***	**0.12 ***	**0.042 J***	**0.014 ***	**1.4 ***
Volatile Organic Compounds						
Carbon disulfide	None	<0.0063 U	NR	NR	NR	NR
Toluene	None	<0.0063 U	NR	NR	NR	NR

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples (continued)

Location		**ASYsb-060**	**ASYsb-061**	**ASYsb-062**	**ASYsb-063**	**ASYsb-064**
Sample ID		**ASYsb-060-5718-SO**	**ASYsb-061-5722-SO**	**ASYsb-062-5726-SO**	**ASYsb-063-5730-SO**	**ASYsb-064-5734-SO**
Date		**03/30/10**	**03/30/10**	**03/30/10**	**04/07/10**	**03/30/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria[b]**					
Inorganic Chemicals						
Aluminum	17700	12000	13900	9900	11600	**18100 ***
Antimony	0.96	<0.69 UJ	0.12 J	0.14 J	0.1 J	**6.1 J***
Arsenic	15.4	6.7	12.5	10.8	13.5 J	9.7
Barium	88.4	40.8	72.4	68.5	**105 ***	**1820 ***
Beryllium	0.88	0.3	0.6	0.51	**0.95 ***	**1.1 ***
Cadmium	0	**0.039 J***	**0.16 J***	**0.17 J***	**0.34 ***	**3.1 ***
Calcium	15800	1250	2140	3450	2390	**20300 ***
Chromium	17.4	13.6	17.4	10.6	16.4	**62 ***
Cobalt	10.4	3.2	9.6	3.5	**19.4 J***	6.9
Copper	17.7	5.1 J	16.7 J	6.4 J	**22.1 ***	**370 J***
Iron	23100	13500	**27100 ***	10100	**35900 ***	**25300 ***
Lead	26.1	10.2 J	20.5 J	12.9 J	16.9 J	**3570 J***
Magnesium	3030	1740 J	**3080 J***	1320 J	2970	**4350 J***
Manganese	1450	47.1	291	120	367	1180
Mercury	0.036	<0.14 U	0.03 J	0.034 J	<0.14 U	**0.12 J***
Nickel	21.1	10.1 J	20.6 J	8.6 J	**36.5 J***	**39.2 J***
Potassium	927	**1030 ***	**1110 ***	681	**1130 J***	**1680 ***
Selenium	1.4	0.84	1.2	0.99	**2 ***	**2.1 ***
Silver	0	**0.02 J***	**0.049 J***	**0.058 J***	<0.044 UJ	**7.1 ***
Sodium	123	47.4 J	39.5 J	72.4 J	<67.7 UJ	**1090 ***
Thallium	0	**0.15 J***	**0.2 J***	**0.16 J***	**0.16 J***	<3.4 U
Vanadium	31.1	18.4	25	13.7	19 J	17.6
Zinc	61.8	37.9	**64.5 ***	41.3	**121 ***	**1560 ***
Explosives/Propellants						
1,3,5-Trinitrobenzene	None	<0.25 U	<0.24 U	<0.24 U	<0.24 U	<0.23 U
2,4-Dinitrotoluene	None	<0.25 U	<0.24 U	<0.24 U	<0.24 U	<0.23 U
2,6-Dinitrotoluene	None	<0.25 U	<0.24 U	<0.24 U	<0.24 U	<0.23 U
3-Nitrotoluene	None	**0.17 J***	<0.24 U	**0.017 J***	<0.24 U	<0.23 U
4-Amino-2,6-Dinitrotoluene	None	<0.25 U	<0.24 U	<0.24 U	<0.24 U	<0.23 U
HMX	None	<0.25 U	<0.24 U	<0.24 U	**0.016 J***	<0.23 U
Nitrocellulose	None	NR	NR	**1.6 J***	NR	NR
Nitroglycerin	None	<0.5 U	<0.49 U	<0.48 U	<0.48 U	<0.46 U
PETN	None	<0.5 U	<0.49 U	<0.48 U	<0.48 U	<0.46 U
Tetryl	None	<0.25 U	<0.24 U	<0.24 U	**0.013 J***	<0.23 U

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples (continued)

Location		**ASYsb-060**	**ASYsb-061**	**ASYsb-062**	**ASYsb-063**	**ASYsb-064**
Sample ID		**ASYsb-060-5718-SO**	**ASYsb-061-5722-SO**	**ASYsb-062-5726-SO**	**ASYsb-063-5730-SO**	**ASYsb-064-5734-SO**
Date		**03/30/10**	**03/30/10**	**03/30/10**	**04/07/10**	**03/30/10**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Parameters Analyzed[a] **Analyte (mg/kg)**	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Semi-volatile Organic Compounds						
2-Methylnaphthalene	None	NR	NR	**0.05 J***	NR	NR
Acenaphthene	None	<0.0092 U	<0.0094 U	<0.061 U	**0.0096 ***	<0.011 U
Acenaphthylene	None	<0.0092 U	<0.0094 U	**0.039 J***	**0.023 ***	<0.011 U
Anthracene	None	<0.0092 U	<0.0094 U	**0.032 J***	**0.046 ***	<0.011 U
Benz(a)anthracene	None	<0.0092 U	<0.0094 U	**0.11 ***	**0.24 ***	<0.011 U
Benzo(a)pyrene	None	<0.0092 U	<0.0094 U	**0.11 ***	**0.27 ***	**0.019 ***
Benzo(b)fluoranthene	None	**0.026 ***	<0.0094 U	**0.2 ***	**0.44 ***	**0.052 ***
Benzo(ghi)perylene	None	<0.0092 U	<0.0094 U	**0.075 ***	**0.2 ***	<0.011 U
Benzo(k)fluoranthene	None	<0.0092 U	<0.0094 U	**0.082 ***	**0.14 ***	<0.011 U
Bis(2-ethylhexyl)phthalate	None	NR	NR	<0.41 U	NR	NR
Chrysene	None	<0.0092 U	<0.0094 U	**0.12 ***	**0.28 ***	**0.037 ***
Di-n-butyl phthalate	None	NR	NR	<0.41 U	NR	NR
Dibenz(a,h)anthracene	None	<0.0092 U	<0.0094 U	<0.061 U	**0.046 ***	<0.011 U
Fluoranthene	None	**0.01 ***	**0.014 ***	**0.24 ***	**0.51 ***	**0.037 ***
Fluorene	None	<0.0092 U	<0.0094 U	**0.012 J***	**0.012 ***	<0.011 U
Indeno(1,2,3-cd)pyrene	None	<0.0092 U	<0.0094 U	**0.067 ***	**0.18 ***	<0.011 U
Naphthalene	None	<0.0092 U	<0.0094 U	**0.039 J***	**0.011 ***	**0.018 ***
Phenanthrene	None	<0.0092 U	<0.0094 U	**0.14 ***	**0.14 ***	**0.032 ***
Pyrene	None	<0.0092 U	**0.011 ***	**0.18 ***	**0.42 ***	**0.023 ***
Volatile Organic Compounds						
Carbon disulfide	None	NR	NR	**0.00087 J***	NR	NR
Toluene	None	NR	NR	**0.00065 J***	NR	NR

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples (continued)

Location		**ASYsb-065**
Sample ID		**ASYsb-065-5738-SO**
Date		**04/07/10**
Depth (ft)		**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals** **Explosives** **PAHs**
Analyte (mg/kg)	**Background Criteria**[b]	
Inorganic Chemicals		
Aluminum	17700	**17800 ***
Antimony	0.96	<0.87 UJ
Arsenic	15.4	5.9 J
Barium	88.4	**148 ***
Beryllium	0.88	**1.2 ***
Cadmium	0	**0.69 ***
Calcium	15800	3400
Chromium	17.4	**17.7 ***
Cobalt	10.4	5.3 J
Copper	17.7	15.5
Iron	23100	12200
Lead	26.1	**37.4 J***
Magnesium	3030	1410
Manganese	1450	297
Mercury	0.036	**0.14 J***
Nickel	21.1	15.1 J
Potassium	927	**1260 J***
Selenium	1.4	**2.2 ***
Silver	0	**0.14 J***
Sodium	123	<54.8 UJ
Thallium	0	**0.3 J***
Vanadium	31.1	14.6 J
Zinc	61.8	**108 ***
Explosives/Propellants		
1,3,5-Trinitrobenzene	None	<0.26 U
2,4-Dinitrotoluene	None	<0.26 U
2,6-Dinitrotoluene	None	<0.26 U
3-Nitrotoluene	None	<0.26 U
4-Amino-2,6-Dinitrotoluene	None	<0.26 U
HMX	None	<0.26 U
Nitrocellulose	None	NR
Nitroglycerin	None	<0.52 U
PETN	None	<0.52 U
Tetryl	None	<0.26 U

Table 5-12. Analytes Detected in PBA08 RI Discrete Surface Soil Samples (continued)

Location		**ASYsb-065**
Sample ID		**ASYsb-065-5738-SO**
Date		**04/07/10**
Depth (ft)		**0.0 - 1.0**
Parameters Analyzed [a]		**TAL Metals** **Explosives** **PAHs**
Analyte (mg/kg)	**Background Criteria**[b]	
Semi-volatile Organic Compounds		
2-Methylnaphthalene	None	NR
Acenaphthene	None	<0.012 U
Acenaphthylene	None	<0.012 U
Anthracene	None	**0.013 ***
Benz(a)anthracene	None	**0.065 ***
Benzo(a)pyrene	None	**0.073 ***
Benzo(b)fluoranthene	None	**0.12 ***
Benzo(ghi)perylene	None	**0.046 ***
Benzo(k)fluoranthene	None	**0.043 ***
Bis(2-ethylhexyl)phthalate	None	NR
Chrysene	None	**0.081 ***
Di-n-butyl phthalate	None	NR
Dibenz(a,h)anthracene	None	<0.012 U
Fluoranthene	None	**0.15 ***
Fluorene	None	<0.012 U
Indeno(1,2,3-cd)pyrene	None	**0.045 ***
Naphthalene	None	<0.012 U
Phenanthrene	None	**0.054 ***
Pyrene	None	**0.12 ***
Volatile Organic Compounds		
Carbon disulfide	None	NR
Toluene	None	NR

[a] Only detected analytes are presented in the table.
[b] Background concentrations are published in the *Phase II Remedial Investigation Report for Winklepeck Burning Grounds* (USACE 2001b).
ft = Feet.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
ID = Identification.
J = Estimated value less than reporting limits.
mg/kg = Milligrams per kilogram.
NR = Not reported/not analyzed.
PAH = Polycyclic Aromatic Hydrocarbon.
PCB = Polychlorinated Biphenyl.
PETN = Pentaerythritol Tetranitrate.
TAL = Target Analyte List.
R = Rejected.
RVAAP = Ravenna Army Ammunition Plant.
U= Non-detectable concentration.
UJ = Non-detectable concentration, reporting limit estimated.
*** = Result exceeds background concentration.**
< = Less than.

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples

Location		**ASYsb-045**	**ASYsb-045**	**ASYsb-045**	**ASYsb-046**	**ASYsb-046**
Sample ID		**ASYsb-045-5661-SO**	**ASYsb-045-5662-SO**	**ASYsb-045-5663-SO**	**ASYsb-046-5665-SO**	**ASYsb-046-5666-SO**
Date		**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**
Depth (ft)		**1.0 - 4.0**	**4.0 - 7.0**	**7.0 - 13.0**	**1.0 - 4.0**	**4.0 - 7.0**
Parameters Analyzed[a]	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**RVAAP Full Suite**
Analyte (mg/kg)						
Inorganic Chemicals						
Aluminum	19500	18600	11600	6570	13100	9960
Antimony	0.96	0.16 J	0.084 J	<0.59 R	0.14 J	0.1 J
Arsenic	19.8	15.9 J	14.3 J	11.4 J	**20.2 J***	15.3 J
Barium	124	60.8	79.8	31.4	105	76.7
Beryllium	0.88	0.65	0.6	0.31	0.76	0.5
Cadmium	0	**0.037 J***	**0.059 J***	**0.04 J***	**0.028 J***	**0.058 J***
Calcium	35500	3010 J	2010 J	13800 J	2010 J	2050 J
Chromium	27.2	21.2	18.2	10.9	19.7	15.7
Cobalt	23.2	8.3	14.9	8	11	19.5
Copper	32.3	22.7 J	21.7 J	15.7 J	16.3 J	24.3 J
Iron	35200	34900	27900	18800	**37800 ***	29700
Lead	19.1	13.6 J	12 J	8.4 J	16.1 J	13.7 J
Magnesium	8790	3380 J	3860 J	3830 J	1670 J	3520 J
Manganese	3030	170	384	272	463	906
Mercury	0.044	<0.13 U	<0.12 U	<0.12 U	0.02 J	<0.12 U
Nickel	60.7	18.9 J	30.4 J	18.7 J	13 J	29.4 J
Potassium	3350	1150 J	1340 J	1110 J	988 J	1140 J
Selenium	1.5	1.1 J	1.2 J	0.67 J	1.1 J	0.97 J
Silver	0	<0.023 UJ	**0.0089 J***	<0.02 UJ	**0.028 J***	**0.017 J***
Sodium	145	<631 U	49.4 J	59.8 J	**198 ***	**167 ***
Thallium	0.91	0.23 J	0.18 J	0.11 J	0.15 J	0.17 J
Vanadium	37.6	33.6 J	18.9 J	11.5 J	28.8 J	17.1 J
Zinc	93.3	59.8	60.5	45.4	48.6	71.4
Explosives/Propellants						
3-Nitrotoluene	None	<0.24 UJ	<0.24 U	<0.25 UJ	<0.24 UJ	<0.24 U
HMX	None	<0.24 U	<0.24 U	<0.25 U	<0.24 U	<0.24 U
Nitrocellulose	None	NR	NR	NR	**2 J***	<5.9 UJ
Semi-volatile Organic Compounds						
Acenaphthene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Acenaphthylene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Anthracene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Benz(a)anthracene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Benzo(a)pyrene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Benzo(b)fluoranthene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Benzo(ghi)perylene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Benzo(k)fluoranthene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-045**	**ASYsb-045**	**ASYsb-045**	**ASYsb-046**	**ASYsb-046**
Sample ID		**ASYsb-045-5661-SO**	**ASYsb-045-5662-SO**	**ASYsb-045-5663-SO**	**ASYsb-046-5665-SO**	**ASYsb-046-5666-SO**
Date		**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**
Depth (ft)		**1.0 - 4.0**	**4.0 - 7.0**	**7.0 - 13.0**	**1.0 - 4.0**	**4.0 - 7.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**RVAAP Full Suite**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	**0.036 J***	<0.39 U
Chrysene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Dibenz(a,h)anthracene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Fluoranthene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Fluorene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Indeno(1,2,3-cd)pyrene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Naphthalene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.052 UJ
Phenanthrene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Pyrene	None	<0.0084 U	<0.0079 U	<0.0078 U	<0.065 U	<0.059 U
Volatile Organic Compounds						
2-Butanone	None	NR	NR	NR	**0.0098 J***	<0.024 U
Carbon disulfide	None	NR	NR	NR	<0.0065 U	<0.0059 U
Toluene	None	NR	NR	NR	<0.0065 U	<0.0059 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location	**Background Criteria**[b]	**ASYsb-047**	**ASYsb-047**	**ASYsb-047**	**ASYsb-048**	**ASYsb-048**
Sample ID		**ASYsb-047-5669-SO**	**ASYsb-047-6223-FD**	**ASYsb-047-5670-SO**	**ASYsb-048-5673-SO**	**ASYsb-048-5674-SO**
Date		**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**
Depth (ft)		**1.0 - 4.0**	**4.0 - 7.0**	**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**
Parameters Analyzed[a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Inorganic Chemicals						
Aluminum	19500	14400	12100	9050	14400	10200
Antimony	0.96	0.092 J	0.083 J	<0.58 UJ	<0.62 R	0.081 J
Arsenic	19.8	13.9 J	14.3 J	9.3 J	9.8 J	14.9 J
Barium	124	62.3	88.5	57	117	71.1
Beryllium	0.88	0.58 J	0.75	0.46	**1.1 ***	0.51
Cadmium	0	**0.027 J***	**0.056 J***	**0.046 J***	**0.043 J***	**0.057 J***
Calcium	35500	2080 J	12600 J	5750 J	34400 J	4890 J
Chromium	27.2	17.8	20.2	14	16.1	17
Cobalt	23.2	9.5	10.9	8.6	4.8	12.7
Copper	32.3	15.3 J	22.2 J	14.9 J	8.2	20.7 J
Iron	35200	24800	28600	19600	19000	27400
Lead	19.1	12.6 J	11.2 J	8.7 J	11.7 J	11.6 J
Magnesium	8790	2930 J	4920 J	3790 J	6320 J	4380 J
Manganese	3030	171	350	280	1010	469
Mercury	0.044	<0.12 U	<0.12 U	<0.12 U	<0.12 U	<0.12 U
Nickel	60.7	18.9 J	32.8 J	24.6 J	10.7 J	31.6 J
Potassium	3350	1220 J	1860 J	1250 J	987 J	1230 J
Selenium	1.5	0.96 J	1.2 J	0.86 J	**1.6 J***	0.98 J
Silver	0	**0.024 J***	**0.031 J***	**0.023 J***	**0.032 J***	**0.019 J***
Sodium	145	49.9 J	61.7 J	91.7 J	**191 ***	51 J
Thallium	0.91	0.17 J	0.17 J	0.14 J	0.14 J	0.16 J
Vanadium	37.6	24.1 J	20.9 J	15.1 J	18.9 J	17.9 J
Zinc	93.3	54.7	59.4	44.3	33.2	54.7
Explosives/Propellants						
3-Nitrotoluene	None	<0.25 UJ	<0.24 U	<0.25 U	<0.24 U	<0.25 U
HMX	None	<0.25 U	<0.24 U	<0.25 U	<0.24 U	<0.25 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Semi-volatile Organic Compounds						
Acenaphthene	None	<0.008 UJ	<0.0077 U	<0.0078 U	<0.0082 U	<0.0079 U
Acenaphthylene	None	<0.008 UJ	<0.0077 U	<0.0078 U	<0.0082 U	<0.0079 U
Anthracene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.013 ***	<0.0079 U
Benz(a)anthracene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.043 ***	<0.0079 U
Benzo(a)pyrene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.04 ***	<0.0079 U
Benzo(b)fluoranthene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.076 ***	<0.0079 U
Benzo(ghi)perylene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.037 ***	<0.0079 U
Benzo(k)fluoranthene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.024 ***	<0.0079 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-047**	**ASYsb-047**	**ASYsb-047**	**ASYsb-048**	**ASYsb-048**
Sample ID		**ASYsb-047-5669-SO**	**ASYsb-047-6223-FD**	**ASYsb-047-5670-SO**	**ASYsb-048-5673-SO**	**ASYsb-048-5674-SO**
Date		**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**	**04/05/10**
Depth (ft)		**1.0 - 4.0**	**4.0 - 7.0**	**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria[b]**					
Semi-volatile Organic Compounds, continued						
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Chrysene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.054 ***	<0.0079 U
Dibenz(a,h)anthracene	None	<0.008 UJ	<0.0077 U	<0.0078 U	<0.0082 U	<0.0079 U
Fluoranthene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.043 ***	<0.0079 U
Fluorene	None	<0.008 UJ	<0.0077 U	<0.0078 U	<0.0082 U	<0.0079 U
Indeno(1,2,3-cd)pyrene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.027 ***	<0.0079 U
Naphthalene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.11 ***	<0.0079 U
Phenanthrene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.076 ***	<0.0079 U
Pyrene	None	<0.008 UJ	<0.0077 U	<0.0078 U	**0.045 ***	<0.0079 U
Volatile Organic Compounds						
2-Butanone	None	NR	NR	NR	NR	NR
Carbon disulfide	None	NR	NR	NR	NR	NR
Toluene	None	NR	NR	NR	NR	NR

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-049**	**ASYsb-049**	**ASYsb-049**	**ASYsb-049**	**ASYsb-050**
Sample ID		**ASYsb-049-5677-SO**	**ASYsb-049-5678-SO**	**ASYsb-049-5679-SO**	**ASYsb-049-5686-SO**	**ASYsb-050-5681-SO**
Date		**04/05/10**	**04/05/10**	**04/05/10**	**04/06/10**	**04/07/10**
Depth (ft)		**1.0 - 4.0**	**4.0 - 7.0**	**7.0 - 13.0**	**8.0 - 9.5**	**1.0 - 4.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria**[b]					
Inorganic Chemicals						
Aluminum	19500	17200	11700	7860	NR	12300
Antimony	0.96	0.078 J	0.075 J	<0.59 R	NR	<0.62 UJ
Arsenic	19.8	9.8 J	13 J	13.7 J	NR	10.6 J
Barium	124	85.2	69.2	30.7	NR	73.3
Beryllium	0.88	0.71	0.59	0.37	NR	0.56
Cadmium	0	**0.07 J***	**0.059 J***	**0.038 J***	NR	**0.044 J***
Calcium	35500	4640 J	12300 J	6920 J	NR	1500
Chromium	27.2	21.2	18.8	13.1	NR	16.9
Cobalt	23.2	8.9	11.8	9.9	NR	15.3 J
Copper	32.3	18.8 J	19.6 J	18.3 J	NR	14
Iron	35200	27900	28100	23300	NR	27700
Lead	19.1	11.4 J	10.9 J	10.6 J	NR	13 J
Magnesium	8790	3660 J	5160 J	4630 J	NR	2600
Manganese	3030	201	320	271	NR	421
Mercury	0.044	0.021 J	<0.12 U	<0.12 U	NR	<0.12 U
Nickel	60.7	26.4 J	29.9 J	23.9 J	NR	20.3 J
Potassium	3350	1430 J	1740 J	1390 J	NR	1080 J
Selenium	1.5	1.3 J	1 J	0.75 J	NR	1.1
Silver	0	**0.04 J***	**0.024 J***	<0.021 UJ	NR	<0.026 UJ
Sodium	145	<620 U	72.3 J	69 J	NR	<51.4 UJ
Thallium	0.91	0.17 J	0.16 J	0.12 J	NR	0.19 J
Vanadium	37.6	25.6 J	20 J	13.9 J	NR	19.8 J
Zinc	93.3	67.6	58.1	50.5	NR	48.3
Explosives/Propellants						
3-Nitrotoluene	None	<0.24 U	<0.24 U	<0.24 U	NR	<0.25 U
HMX	None	<0.24 U	<0.24 U	<0.24 U	NR	<0.25 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Semi-volatile Organic Compounds						
Acenaphthene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Acenaphthylene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Anthracene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Benz(a)anthracene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Benzo(a)pyrene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Benzo(b)fluoranthene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Benzo(ghi)perylene	None	<0.0083 U	<0.0078 U	**0.0097 ***	<0.059 U	<0.0083 U
Benzo(k)fluoranthene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-049**	**ASYsb-049**	**ASYsb-049**	**ASYsb-049**	**ASYsb-050**
Sample ID		**ASYsb-049-5677-SO**	**ASYsb-049-5678-SO**	**ASYsb-049-5679-SO**	**ASYsb-049-5686-SO**	**ASYsb-050-5681-SO**
Date		**04/05/10**	**04/05/10**	**04/05/10**	**04/06/10**	**04/07/10**
Depth (ft)		**1.0 - 4.0**	**4.0 - 7.0**	**7.0 - 13.0**	**8.0 - 9.5**	**1.0 - 4.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	<0.39 U	NR
Chrysene	None	<0.0083 U	<0.0078 U	**0.012 ***	<0.059 U	<0.0083 U
Dibenz(a,h)anthracene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Fluoranthene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Fluorene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Indeno(1,2,3-cd)pyrene	None	<0.0083 U	<0.0078 U	<0.0079 U	<0.059 U	<0.0083 U
Naphthalene	None	<0.0083 U	<0.0078 U	**0.039 ***	<0.059 U	<0.0083 U
Phenanthrene	None	<0.0083 U	<0.0078 U	**0.014 ***	<0.059 U	<0.0083 U
Pyrene	None	<0.0083 U	<0.0078 U	**0.0082 ***	<0.059 U	<0.0083 U
Volatile Organic Compounds						
2-Butanone	None	NR	NR	NR	<0.024 U	NR
Carbon disulfide	None	NR	NR	NR	**0.00062 J***	NR
Toluene	None	NR	NR	NR	<0.0059 U	NR

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-050**	**ASYsb-052**	**ASYsb-052**	**ASYsb-053**	**ASYsb-053**
Sample ID		**ASYsb-050-5682-SO**	**ASYsb-052-5689-SO**	**ASYsb-052-5690-SO**	**ASYsb-053-5693-SO**	**ASYsb-053-5694-SO**
Date		**04/07/10**	**04/06/10**	**04/06/10**	**04/07/10**	**04/07/10**
Depth (ft)		**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria** [b]					
Inorganic Chemicals						
Aluminum	19500	13400 J	14600	10300 J	11500	11900 J
Antimony	0.96	0.093 J	0.12 J	0.091 J	<0.63 UJ	<0.61 UJ
Arsenic	19.8	16.7 J	16.4	14 J	13.8 J	16.6 J
Barium	124	97.2	70.4	80.5	54.5	59.5
Beryllium	0.88	0.77	0.85	0.55 J	0.63	0.61
Cadmium	0	**0.11 J***	**0.057 J***	**0.076 J***	**0.066 J***	**0.058 J***
Calcium	35500	25900	1290 J	7590	720	2710
Chromium	27.2	20.1	19.1 J	17	15.7	18.5
Cobalt	23.2	21 J	**31.5 ***	11.6	15.9 J	12.9 J
Copper	32.3	19.9	20.3 J	20.2 J	18.3	21.2
Iron	35200	33200	33600	29300	28300	33200
Lead	19.1	13.6 J	14.7 J	11.7	11.2 J	12.8 J
Magnesium	8790	6310	2920	4730	3120	4640
Manganese	3030	698	330	411	347	369
Mercury	0.044	<0.12 U	0.022 J	<0.12 U	<0.13 U	<0.12 U
Nickel	60.7	37.4	23.7	30.4 J	22.3 J	31.5
Potassium	3350	2270 J	1340	1540	716 J	1190 J
Selenium	1.5	1.1	0.79 J	1.2 J	1.4	1.3
Silver	0	**0.03 J***	**0.027 J***	**0.021 J***	<0.015 UJ	<0.02 UJ
Sodium	145	92.1 J	57.2 J	73 J	<37.3 UJ	<59.3 UJ
Thallium	0.91	0.25	0.2 J	0.18 J	0.17 J	0.19 J
Vanadium	37.6	22.5 J	24.9 J	18.4	17.9 J	18.3 J
Zinc	93.3	64.1	57.7 J	60.8	50.1	60.9
Explosives/Propellants						
3-Nitrotoluene	None	<0.26 U	<0.25 U	<0.25 U	<0.25 U	<0.24 U
HMX	None	<0.26 U	<0.25 U	<0.25 U	<0.25 U	<0.24 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Semi-volatile Organic Compounds						
Acenaphthene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Acenaphthylene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Anthracene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Benz(a)anthracene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Benzo(a)pyrene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Benzo(b)fluoranthene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Benzo(ghi)perylene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Benzo(k)fluoranthene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-050**	**ASYsb-052**	**ASYsb-052**	**ASYsb-053**	**ASYsb-053**
Sample ID		**ASYsb-050-5682-SO**	**ASYsb-052-5689-SO**	**ASYsb-052-5690-SO**	**ASYsb-053-5693-SO**	**ASYsb-053-5694-SO**
Date		**04/07/10**	**04/06/10**	**04/06/10**	**04/07/10**	**04/07/10**
Depth (ft)		**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**	**TAL Metals** **Explosives** **PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Chrysene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Dibenz(a,h)anthracene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Fluoranthene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Fluorene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Indeno(1,2,3-cd)pyrene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Naphthalene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Phenanthrene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Pyrene	None	<0.008 U	<0.0085 U	<0.0079 U	<0.0084 U	<0.0081 U
Volatile Organic Compounds						
2-Butanone	None	NR	NR	NR	NR	NR
Carbon disulfide	None	NR	NR	NR	NR	NR
Toluene	None	NR	NR	NR	NR	NR

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-054**	**ASYsb-054**	**ASYsb-056**	**ASYsb-056**	**ASYsb-057**
Sample ID		**ASYsb-054-5697-SO**	**ASYsb-054-5698-SO**	**ASYsb-056-5703-SO**	**ASYsb-056-5704-SO**	**ASYsb-057-5707-SO**
Date		**04/06/10**	**04/06/10**	**04/07/10**	**04/07/10**	**04/07/10**
Depth (ft)		**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**
Parameters Analyzed [a]		**RVAAP Full Suite**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria[b]**					
Inorganic Chemicals						
Aluminum	19500	13100	10300 J	12300	12200 J	14000
Antimony	0.96	0.098 J	0.077 J	<0.61 UJ	0.077 J	0.1 J
Arsenic	19.8	16.3	13.4 J	7.1 J	13.5 J	**20.8 J***
Barium	124	68.4	52.6	86.6	59.9	100
Beryllium	0.88	0.72	0.51 J	0.64	0.63	**0.96 ***
Cadmium	0	**0.048 J***	**0.05 J***	**0.1 J***	**0.051 J***	**0.083 J***
Calcium	35500	1350 J	12900	3010	10400	1540
Chromium	27.2	17.6 J	16.6	17.5	17.5	18.6
Cobalt	23.2	12.1	11.3	12.9 J	12 J	22.6 J
Copper	32.3	18.3 J	18.9 J	15.6	19.2	22.3
Iron	35200	32400	28800	26800	29600	**40000 ***
Lead	19.1	14.7 J	11	12.6 J	11.8 J	14.8 J
Magnesium	8790	3050	5550	3560	6220	3650
Manganese	3030	302	376	456	337	401
Mercury	0.044	<0.12 U	<0.12 U	0.023 J	<0.12 U	<0.12 U
Nickel	60.7	23.4	27.3 J	26 J	28.2	31.9 J
Potassium	3350	1100	1810	1140 J	1820 J	1080 J
Selenium	1.5	0.79 J	1.2 J	1.3	1.2	**1.7 ***
Silver	0	**0.02 J***	**0.023 J***	<0.033 UJ	<0.026 UJ	<0.019 UJ
Sodium	145	53.5 J	74.4 J	<70.5 UJ	87.1 J	<47.3 UJ
Thallium	0.91	0.18 J	0.2 J	0.16 J	0.18 J	0.19 J
Vanadium	37.6	23.4 J	17.3	18.7 J	18.7 J	21 J
Zinc	93.3	51.7 J	56.1	63.3	62	63.2
Explosives/Propellants						
3-Nitrotoluene	None	<0.24 U	<0.24 U	<0.25 U	<0.24 U	<0.25 U
HMX	None	<0.24 U	<0.24 U	<0.25 U	<0.24 U	<0.25 U
Nitrocellulose	None	<6.1 U	<5.8 U	NR	NR	NR
Semi-volatile Organic Compounds						
Acenaphthene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Acenaphthylene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Anthracene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Benz(a)anthracene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Benzo(a)pyrene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Benzo(b)fluoranthene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Benzo(ghi)perylene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Benzo(k)fluoranthene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-054**	**ASYsb-054**	**ASYsb-056**	**ASYsb-056**	**ASYsb-057**
Sample ID		**ASYsb-054-5697-SO**	**ASYsb-054-5698-SO**	**ASYsb-056-5703-SO**	**ASYsb-056-5704-SO**	**ASYsb-057-5707-SO**
Date		**04/06/10**	**04/06/10**	**04/07/10**	**04/07/10**	**04/07/10**
Depth (ft)		**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**RVAAP Full Suite**	**RVAAP Full Suite**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Bis(2-ethylhexyl)phthalate	None	<0.4 U	<0.38 U	NR	NR	NR
Chrysene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Dibenz(a,h)anthracene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Fluoranthene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Fluorene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Indeno(1,2,3-cd)pyrene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Naphthalene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Phenanthrene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Pyrene	None	<0.061 U	<0.058 U	<0.0082 U	<0.0078 U	<0.008 U
Volatile Organic Compounds						
2-Butanone	None	<0.024 U	<0.023 U	NR	NR	NR
Carbon disulfide	None	<0.0061 U	<0.0058 U	NR	NR	NR
Toluene	None	<0.0061 U	<0.0058 U	NR	NR	NR

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location	**Background Criteria**[b]	**ASYsb-057**	**ASYsb-058**	**ASYsb-058**	**ASYsb-059**	**ASYsb-059**
Sample ID		**ASYsb-057-5708-SO**	**ASYsb-058-5711-SO**	**ASYsb-058-5712-SO**	**ASYsb-059-5715-SO**	**ASYsb-059-6220-FD**
Date		**04/07/10**	**04/07/10**	**04/07/10**	**03/30/10**	**03/30/10**
Depth (ft)		**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Inorganic Chemicals						
Aluminum	19500	13000 J	12200	11100 J	12500	14300
Antimony	0.96	0.079 J	0.094 J	0.081 J	<0.62 UJ	0.1 J
Arsenic	19.8	15.8 J	18 J	19.7 J	**25.2 ***	**23.1 ***
Barium	124	71.1	113	74.6	84.1	77.2
Beryllium	0.88	0.75	0.84	0.59	**1.2 ***	0.79
Cadmium	0	**0.058 J***	**0.32 ***	**0.063 J***	**0.086 J***	**0.077 J***
Calcium	35500	11100	2990	14300	1460	2900
Chromium	27.2	19	17.2	16.7	20.4	19.8
Cobalt	23.2	12 J	16.1 J	14 J	**33.7 ***	10.7
Copper	32.3	20.2	22.2	19.8	9.9 J	21.2 J
Iron	35200	32200	35000	30900	**45400 ***	**36800 ***
Lead	19.1	12.6 J	13.8 J	13.6 J	16.2 J	16.3 J
Magnesium	8790	5580	4340	6170	2450 J	3610 J
Manganese	3030	437	740	383	2010	662
Mercury	0.044	<0.12 U	<0.12 U	<0.12 U	<0.12 U	<0.13 U
Nickel	60.7	32.3	47.4 J	29.4	19.4 J	24.9 J
Potassium	3350	1680 J	1200 J	1580 J	1080	1350
Selenium	1.5	1.3	**1.8 ***	1	1.2	1.5
Silver	0	<0.022 UJ	<0.035 UJ	<0.026 UJ	**0.011 J***	**0.031 J***
Sodium	145	<75.8 UJ	<59.6 UJ	<77.9 UJ	51.5 J	86.2 J
Thallium	0.91	0.2 J	0.18 J	0.18 J	0.17 J	0.19 J
Vanadium	37.6	20.6 J	19.3 J	17.9 J	33.3	24.8
Zinc	93.3	66.9	63.2	59.3	89.4	78.1
Explosives/Propellants						
3-Nitrotoluene	None	<0.24 U	<0.24 U	<0.25 U	<0.25 U	<0.24 U
HMX	None	<0.24 U	<0.24 U	<0.25 U	<0.25 U	<0.24 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Semi-volatile Organic Compounds						
Acenaphthene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Acenaphthylene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Anthracene	None	<0.0079 U	<0.0078 U	**0.011 ***	<0.0083 U	<0.0083 U
Benz(a)anthracene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Benzo(a)pyrene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Benzo(b)fluoranthene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Benzo(ghi)perylene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Benzo(k)fluoranthene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location	**Background Criteria**^{b}	**ASYsb-057**	**ASYsb-058**	**ASYsb-058**	**ASYsb-059**	**ASYsb-059**
Sample ID		**ASYsb-057-5708-SO**	**ASYsb-058-5711-SO**	**ASYsb-058-5712-SO**	**ASYsb-059-5715-SO**	**ASYsb-059-6220-FD**
Date		**04/07/10**	**04/07/10**	**04/07/10**	**03/30/10**	**03/30/10**
Depth (ft)		**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**	**4.0 - 7.0**
Parameters Analyzed ^{a}		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Chrysene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Dibenz(a,h)anthracene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Fluoranthene	None	<0.0079 U	<0.0078 U	**0.019 ***	<0.0083 U	<0.0083 U
Fluorene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Indeno(1,2,3-cd)pyrene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Naphthalene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Phenanthrene	None	<0.0079 U	<0.0078 U	<0.0079 U	<0.0083 U	<0.0083 U
Pyrene	None	<0.0079 U	<0.0078 U	**0.014 ***	<0.0083 U	<0.0083 U
Volatile Organic Compounds						
2-Butanone	None	NR	NR	NR	NR	NR
Carbon disulfide	None	NR	NR	NR	NR	NR
Toluene	None	NR	NR	NR	NR	NR

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-059**	**ASYsb-059**	**ASYsb-060**	**ASYsb-060**	**ASYsb-061**
Sample ID		**ASYsb-059-5716-SO**	**ASYsb-059-5717-SO**	**ASYsb-060-5719-SO**	**ASYsb-060-5720-SO**	**ASYsb-061-5723-SO**
Date		**03/30/10**	**03/30/10**	**03/30/10**	**03/30/10**	**03/30/10**
Depth (ft)		**4.0 - 7.0**	**7.0 - 13.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria**[b]					
			Inorganic Chemicals			
Aluminum	19500	12900 J	8130	12200	11100 J	17000
Antimony	0.96	0.088 J	0.081 J	0.088 J	<0.6 UJ	0.12 J
Arsenic	19.8	14.6	14	11.6	14.3	14.9
Barium	124	75.3	38.6	111	61.2	72.3
Beryllium	0.88	0.67	0.48	0.82	0.64	0.85
Cadmium	0	**0.084 J***	**0.078 J***	**0.042 J***	**0.079 J***	**0.088 J***
Calcium	35500	1580 J	16700	1390	8750 J	769
Chromium	27.2	18.9 J	12.9	18.3	17.6 J	22.1
Cobalt	23.2	11 J	8.9	8.6	12.3 J	12.4
Copper	32.3	18.8	19.3 J	20.2 J	17.9	19.1 J
Iron	35200	29600	23600	28300	28900	30600
Lead	19.1	9.5	11.6 J	12 J	11.2	13.5 J
Magnesium	8790	3670 J	6320 J	4010 J	5370 J	3860 J
Manganese	3030	354	355	203	566	304
Mercury	0.044	<0.12 U	<0.12 U	<0.12 U	<0.12 U	<0.13 U
Nickel	60.7	28.6 J	21.1 J	30.3 J	29.5 J	25.7 J
Potassium	3350	1910 J	1470	1420	1940 J	1790
Selenium	1.5	1.3 J	1	1.5	1.1 J	1.4
Silver	0	<0.023 UJ	**0.025 J***	**0.02 J***	<0.021 UJ	**0.031 J***
Sodium	145	93.8 J	130	84.8 J	81.3 J	55.2 J
Thallium	0.91	0.19 J	0.15 J	0.18 J	0.18 J	0.25 J
Vanadium	37.6	21.2	14.6	22.5	18.5	29.5
Zinc	93.3	71.3	62.6	62.3	57.9	65
			Explosives/Propellants			
3-Nitrotoluene	None	<0.24 U	<0.23 U	<0.24 U	<0.24 U	**0.021 J***
HMX	None	<0.24 U	<0.23 U	<0.24 U	<0.24 U	<0.24 U
Nitrocellulose	None	NR	NR	NR	NR	NR
			Semi-volatile Organic Compounds			
Acenaphthene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Acenaphthylene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Anthracene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Benz(a)anthracene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Benzo(a)pyrene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Benzo(b)fluoranthene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Benzo(ghi)perylene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Benzo(k)fluoranthene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-059**	**ASYsb-059**	**ASYsb-060**	**ASYsb-060**	**ASYsb-061**
Sample ID		**ASYsb-059-5716-SO**	**ASYsb-059-5717-SO**	**ASYsb-060-5719-SO**	**ASYsb-060-5720-SO**	**ASYsb-061-5723-SO**
Date		**03/30/10**	**03/30/10**	**03/30/10**	**03/30/10**	**03/30/10**
Depth (ft)		**4.0 - 7.0**	**7.0 - 13.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Chrysene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Dibenz(a,h)anthracene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Fluoranthene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Fluorene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Indeno(1,2,3-cd)pyrene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Naphthalene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Phenanthrene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Pyrene	None	<0.0083 U	<0.008 U	<0.0081 U	<0.008 U	<0.0086 U
Volatile Organic Compounds						
2-Butanone	None	NR	NR	NR	NR	NR
Carbon disulfide	None	NR	NR	NR	NR	NR
Toluene	None	NR	NR	NR	NR	NR

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-061**	**ASYsb-062**	**ASYsb-062**	**ASYsb-062**	**ASYsb-063**
Sample ID		**ASYsb-061-5724-SO**	**ASYsb-062-6218-FD**	**ASYsb-062-5727-SO**	**ASYsb-062-5728-SO**	**ASYsb-063-5731-SO**
Date		**03/30/10**	**03/30/10**	**03/30/10**	**03/30/10**	**04/07/10**
Depth (ft)		**4.0 - 7.0**	**1.0 - 4.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals** **Explosives** **PAHs**	**RVAAP Full Suite**	**RVAAP Full Suite**	**RVAAP Full Suite**	**TAL Metals** **Explosives** **PAHs**
Analyte (mg/kg)						
Inorganic Chemicals						
Aluminum	19500	10600 J	14200	10400	10300 J	12100
Antimony	0.96	0.081 J	0.12 J	<0.62 UJ	<0.59 UJ	0.099 J
Arsenic	19.8	14.4	**26.8 ***	19.1	16	14.5 J
Barium	124	68.2	72	55.9	67.7	105
Beryllium	0.88	0.59	0.8	0.46	0.58	0.8
Cadmium	0	**0.055 J***	<0.032 UJ	<0.026 UJ	**0.13 J***	**0.25 J***
Calcium	35500	2420 J	1620	1340	7350 J	2720
Chromium	27.2	16.3 J	18.5	14.3	16.3 J	17.4
Cobalt	23.2	10.8 J	8.9	11.1	13.4 J	15.9 J
Copper	32.3	19.2	15.3 J	11.7 J	18.7	21.4
Iron	35200	29600	**42000 ***	24600	30400	32700
Lead	19.1	10.7	16.3 J	10.8 J	12.1	13.9 J
Magnesium	8790	4160 J	2450 J	2080 J	4590 J	3650
Manganese	3030	287	270	213	590	484
Mercury	0.044	<0.12 U	<0.13 U	<0.12 U	<0.12 U	0.027 J
Nickel	60.7	28.8 J	17.9 J	17.9 J	29.8 J	39 J
Potassium	3350	1090 J	1370	1030	1600 J	1370 J
Selenium	1.5	1.4 J	1.2	1	1.1 J	**1.7 ***
Silver	0	<0.022 UJ	<0.027 UJ	<0.025 UJ	<0.03 UJ	<0.044 UJ
Sodium	145	47.9 J	44.2 J	33.8 J	66.2 J	<69.7 UJ
Thallium	0.91	0.16 J	0.18 J	0.15 J	0.17 J	0.16 J
Vanadium	37.6	17	24.9	16.5	16.7	20 J
Zinc	93.3	56.9	60.5	48.4	64	87.3
Explosives/Propellants						
3-Nitrotoluene	None	<0.26 U	<0.24 U	<0.24 U	<0.25 U	<0.24 U
HMX	None	<0.26 U	<0.24 U	<0.24 U	<0.25 U	**0.014 J***
Nitrocellulose	None	NR	<6.3 U	<6.2 U	<5.9 U	NR
Semi-volatile Organic Compounds						
Acenaphthene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.015 ***
Acenaphthylene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.03 ***
Anthracene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.075 ***
Benz(a)anthracene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.35 ***
Benzo(a)pyrene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.43 ***
Benzo(b)fluoranthene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.62 ***
Benzo(ghi)perylene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.29 ***
Benzo(k)fluoranthene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.28 ***

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-061**	**ASYsb-062**	**ASYsb-062**	**ASYsb-062**	**ASYsb-063**
Sample ID		**ASYsb-061-5724-SO**	**ASYsb-062-6218-FD**	**ASYsb-062-5727-SO**	**ASYsb-062-5728-SO**	**ASYsb-063-5731-SO**
Date		**03/30/10**	**03/30/10**	**03/30/10**	**03/30/10**	**04/07/10**
Depth (ft)		**4.0 - 7.0**	**1.0 - 4.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals** **Explosives** **PAHs**	**RVAAP Full Suite**	**RVAAP Full Suite**	**RVAAP Full Suite**	**TAL Metals** **Explosives** **PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Bis(2-ethylhexyl)phthalate	None	NR	<0.42 U	<0.41 U	<0.39 U	NR
Chrysene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.47 ***
Dibenz(a,h)anthracene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.074 ***
Fluoranthene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.82 ***
Fluorene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.021 ***
Indeno(1,2,3-cd)pyrene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.27 ***
Naphthalene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.018 ***
Phenanthrene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.23 ***
Pyrene	None	<0.008 U	<0.063 U	<0.062 U	<0.059 U	**0.66 ***
Volatile Organic Compounds						
2-Butanone	None	NR	<0.025 U	<0.025 U	<0.023 U	NR
Carbon disulfide	None	NR	**0.0015 J***	**0.0011 J***	**0.0014 J***	NR
Toluene	None	NR	<0.0063 U	<0.0062 U	**0.00037 J***	NR

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-063**	**ASYsb-064**	**ASYsb-064**	**ASYsb-064**	**ASYsb-065**
Sample ID		**ASYsb-063-5732-SO**	**ASYsb-064-6219-FD**	**ASYsb-064-5735-SO**	**ASYsb-064-5736-SO**	**ASYsb-065-5739-SO**
Date		**04/07/10**	**03/30/10**	**03/30/10**	**03/30/10**	**04/07/10**
Depth (ft)		**4.0 - 7.0**	**1.0 - 4.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**
Parameters Analyzed [a]		**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)	**Background Criteria**[b]					
Inorganic Chemicals						
Aluminum	19500	10400	15700	15900	14900 J	12600
Antimony	0.96	0.098 J	0.1 J	0.085 J	0.13 J	0.1 J
Arsenic	19.8	7.8 J	10.8	9.4	18.1	3.8 J
Barium	124	50	78.5	105	102	104
Beryllium	0.88	0.52	0.54	0.56	**0.94 ***	0.52
Cadmium	0	**0.09 J***	**0.059 J***	<0.028 UJ	**0.074 J***	**0.079 J***
Calcium	35500	5600	926	973	1510 J	2540
Chromium	27.2	15.8	20.3	20.1	22.4 J	15.4
Cobalt	23.2	11.5 J	9.9	9.3	13.1 J	4.8 J
Copper	32.3	26.1	17.5 J	16.7 J	26	13.7
Iron	35200	31000	29100	24800	**36000 ***	17700
Lead	19.1	12.2 J	**31.6 J***	18.4 J	**33 ***	12.5 J
Magnesium	8790	5480	2800 J	3190 J	4200 J	2080
Manganese	3030	327	242	209	369	72.1
Mercury	0.044	<0.13 U	<0.13 U	<0.13 U	<0.12 U	0.031 J
Nickel	60.7	27.8 J	15.6 J	18.3 J	31.2 J	15.2 J
Potassium	3350	1420 J	1220	1230	1430 J	761 J
Selenium	1.5	1.4	1.1	1.3	**1.7 J***	1.5
Silver	0	<0.038 UJ	**0.046 J***	**0.035 J***	**0.047 J***	<0.049 UJ
Sodium	145	85.1 J	**147 ***	83.1 J	140	<64 UJ
Thallium	0.91	0.15 J	0.21 J	0.22 J	0.2 J	0.21 J
Vanadium	37.6	16.3 J	26.7	23.2	25.1	18.2 J
Zinc	93.3	68	54.9	56	73.7	53.4
Explosives/Propellants						
3-Nitrotoluene	None	<0.24 U	<0.24 U	<0.24 U	<0.24 U	<0.24 U
HMX	None	<0.24 U	<0.24 U	<0.24 U	<0.24 U	<0.24 U
Nitrocellulose	None	NR	NR	NR	NR	NR
Semi-volatile Organic Compounds						
Acenaphthene	None	<0.0085 U	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Acenaphthylene	None	<0.0085 U	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Anthracene	None	<0.0085 U	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Benz(a)anthracene	None	**0.011 ***	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Benzo(a)pyrene	None	**0.011 ***	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Benzo(b)fluoranthene	None	**0.021 ***	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Benzo(ghi)perylene	None	**0.018 ***	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Benzo(k)fluoranthene	None	<0.0085 U	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-063**	**ASYsb-064**	**ASYsb-064**	**ASYsb-064**	**ASYsb-065**
Sample ID		**ASYsb-063-5732-SO**	**ASYsb-064-6219-FD**	**ASYsb-064-5735-SO**	**ASYsb-064-5736-SO**	**ASYsb-065-5739-SO**
Date		**04/07/10**	**03/30/10**	**03/30/10**	**03/30/10**	**04/07/10**
Depth (ft)		**4.0 - 7.0**	**1.0 - 4.0**	**1.0 - 4.0**	**4.0 - 7.0**	**1.0 - 4.0**
Parameters Analyzed [a]	**Background Criteria[b]**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**	**TAL Metals Explosives PAHs**
Analyte (mg/kg)						
Semi-volatile Organic Compounds, continued						
Bis(2-ethylhexyl)phthalate	None	NR	NR	NR	NR	NR
Chrysene	None	**0.014 ***	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Dibenz(a,h)anthracene	None	<0.0085 U	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Fluoranthene	None	**0.02 ***	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Fluorene	None	<0.0085 U	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Indeno(1,2,3-cd)pyrene	None	<0.0085 U	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Naphthalene	None	<0.0085 U	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Phenanthrene	None	<0.0085 U	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Pyrene	None	**0.017 ***	<0.0085 U	<0.0086 U	<0.0083 U	<0.0088 U
Volatile Organic Compounds						
2-Butanone	None	NR	NR	NR	NR	NR
Carbon disulfide	None	NR	NR	NR	NR	NR
Toluene	None	NR	NR	NR	NR	NR

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location	**Background Criteria**^{b}	**ASYsb-065**
Sample ID		**ASYsb-065-5740-SO**
Date		**04/07/10**
Depth (ft)		**4.0 - 7.0**
Parameters Analyzed [a]		**TAL Metals** **Explosives** **PAHs**
Analyte (mg/kg)		
Inorganic Chemicals		
Aluminum	19500	17300
Antimony	0.96	0.13 J
Arsenic	19.8	4.7 J
Barium	124	121
Beryllium	0.88	0.63
Cadmium	0	**0.088 J***
Calcium	35500	2700 J
Chromium	27.2	17.3 J
Cobalt	23.2	3.9 J
Copper	32.3	23.4
Iron	35200	13100
Lead	19.1	15.8
Magnesium	8790	1620 J
Manganese	3030	61.9
Mercury	0.044	0.037 J
Nickel	60.7	13.5
Potassium	3350	919 J
Selenium	1.5	1 J
Silver	0	**0.13 J***
Sodium	145	77.3 J
Thallium	0.91	0.26 J
Vanadium	37.6	20.1 J
Zinc	93.3	52.8
Explosives/Propellants		
3-Nitrotoluene	None	<0.26 U
HMX	None	<0.26 U
Nitrocellulose	None	NR
Semi-volatile Organic Compounds		
Acenaphthene	None	<0.0092 U
Acenaphthylene	None	<0.0092 U
Anthracene	None	<0.0092 U
Benz(a)anthracene	None	<0.0092 U
Benzo(a)pyrene	None	<0.0092 U
Benzo(b)fluoranthene	None	<0.0092 U
Benzo(ghi)perylene	None	<0.0092 U
Benzo(k)fluoranthene	None	<0.0092 U

Table 5-13. Analytes Detected in PBA08 RI Subsurface Soil Samples (continued)

Location		**ASYsb-065**
Sample ID		**ASYsb-065-5740-SO**
Date		**04/07/10**
Depth (ft)		**4.0 - 7.0**
Parameters Analyzed [a]	**Background Criteria**[b]	**TAL Metals** **Explosives** **PAHs**
Analyte (mg/kg)		
Semi-volatile Organic Compounds, continued		
Bis(2-ethylhexyl)phthalate	None	NR
Chrysene	None	<0.0092 U
Dibenz(a,h)anthracene	None	<0.0092 U
Fluoranthene	None	<0.0092 U
Fluorene	None	<0.0092 U
Indeno(1,2,3-cd)pyrene	None	<0.0092 U
Naphthalene	None	<0.0092 U
Phenanthrene	None	<0.0092 U
Pyrene	None	<0.0092 U
Volatile Organic Compounds		
2-Butanone	None	NR
Carbon disulfide	None	NR
Toluene	None	NR

[a] Only detected analytes are presented in the table.

[b] Background concentrations are published in the *Phase II Remedial Investigation Report for Winklepeck Burning Grounds* (USACE 2001b).

ft = Feet.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
ID = Identification.
J = Estimated value less than reporting limits.
mg/kg = Milligrams per kilogram.
NR = Not reported/not analyzed.
PAH = Polycyclic Aromatic Hydrocarbon.
PCB = Polychlorinated Biphenyl.
PETN = Pentaerythritol Tetranitrate.
TAL = Target Analyte List.
R = Rejected.
RVAAP = Ravenna Army Ammunition Plant.
U= Non-detectable concentration.
UJ = Non-detectable concentration, reporting limit estimated.
*** = Result exceeds background concentration.**
< = Less than.

Table 5-14. Analytes Detected in PBA08 RI Sediment Samples

Location	**Background Criteria[b]**	**L12sd-308**
Sample ID		**L12sd-308-5004-SD**
Date		**02/15/10**
Depth (ft)		**0.0 - 0.5**
Parameters Analyzed[a]		**RVAAP Full Suite**
Analyte (mg/kg)		
Inorganic Chemicals		
Aluminum	13900.00	13000 J
Arsenic	19.50	6.8
Barium	123.00	95.3 J
Beryllium	0.38	**0.74 ***
Cadmium	0.00	**0.51 ***
Calcium	5510.00	3580 J
Chromium	18.10	16.4
Cobalt	9.10	6.7
Copper	27.60	17
Iron	28200.00	18200
Lead	27.40	20.6 J
Magnesium	2760.00	2020
Manganese	1950.00	173
Mercury	0.06	**0.062 J***
Nickel	17.70	**18.2 ***
Potassium	1950.00	1150
Selenium	1.70	1.5 J
Silver	0.00	**0.078 J***
Sodium	112.00	**1290 ***
Thallium	0.89	0.19 J
Vanadium	26.10	18.1
Zinc	532.00	135
Semi-volatile Organic Compounds		
2-Methylnaphthalene	None	**0.041 J***
Acenaphthene	None	**0.03 J***
Acenaphthylene	None	**0.061 J***
Anthracene	None	**0.078 J***
Benz(a)anthracene	None	**0.35 ***
Benzo(a)pyrene	None	**0.41 ***
Benzo(b)fluoranthene	None	**0.68 ***
Benzo(ghi)perylene	None	**0.34 ***
Benzo(k)fluoranthene	None	**0.28 ***
Chrysene	None	**0.46 ***

Table 5-14. Analytes Detected in PBA08 RI Sediment Samples (continued)

Location		**L12sd-308**
Sample ID		**L12sd-308-5004-SD**
Date		**02/15/10**
Depth (ft)		**0.0 - 0.5**
Parameters Analyzed [a]	**Background Criteria**[b]	**RVAAP Full Suite**
Analyte (mg/kg)		
Semi-volatile Organic Compounds, continued		
Dibenz(a,h)anthracene	None	**0.085 J***
Fluoranthene	None	**0.68 ***
Fluorene	None	**0.024 J***
Indeno(1,2,3-cd)pyrene	None	**0.31 ***
Naphthalene	None	**0.033 J***
Phenanthrene	None	**0.23 ***
Pyrene	None	**0.54 ***

[a] Only detected analytes are presented in the table.

[b] Background concentrations are published in the *Phase II Remedial Investigation Report for Winklepeck Burning Grounds* (USACE 2001b).

ft = Feet.
ID = Identification.
J = Estimated value less than reporting limits.
mg/kg = Milligrams per kilogram.
RVAAP = Ravenna Army Ammunition Plant.
*** = Result exceeds background concentration.**

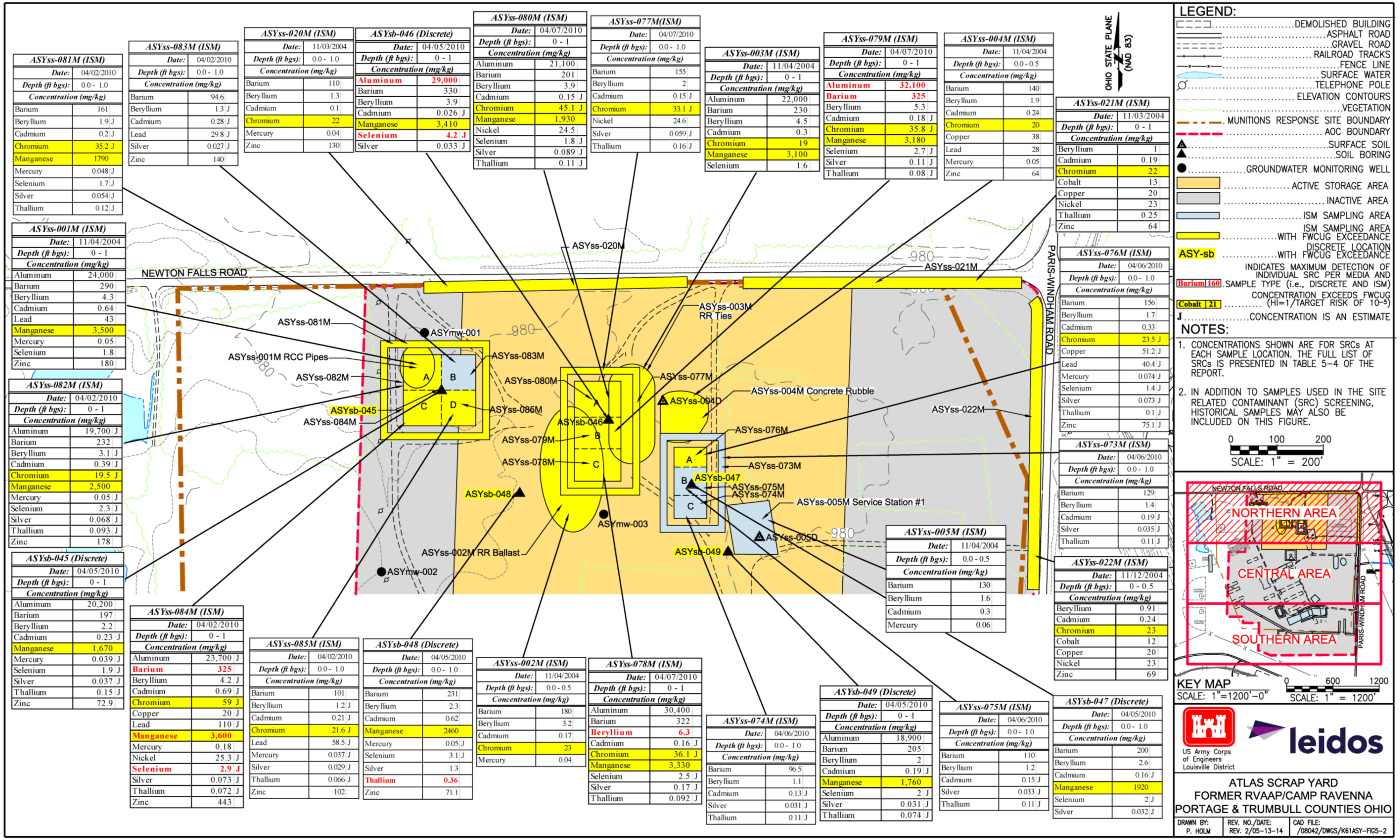
Table 5-15. Analytes Detected in PBA08 RI Surface Water Samples

Location	**Background Criteria**[b]	**L12sw-308**
Sample ID		**L12sw-308-5005-SW**
Date		**02/15/10**
Parameters Analyzed [a]		**RVAAP Full Suite**
Analyte (mg/L)		
Inorganic Chemicals		
Aluminum	3.37	**21.3 J***
Antimony	0	**0.00051 J***
Arsenic	0.0032	**0.0144 ***
Barium	0.0475	**0.187 ***
Beryllium	0	**0.0012 ***
Cadmium	0	**0.0012 J***
Calcium	41.4	**55.3 ***
Chromium	0	**0.0231 ***
Cobalt	0	**0.0109 ***
Copper	0.0079	**0.0249 ***
Iron	2.56	**27.4 ***
Lead	0	**0.0365 ***
Magnesium	10.8	9.2
Manganese	0.391	**1.18 ***
Nickel	0	**0.0244 ***
Potassium	3.17	**5.12 ***
Selenium	0	**0.0019 J***
Sodium	21.3	3.11
Vanadium	0	**0.0367 ***
Zinc	0.042	**0.346 ***
Nitrate	None	**0.1 ***
Semi-volatile Organic Compounds		
Benz(a)anthracene	None	**0.00024 J***
Benzo(a)pyrene	None	**0.00022 J***
Benzo(b)fluoranthene	None	**0.00032 J***
Bis(2-ethylhexyl)phthalate	None	**0.0011 J***
Chrysene	None	**0.00022 J***
Fluoranthene	None	**0.00046 J***
Pyrene	None	**0.00033 J***
Pesticides/PCBs		
delta-BHC	None	**0.00001 J***

[a] Only detected analytes are presented in the table.

[b] Background concentrations are published in the *Phase II Remedial Investigation Report for Winklepeck Burning Grounds* (USACE 2001b).

BHC = Hexachlorobenzene.
ID = Identification.
J = estimated value less than reporting limits.
mg/L = Milligrams per Liter.
PCB = Polychlorinated biphenyl.
RVAAP = Ravenna Army Ammunition Plant.
*** = Result exceeds background concentration.**



ASYss-081M (ISM)

Date:	04/02/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	161	
Beryllium	1.9	J
Cadmium	0.2	J
Chromium	35.2	J
Manganese	1790	
Mercury	0.048	J
Selenium	1.7	J
Silver	0.054	J
Thallium	0.12	J

ASYss-001M (ISM)

Date:	11/04/2004	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	24,000	
Barium	290	
Beryllium	4.3	
Cadmium	0.64	
Lead	43	
Manganese	3,500	
Mercury	0.05	
Selenium	1.8	
Zinc	180	

ASYss-082M (ISM)

Date:	04/02/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	19,700	J
Barium	232	
Beryllium	3.1	J
Cadmium	0.39	J
Chromium	19.5	J
Manganese	2,500	
Mercury	0.05	J
Selenium	2.3	J
Silver	0.068	J
Thallium	0.093	J
Zinc	178	

ASYsb-045 (Discrete)

Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	20,200	
Barium	197	
Beryllium	2.2	
Cadmium	0.23	J
Manganese	1,670	
Mercury	0.039	J
Selenium	1.9	J
Silver	0.037	J
Thallium	0.15	J
Zinc	72.9	

ASYss-083M (ISM)

Date:	04/02/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	94.6	
Beryllium	1.3	J
Cadmium	0.28	J
Lead	29.8	J
Silver	0.027	J
Zinc	140	

ASYss-084M (ISM)

Date:	04/02/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	23,700	J
Barium	**325**	
Beryllium	4.2	J
Cadmium	0.69	J
Chromium	59	J
Copper	20	J
Lead	110	J
Manganese	**3,600**	
Mercury	0.18	
Nickel	25.3	J
Selenium	**2.9**	**J**
Silver	0.073	J
Thallium	0.072	J
Zinc	443	

ASYss-020M (ISM)

Date:	11/03/2004	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	110	
Beryllium	1.3	
Cadmium	0.1	
Chromium	22	
Mercury	0.04	
Zinc	130	

ASYsb-046 (Discrete)

Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	**29,000**	
Barium	330	
Beryllium	3.9	
Cadmium	0.026	J
Manganese	3,410	
Selenium	**4.2**	**J**
Silver	0.033	J

ASYss-085M (ISM)

Date:	04/02/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	101	
Beryllium	1.2	J
Cadmium	0.21	J
Chromium	21.6	J
Lead	58.5	J
Mercury	0.037	J
Silver	0.029	J
Thallium	0.066	J
Zinc	102	

ASYsb-048 (Discrete)

Date:	04/05/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	231	
Beryllium	2.3	
Cadmium	0.62	
Manganese	2460	
Mercury	0.05	J
Selenium	3.1	J
Silver	1.3	
Thallium	**0.36**	
Zinc	71.1	

ASYss-080M (ISM)

Date:	04/07/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	21,100	
Barium	201	
Beryllium	3.9	
Cadmium	0.15	J
Chromium	45.1	J
Manganese	1,930	
Nickel	24.5	
Selenium	1.8	J
Silver	0.089	J
Thallium	0.11	J

ASYss-002M (ISM)

Date:	11/04/2004	
Depth (ft bgs):	0.0 - 0.5	
Concentration (mg/kg)		
Barium	180	
Beryllium	3.2	
Cadmium	0.17	
Chromium	23	
Mercury	0.04	

ASYss-077M(ISM)

Date:	04/07/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	155	
Beryllium	2	
Cadmium	0.15	J
Chromium	33.1	J
Nickel	24.6	
Silver	0.059	J
Thallium	0.16	J

ASYss-078M (ISM)

Date:	04/07/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	30,400	
Barium	322	
Beryllium	**6.3**	
Cadmium	0.16	J
Chromium	36.1	J
Manganese	3,330	
Selenium	2.5	J
Silver	0.17	J
Thallium	0.092	J

ASYss-003M (ISM)

Date:	11/04/2004	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	22,000	
Barium	230	
Beryllium	4.5	
Cadmium	0.3	
Chromium	19	
Manganese	3,100	
Selenium	1.6	

ASYss-074M (ISM)

Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	96.5	
Beryllium	1.1	
Cadmium	0.13	J
Silver	0.031	J
Thallium	0.11	J

ASYss-079M (ISM)

Date:	04/07/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	**32,100**	
Barium	**325**	
Beryllium	5.3	
Cadmium	0.18	J
Chromium	35.8	J
Manganese	3,180	
Selenium	2.7	J
Silver	0.11	J
Thallium	0.08	J

ASYsb-049 (Discrete)

Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	18,900	
Barium	205	
Beryllium	2	
Cadmium	0.19	J
Manganese	1,760	
Selenium	2	J
Silver	0.031	J
Thallium	0.074	J

ASYss-004M (ISM)

Date:	11/04/2004	
Depth (ft bgs):	0.0 - 0.5	
Concentration (mg/kg)		
Barium	140	
Beryllium	1.9	
Cadmium	0.24	
Chromium	20	
Copper	38	
Lead	28	
Mercury	0.05	
Zinc	64	

ASYss-075M (ISM)

Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	110	
Beryllium	1.2	
Cadmium	0.15	J
Silver	0.033	J
Thallium	0.11	J

ASYss-021M (ISM)

Date:	11/03/2004	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Beryllium	1	
Cadmium	0.19	
Chromium	22	
Cobalt	13	
Copper	20	
Nickel	23	
Thallium	0.25	
Zinc	64	

ASYss-076M (ISM)

Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	156	
Beryllium	1.7	
Cadmium	0.33	
Chromium	23.5	J
Copper	51.2	J
Lead	40.4	J
Mercury	0.074	J
Selenium	1.4	J
Silver	0.073	J
Thallium	0.1	J
Zinc	75.1	J

ASYss-073M (ISM)

Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	129	
Beryllium	1.4	
Cadmium	0.19	J
Silver	0.035	J
Thallium	0.11	J

ASYss-005M (ISM)

Date:	11/04/2004	
Depth (ft bgs):	0.0 - 0.5	
Concentration (mg/kg)		
Barium	130	
Beryllium	1.6	
Cadmium	0.3	
Mercury	0.06	

ASYss-022M (ISM)

Date:	11/12/2004	
Depth (ft bgs):	0 - 0.5	
Concentration (mg/kg)		
Beryllium	0.91	
Cadmium	0.24	
Chromium	23	
Cobalt	12	
Copper	20	
Nickel	23	
Zinc	69	

ASYsb-047 (Discrete)

Date:	04/05/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	200	
Beryllium	2.6	
Cadmium	0.16	J
Manganese	1920	
Selenium	2	J
Silver	0.032	J

LEGEND:

- ⌐ ⌐ ⌐ ....DEMOLISHED BUILDING
- ═══ ....ASPHALT ROAD
- ‐ ‐ ‐ ....GRAVEL ROAD
- ─┼─┼─ ....RAILROAD TRACKS
- ─x─x─ ....FENCE LINE
- ▬ ....SURFACE WATER
- ⌀ ....TELEPHONE POLE
- ‐ ‐ ‐ ....ELEVATION CONTOURS
- 〰 ....VEGETATION
- ▬ ‐ ‐ ▬ . MUNITIONS RESPONSE SITE BOUNDARY
- ▬ ▬ ▬ .... AOC BOUNDARY
- △ ....SURFACE SOIL
- ▲ ....SOIL BORING
- ● ....GROUNDWATER MONITORING WELL
- 🟧 .... ACTIVE STORAGE AREA
- ▨ .... INACTIVE AREA
- ▭ .... ISM SAMPLING AREA
- 🟨 ....WITH FWCUG EXCEEDANCE ISM SAMPLING AREA
- **ASY-sb** ....WITH FWCUG EXCEEDANCE DISCRETE LOCATION
- **Barium | 160** .SAMPLE TYPE (i.e., DISCRETE AND ISM) INDICATES MAXIMUM DETECTION OF INDIVIDUAL SRC PER MEDIA AND
- **Cobalt | 21** .... CONCENTRATION EXCEEDS FWCUG (HI=1/TARGET RISK OF 10^{-5})
- **J** ..................CONCENTRATION IS AN ESTIMATE

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5–4 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.

0 100 200
SCALE: 1" = 200'

US Army Corps
of Engineers
Louisville District

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ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

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P. HOLM	REV. 2/05–13–14	/08042/DWGS/K61ASY–FIG5–2

Figure 5-2. Concentrations of Inorganic SRCs in Surface Soil Samples at the Northern Area of Atlas Scrap Yard

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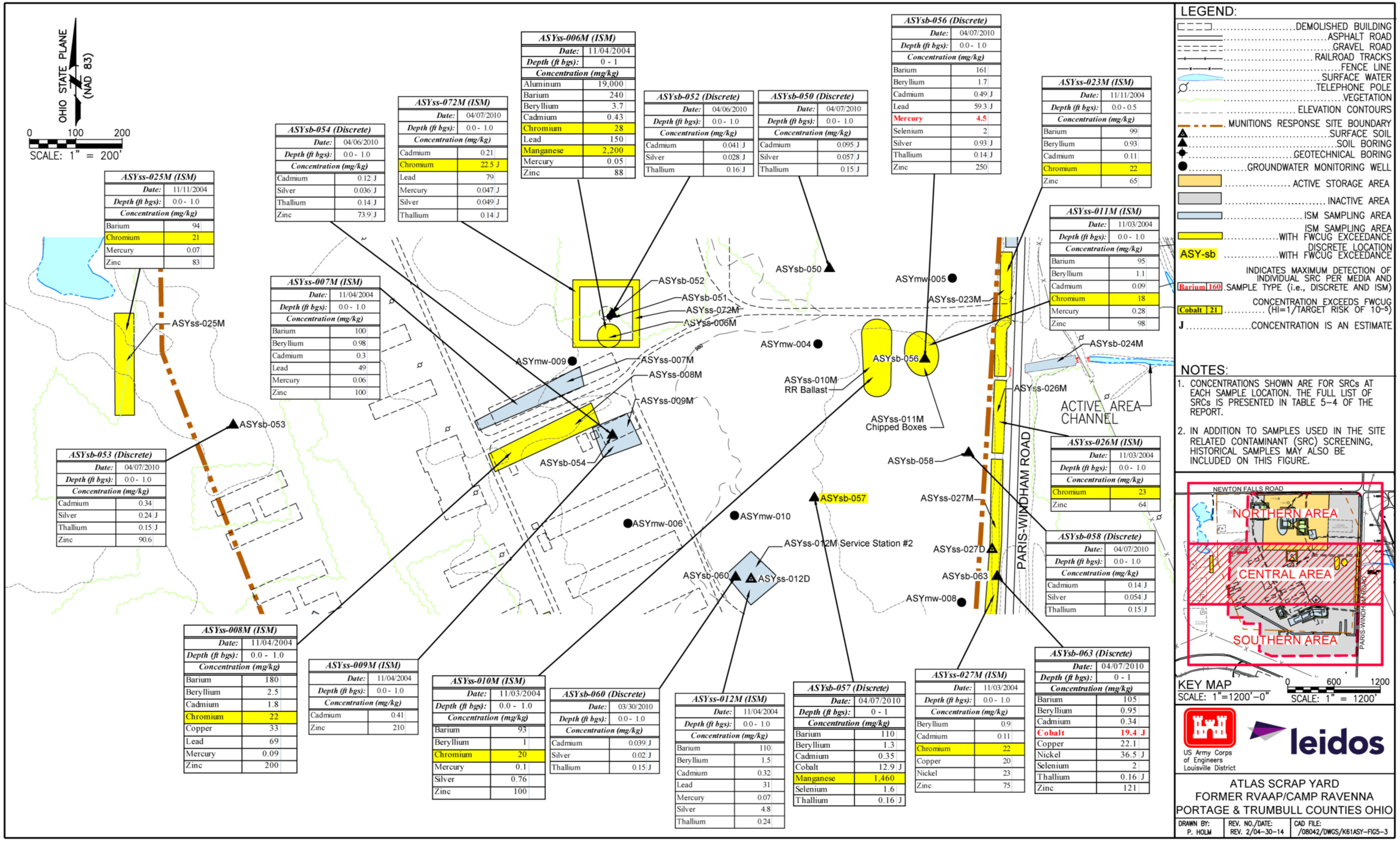

ASYss-025M (ISM)	
Date:	11/11/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	94
Chromium	21
Mercury	0.07
Zinc	83

ASYsb-054 (Discrete)	
Date:	04/06/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.12 J
Silver	0.036 J
Thallium	0.14 J
Zinc	73.9 J

ASYss-072M (ISM)	
Date:	04/07/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.21
Chromium	22.5 J
Lead	79
Mercury	0.047 J
Silver	0.049 J
Thallium	0.14 J

ASYss-006M (ISM)	
Date:	11/04/2004
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Aluminum	19,000
Barium	240
Beryllium	3.7
Cadmium	0.43
Chromium	28
Lead	150
Manganese	2,200
Mercury	0.05
Zinc	88

ASYsb-052 (Discrete)	
Date:	04/06/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.041 J
Silver	0.028 J
Thallium	0.16 J

ASYsb-050 (Discrete)	
Date:	04/07/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.095 J
Silver	0.057 J
Thallium	0.15 J

ASYsb-056 (Discrete)	
Date:	04/07/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	161
Beryllium	1.7
Cadmium	0.49 J
Lead	59.3 J
Mercury	4.5
Selenium	2
Silver	0.93 J
Thallium	0.14 J
Zinc	250

ASYss-023M (ISM)	
Date:	11/11/2004
Depth (ft bgs):	0.0 - 0.5
Concentration (mg/kg)	
Barium	99
Beryllium	0.93
Cadmium	0.11
Chromium	22
Zinc	65

ASYss-011M (ISM)	
Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	95
Beryllium	1.1
Cadmium	0.09
Chromium	18
Mercury	0.28
Zinc	98

ASYss-007M (ISM)	
Date:	11/04/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	100
Beryllium	0.98
Cadmium	0.3
Lead	49
Mercury	0.06
Zinc	100

ASYsb-053 (Discrete)	
Date:	04/07/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.34
Silver	0.24 J
Thallium	0.15 J
Zinc	90.6

ASYss-026M (ISM)	
Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Chromium	23
Zinc	64

ASYsb-058 (Discrete)	
Date:	04/07/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.14 J
Silver	0.054 J
Thallium	0.15 J

ASYss-008M (ISM)	
Date:	11/04/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	180
Beryllium	2.5
Cadmium	1.8
Chromium	22
Copper	33
Lead	69
Mercury	0.09
Zinc	200

ASYss-009M (ISM)	
Date:	11/04/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.41
Zinc	210

ASYss-010M (ISM)	
Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	93
Beryllium	1
Chromium	20
Mercury	0.1
Silver	0.76
Zinc	100

ASYsb-060 (Discrete)	
Date:	03/30/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.039 J
Silver	0.02 J
Thallium	0.15 J

ASYss-012M (ISM)	
Date:	11/04/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	110
Beryllium	1.5
Cadmium	0.32
Lead	31
Mercury	0.07
Silver	4.8
Thallium	0.24

ASYsb-057 (Discrete)	
Date:	04/07/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Barium	110
Beryllium	1.3
Cadmium	0.35
Cobalt	12.9 J
Manganese	1,460
Selenium	1.6
Thallium	0.16 J

ASYss-027M (ISM)	
Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Beryllium	0.9
Cadmium	0.11
Chromium	22
Copper	20
Nickel	23
Zinc	75

ASYsb-063 (Discrete)	
Date:	04/07/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Barium	105
Beryllium	0.95
Cadmium	0.34
Cobalt	19.4 J
Copper	22.1
Nickel	36.5 J
Selenium	2
Thallium	0.16 J
Zinc	121

LEGEND:

- ....DEMOLISHED BUILDING
- ....ASPHALT ROAD
- ....GRAVEL ROAD
- ....RAILROAD TRACKS
- ....FENCE LINE
- ....SURFACE WATER
- ....TELEPHONE POLE
- ....VEGETATION
- ....ELEVATION CONTOURS
- ....MUNITIONS RESPONSE SITE BOUNDARY
- ▲..........SURFACE SOIL
- ▲..........SOIL BORING
- ✦..........GEOTECHNICAL BORING
- ●..........GROUNDWATER MONITORING WELL
- ....ACTIVE STORAGE AREA
- ....INACTIVE AREA
- ....ISM SAMPLING AREA
- ....ISM SAMPLING AREA WITH FWCUG EXCEEDANCE
- ASY-sb ....DISCRETE LOCATION WITH FWCUG EXCEEDANCE
- Barium 160 .SAMPLE TYPE (i.e., DISCRETE AND ISM) INDICATES MAXIMUM DETECTION OF INDIVIDUAL SRC PER MEDIA AND
- Cobalt 21 ..........CONCENTRATION EXCEEDS FWCUG (HI=1/TARGET RISK OF 10^{-5})
- J ..........CONCENTRATION IS AN ESTIMATE

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5-4 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.

ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

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Figure 5-3. Concentrations of Inorganic SRCs in Surface Soil Samples at the Central Area of Atlas Scrap Yard

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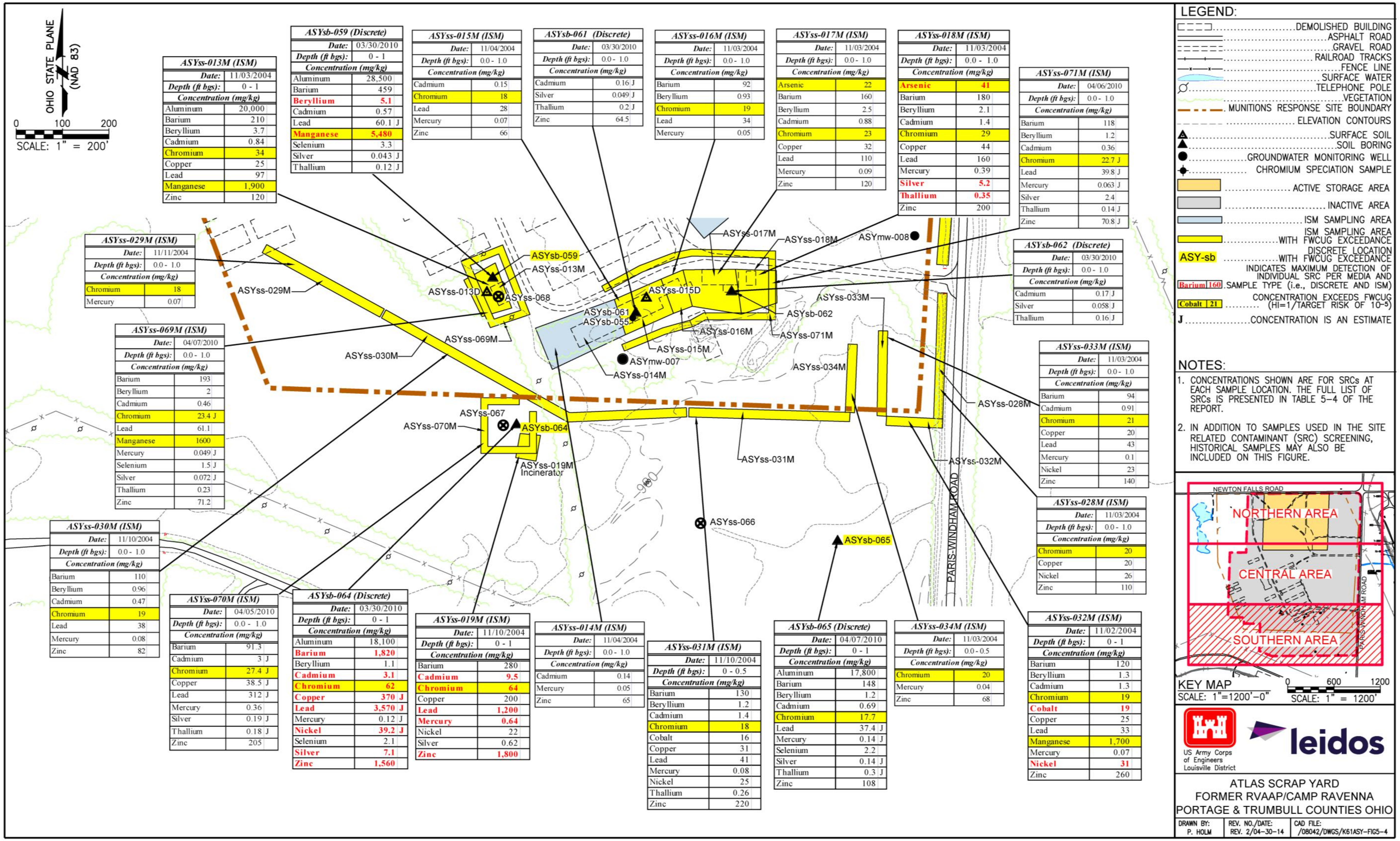

ASYss-013M (ISM)

Date:	11/03/2004
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Aluminum	20,000
Barium	210
Beryllium	3.7
Cadmium	0.84
Chromium	34
Copper	25
Lead	97
Manganese	1,900
Zinc	120

ASYsb-059 (Discrete)

Date:	03/30/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Aluminum	28,500
Barium	459
Beryllium	**5.1**
Cadmium	0.57
Lead	60.1 J
Manganese	**5,480**
Selenium	3.3
Silver	0.043 J
Thallium	0.12 J

ASYss-015M (ISM)

Date:	11/04/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.15
Chromium	18
Lead	28
Mercury	0.07
Zinc	66

ASYsb-061 (Discrete)

Date:	03/30/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.16 J
Silver	0.049 J
Thallium	0.2 J
Zinc	64.5

ASYss-016M (ISM)

Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	92
Beryllium	0.93
Chromium	19
Lead	34
Mercury	0.05

ASYss-017M (ISM)

Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Arsenic	22
Barium	160
Beryllium	2.5
Cadmium	0.88
Chromium	23
Copper	32
Lead	110
Mercury	0.09
Zinc	120

ASYss-018M (ISM)

Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Arsenic	**41**
Barium	180
Beryllium	2.1
Cadmium	1.4
Chromium	29
Copper	44
Lead	160
Mercury	0.39
Silver	**5.2**
Thallium	**0.35**
Zinc	200

ASYss-071M (ISM)

Date:	04/06/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	118
Beryllium	1.2
Cadmium	0.36
Chromium	22.7 J
Lead	39.8 J
Mercury	0.063 J
Silver	2.4
Thallium	0.14 J
Zinc	70.8 J

ASYsb-062 (Discrete)

Date:	03/30/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.17 J
Silver	0.058 J
Thallium	0.16 J

ASYss-029M (ISM)

Date:	11/11/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Chromium	18
Mercury	0.07

ASYss-069M (ISM)

Date:	04/07/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	193
Beryllium	2
Cadmium	0.46
Chromium	23.4 J
Lead	61.1
Manganese	1600
Mercury	0.049 J
Selenium	1.5 J
Silver	0.072 J
Thallium	0.23
Zinc	71.2

ASYss-033M (ISM)

Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	94
Cadmium	0.91
Chromium	21
Copper	20
Lead	43
Mercury	0.1
Nickel	23
Zinc	140

ASYss-028M (ISM)

Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Chromium	20
Copper	20
Nickel	26
Zinc	110

ASYss-030M (ISM)

Date:	11/10/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	110
Beryllium	0.96
Cadmium	0.47
Chromium	19
Lead	38
Mercury	0.08
Zinc	82

ASYss-070M (ISM)

Date:	04/05/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Barium	91.3
Cadmium	3 J
Chromium	27.4 J
Copper	38.5 J
Lead	312 J
Mercury	0.36
Silver	0.19 J
Thallium	0.18 J
Zinc	205

ASYsb-064 (Discrete)

Date:	03/30/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Aluminum	18,100
Barium	**1,820**
Beryllium	1.1
Cadmium	**3.1**
Chromium	**62**
Copper	**370 J**
Lead	**3,570 J**
Mercury	0.12 J
Nickel	**39.2 J**
Selenium	2.1
Silver	**7.1**
Zinc	**1,560**

ASYss-019M (ISM)

Date:	11/10/2004
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Barium	280
Cadmium	**9.5**
Chromium	**64**
Copper	200
Lead	**1,200**
Mercury	**0.64**
Nickel	22
Silver	0.62
Zinc	**1,800**

ASYss-014M (ISM)

Date:	11/04/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Cadmium	0.14
Mercury	0.05
Zinc	65

ASYss-031M (ISM)

Date:	11/10/2004
Depth (ft bgs):	0 - 0.5
Concentration (mg/kg)	
Barium	130
Beryllium	1.2
Cadmium	1.4
Chromium	18
Cobalt	16
Copper	31
Lead	41
Mercury	0.08
Nickel	25
Thallium	0.26
Zinc	220

ASYsb-065 (Discrete)

Date:	04/07/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Aluminum	17,800
Barium	148
Beryllium	1.2
Cadmium	0.69
Chromium	17.7
Lead	37.4 J
Mercury	0.14 J
Selenium	2.2
Silver	0.14 J
Thallium	0.3 J
Zinc	108

ASYss-034M (ISM)

Date:	11/03/2004
Depth (ft bgs):	0.0 - 0.5
Concentration (mg/kg)	
Chromium	20
Mercury	0.04
Zinc	68

ASYss-032M (ISM)

Date:	11/02/2004
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Barium	120
Beryllium	1.3
Cadmium	1.3
Chromium	19
Cobalt	**19**
Copper	25
Lead	33
Manganese	1,700
Mercury	0.07
Nickel	**31**
Zinc	260

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5–4 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.

ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

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Figure 5-4. Concentrations of Inorganic SRCs in Surface Soil Samples at the Southern Area of Atlas Scrap Yard

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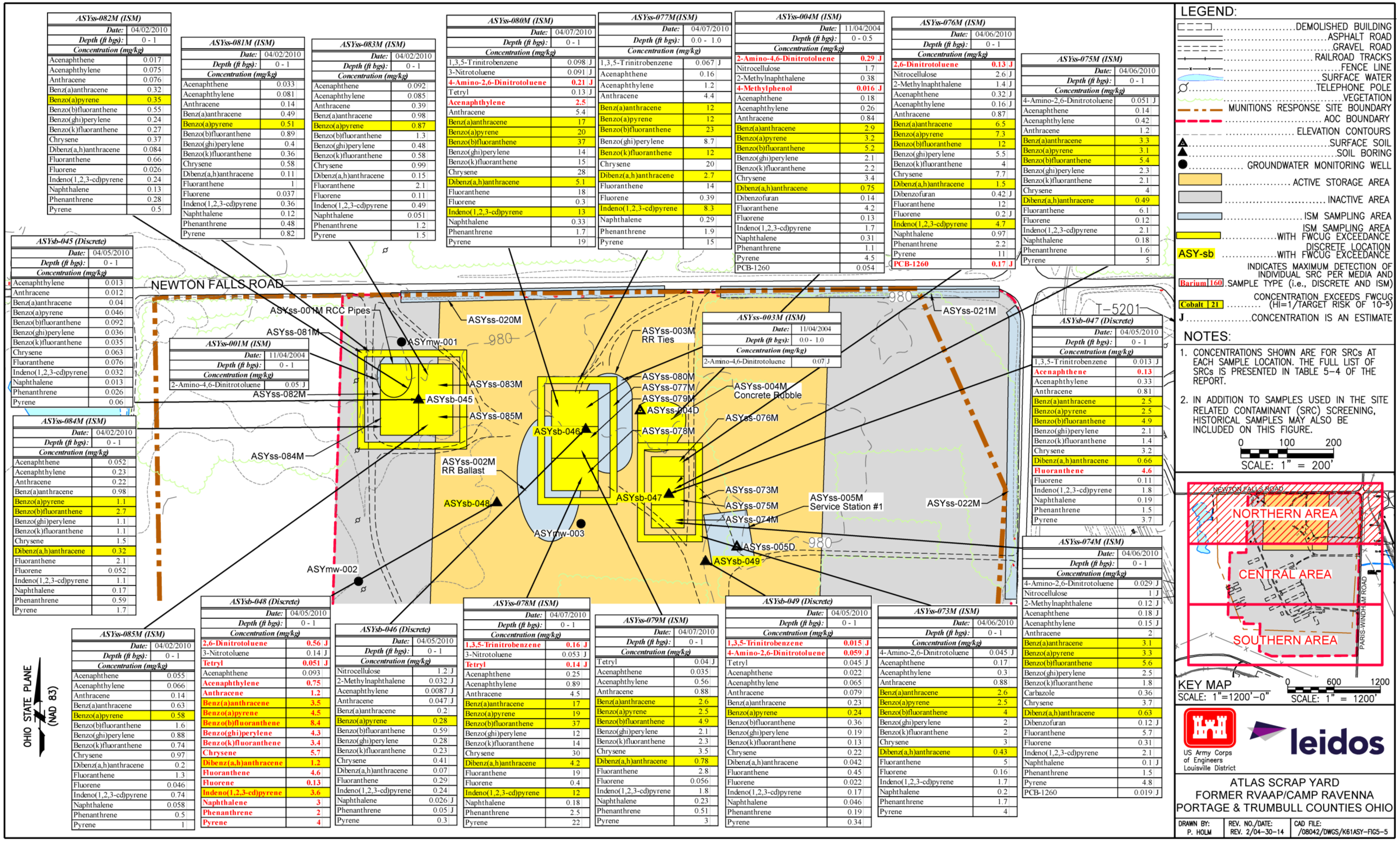

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5–4 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.

ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

DRAWN BY:	REV. NO./DATE:	CAD FILE:
P. HOLM	REV. 2/04-30-14	/08042/DWGS/K61ASY-FIG5-5

ASYss-082M (ISM)	
Date:	04/02/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Acenaphthene	0.017
Acenaphthylene	0.075
Anthracene	0.076
Benz(a)anthracene	0.32
Benzo(a)pyrene	0.35
Benzo(b)fluoranthene	0.55
Benzo(ghi)perylene	0.24
Benzo(k)fluoranthene	0.27
Chrysene	0.37
Dibenz(a,h)anthracene	0.084
Fluoranthene	0.66
Fluorene	0.026
Indeno(1,2,3-cd)pyrene	0.24
Naphthalene	0.13
Phenanthrene	0.28
Pyrene	0.5

ASYss-081M (ISM)	
Date:	04/02/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Acenaphthene	0.033
Acenaphthylene	0.081
Anthracene	0.14
Benz(a)anthracene	0.49
Benzo(a)pyrene	0.51
Benzo(b)fluoranthene	0.89
Benzo(ghi)perylene	0.4
Benzo(k)fluoranthene	0.36
Chrysene	0.58
Dibenz(a,h)anthracene	0.11
Fluoranthene	1
Fluorene	0.037
Indeno(1,2,3-cd)pyrene	0.36
Naphthalene	0.12
Phenanthrene	0.48
Pyrene	0.82

ASYss-083M (ISM)	
Date:	04/02/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Acenaphthene	0.092
Acenaphthylene	0.085
Anthracene	0.39
Benz(a)anthracene	0.98
Benzo(a)pyrene	0.87
Benzo(b)fluoranthene	1.3
Benzo(ghi)perylene	0.48
Benzo(k)fluoranthene	0.58
Chrysene	0.99
Dibenz(a,h)anthracene	0.15
Fluoranthene	2.1
Fluorene	0.11
Indeno(1,2,3-cd)pyrene	0.49
Naphthalene	0.051
Phenanthrene	1.2
Pyrene	1.5

ASYss-080M (ISM)	
Date:	04/07/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
1,3,5-Trinitrobenzene	0.098 J
3-Nitrotoluene	0.091 J
4-Amino-2,6-Dinitrotoluene	**0.21 J**
Tetryl	0.13 J
Acenaphthylene	**2.5**
Anthracene	5.4
Benz(a)anthracene	17
Benzo(a)pyrene	20
Benzo(b)fluoranthene	37
Benzo(ghi)perylene	14
Benzo(k)fluoranthene	15
Chrysene	28
Dibenz(a,h)anthracene	5.1
Fluoranthene	18
Fluorene	0.3
Indeno(1,2,3-cd)pyrene	13
Naphthalene	0.33
Phenanthrene	1.7
Pyrene	19

ASYss-077M(ISM)	
Date:	04/07/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
1,3,5-Trinitrobenzene	0.067 J
Acenaphthene	0.16
Acenaphthylene	1.2
Anthracene	4.4
Benz(a)anthracene	12
Benzo(a)pyrene	12
Benzo(b)fluoranthene	23
Benzo(ghi)perylene	8.7
Benzo(k)fluoranthene	12
Chrysene	20
Dibenz(a,h)anthracene	2.7
Fluoranthene	14
Fluorene	0.39
Indeno(1,2,3-cd)pyrene	8.3
Naphthalene	0.29
Phenanthrene	1.9
Pyrene	15

ASYss-004M (ISM)	
Date:	11/04/2004
Depth (ft bgs):	0 - 0.5
Concentration (mg/kg)	
2-Amino-4,6-Dinitrotoluene	**0.29 J**
Nitrocellulose	1.7
2-Methylnaphthalene	0.38
4-Methylphenol	**0.016 J**
Acenaphthene	0.18
Acenaphthylene	0.26
Anthracene	0.84
Benz(a)anthracene	2.9
Benzo(a)pyrene	3.2
Benzo(b)fluoranthene	5.2
Benzo(ghi)perylene	2.1
Benzo(k)fluoranthene	2.2
Chrysene	3.4
Dibenz(a,h)anthracene	0.75
Dibenzofuran	0.14
Fluoranthene	4.2
Fluorene	0.13
Indeno(1,2,3-cd)pyrene	1.7
Naphthalene	0.31
Phenanthrene	1.1
Pyrene	4.5
PCB-1260	0.054

ASYss-076M (ISM)	
Date:	04/06/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
2,6-Dinitrotoluene	**0.13 J**
Nitrocellulose	2.6 J
2-Methylnaphthalene	1.4 J
Acenaphthene	0.32 J
Acenaphthylene	0.16 J
Anthracene	0.87
Benz(a)anthracene	6.5
Benzo(a)pyrene	7.3
Benzo(b)fluoranthene	12
Benzo(ghi)perylene	5.5
Benzo(k)fluoranthene	4
Chrysene	7.7
Dibenz(a,h)anthracene	1.5
Dibenzofuran	0.42 J
Fluoranthene	12
Fluorene	0.2 J
Indeno(1,2,3-cd)pyrene	4.7
Naphthalene	0.97
Phenanthrene	2.2
Pyrene	11
PCB-1260	**0.17 J**

ASYss-075M (ISM)	
Date:	04/06/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
4-Amino-2,6-Dinitrotoluene	0.051 J
Acenaphthene	0.14
Acenaphthylene	0.42
Anthracene	1.2
Benz(a)anthracene	3.3
Benzo(a)pyrene	3.1
Benzo(b)fluoranthene	5.4
Benzo(ghi)perylene	2.3
Benzo(k)fluoranthene	2.1
Chrysene	4
Dibenz(a,h)anthracene	0.49
Fluoranthene	6.1
Fluorene	0.12
Indeno(1,2,3-cd)pyrene	2.1
Naphthalene	0.18
Phenanthrene	1.6
Pyrene	5

ASYsb-045 (Discrete)	
Date:	04/05/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Acenaphthylene	0.013
Anthracene	0.012
Benz(a)anthracene	0.04
Benzo(a)pyrene	0.046
Benzo(b)fluoranthene	0.092
Benzo(ghi)perylene	0.036
Benzo(k)fluoranthene	0.035
Chrysene	0.063
Fluoranthene	0.076
Indeno(1,2,3-cd)pyrene	0.032
Naphthalene	0.013
Phenanthrene	0.026
Pyrene	0.06

ASYss-001M (ISM)	
Date:	11/04/2004
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
2-Amino-4,6-Dinitrotoluene	0.05 J

ASYss-084M (ISM)	
Date:	04/02/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Acenaphthene	0.052
Acenaphthylene	0.23
Anthracene	0.22
Benz(a)anthracene	0.98
Benzo(a)pyrene	1.1
Benzo(b)fluoranthene	2.7
Benzo(ghi)perylene	1.1
Benzo(k)fluoranthene	1.1
Chrysene	1.5
Dibenz(a,h)anthracene	0.32
Fluoranthene	2.1
Fluorene	0.052
Indeno(1,2,3-cd)pyrene	1.1
Naphthalene	0.17
Phenanthrene	0.59
Pyrene	1.7

ASYss-003M (ISM)	
Date:	11/04/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
2-Amino-4,6-Dinitrotoluene	0.07 J

ASYsb-047 (Discrete)	
Date:	04/05/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
1,3,5-Trinitrobenzene	0.013 J
Acenaphthene	**0.13**
Acenaphthylene	0.33
Anthracene	0.81
Benz(a)anthracene	2.5
Benzo(a)pyrene	2.5
Benzo(b)fluoranthene	4.9
Benzo(ghi)perylene	2.1
Benzo(k)fluoranthene	1.4
Chrysene	3.2
Dibenz(a,h)anthracene	0.66
Fluoranthene	**4.6**
Fluorene	0.11
Indeno(1,2,3-cd)pyrene	1.8
Naphthalene	0.19
Phenanthrene	1.5
Pyrene	3.7

ASYss-074M (ISM)	
Date:	04/06/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
4-Amino-2,6-Dinitrotoluene	0.029 J
Nitrocellulose	1 J
2-Methylnaphthalene	0.12 J
Acenaphthene	0.18 J
Acenaphthylene	0.15 J
Anthracene	2
Benz(a)anthracene	3.1
Benzo(a)pyrene	3.3
Benzo(b)fluoranthene	5.6
Benzo(ghi)perylene	2.5
Benzo(k)fluoranthene	1.8
Carbazole	0.36
Chrysene	3.7
Dibenz(a,h)anthracene	0.63
Dibenzofuran	0.12 J
Fluoranthene	5.7
Fluorene	0.31
Indeno(1,2,3-cd)pyrene	2.1
Naphthalene	0.1 J
Phenanthrene	1.5
Pyrene	4.8
PCB-1260	0.019 J

ASYss-085M (ISM)	
Date:	04/02/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Acenaphthene	0.055
Acenaphthylene	0.066
Anthracene	0.14
Benz(a)anthracene	0.63
Benzo(a)pyrene	0.58
Benzo(b)fluoranthene	1.6
Benzo(ghi)perylene	0.88
Benzo(k)fluoranthene	0.74
Chrysene	0.97
Dibenz(a,h)anthracene	0.2
Fluoranthene	1.3
Fluorene	0.046
Indeno(1,2,3-cd)pyrene	0.74
Naphthalene	0.058
Phenanthrene	0.5
Pyrene	1

ASYsb-048 (Discrete)	
Date:	04/05/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
2,6-Dinitrotoluene	**0.56 J**
3-Nitrotoluene	0.14 J
Tetryl	**0.051 J**
Acenaphthene	0.093
Acenaphthylene	**0.75**
Anthracene	**1.2**
Benz(a)anthracene	**3.5**
Benzo(a)pyrene	**4.5**
Benzo(b)fluoranthene	**8.4**
Benzo(ghi)perylene	**4.3**
Benzo(k)fluoranthene	**3.4**
Chrysene	**5.7**
Dibenz(a,h)anthracene	**1.2**
Fluoranthene	**4.6**
Fluorene	**0.13**
Indeno(1,2,3-cd)pyrene	**3.6**
Naphthalene	**3**
Phenanthrene	**2**
Pyrene	**4**

ASYsb-046 (Discrete)	
Date:	04/05/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Nitrocellulose	1.2 J
2-Methylnaphthalene	0.032 J
Acenaphthylene	0.0087 J
Anthracene	0.047 J
Benz(a)anthracene	0.2
Benzo(a)pyrene	0.28
Benzo(b)fluoranthene	0.59
Benzo(ghi)perylene	0.28
Benzo(k)fluoranthene	0.23
Chrysene	0.41
Dibenz(a,h)anthracene	0.07
Fluoranthene	0.29
Indeno(1,2,3-cd)pyrene	0.24
Naphthalene	0.026 J
Phenanthrene	0.05 J
Pyrene	0.3

ASYss-078M (ISM)	
Date:	04/07/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
1,3,5-Trinitrobenzene	**0.16 J**
3-Nitrotoluene	0.053 J
Tetryl	**0.14 J**
Acenaphthene	0.25
Acenaphthylene	0.89
Anthracene	4.5
Benz(a)anthracene	17
Benzo(a)pyrene	19
Benzo(b)fluoranthene	37
Benzo(ghi)perylene	12
Benzo(k)fluoranthene	14
Chrysene	30
Dibenz(a,h)anthracene	4.2
Fluoranthene	19
Fluorene	0.4
Indeno(1,2,3-cd)pyrene	12
Naphthalene	0.18
Phenanthrene	2.5
Pyrene	22

ASYss-079M (ISM)	
Date:	04/07/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Tetryl	0.04 J
Acenaphthene	0.035
Acenaphthylene	0.56
Anthracene	0.88
Benz(a)anthracene	2.6
Benzo(a)pyrene	2.5
Benzo(b)fluoranthene	4.9
Benzo(ghi)perylene	2.1
Benzo(k)fluoranthene	2.3
Chrysene	3.5
Dibenz(a,h)anthracene	0.78
Fluoranthene	2.8
Fluorene	0.056
Indeno(1,2,3-cd)pyrene	1.8
Naphthalene	0.23
Phenanthrene	0.51
Pyrene	3

ASYsb-049 (Discrete)	
Date:	04/05/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
1,3,5-Trinitrobenzene	**0.015 J**
4-Amino-2,6-Dinitrotoluene	**0.059 J**
Tetryl	0.045 J
Acenaphthene	0.022
Acenaphthylene	0.065
Anthracene	0.079
Benz(a)anthracene	0.23
Benzo(a)pyrene	0.24
Benzo(b)fluoranthene	0.36
Benzo(ghi)perylene	0.19
Benzo(k)fluoranthene	0.13
Chrysene	0.22
Dibenz(a,h)anthracene	0.042
Fluoranthene	0.45
Fluorene	0.022
Indeno(1,2,3-cd)pyrene	0.17
Naphthalene	0.046
Phenanthrene	0.19
Pyrene	0.34

ASYss-073M (ISM)	
Date:	04/06/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
4-Amino-2,6-Dinitrotoluene	0.045 J
Acenaphthene	0.17
Acenaphthylene	0.3
Anthracene	0.88
Benz(a)anthracene	2.6
Benzo(a)pyrene	2.5
Benzo(b)fluoranthene	4
Benzo(ghi)perylene	2
Benzo(k)fluoranthene	2
Chrysene	3
Dibenz(a,h)anthracene	0.43
Fluoranthene	5
Fluorene	0.16
Indeno(1,2,3-cd)pyrene	1.7
Naphthalene	0.2
Phenanthrene	1.7
Pyrene	4

Figure 5-5. Concentrations of Organic SRCs in Surface Soil Samples at the Northern Area of Atlas Scrap Yard

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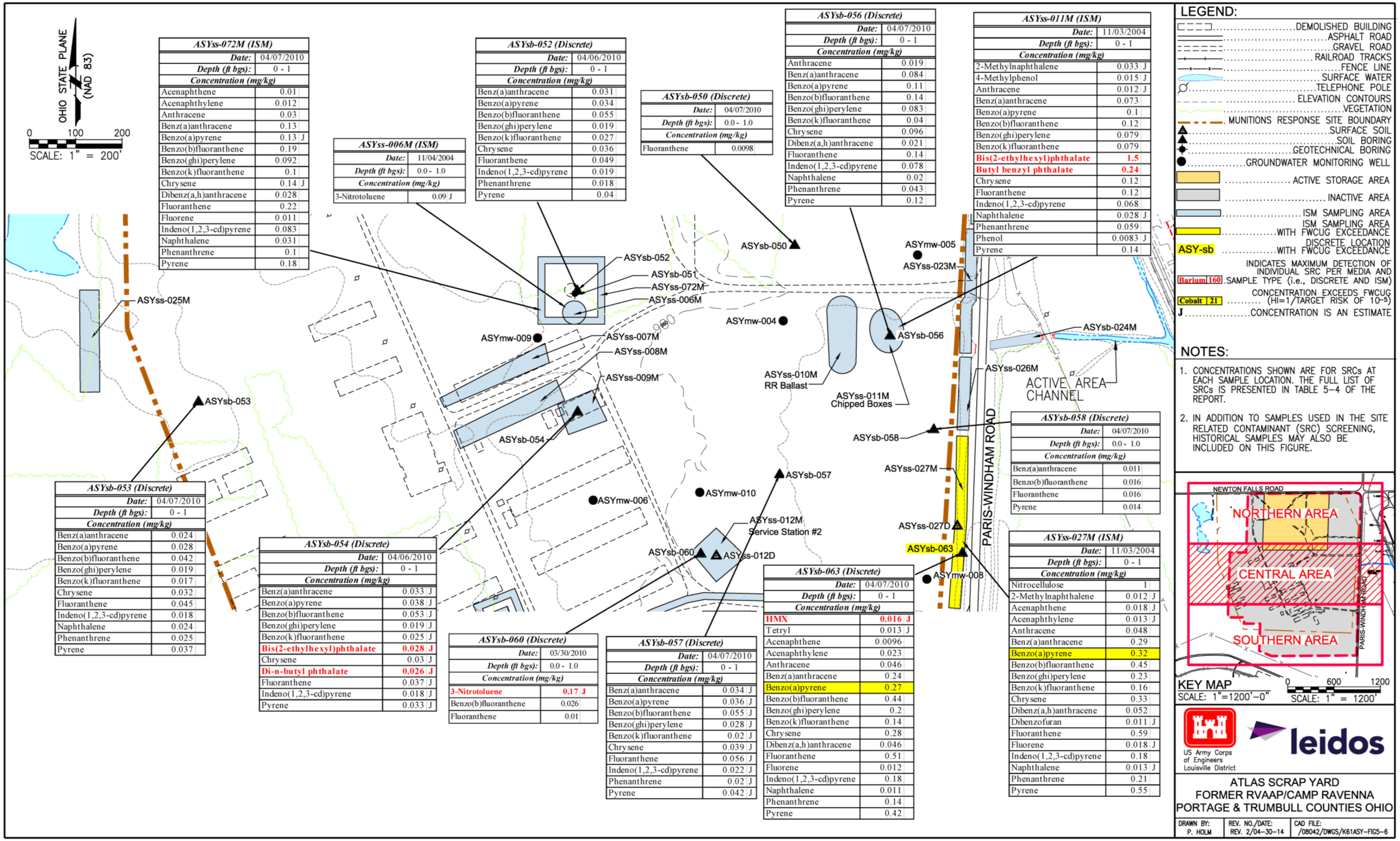

ASYss-072M (ISM)		
Date:	04/07/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.01	
Acenaphthylene	0.012	
Anthracene	0.03	
Benz(a)anthracene	0.13	
Benzo(a)pyrene	0.13	J
Benzo(b)fluoranthene	0.19	
Benzo(ghi)perylene	0.092	
Benzo(k)fluoranthene	0.1	
Chrysene	0.14	J
Dibenz(a,h)anthracene	0.028	
Fluoranthene	0.22	
Fluorene	0.011	
Indeno(1,2,3-cd)pyrene	0.083	
Naphthalene	0.031	
Phenanthrene	0.1	
Pyrene	0.18	

ASYss-006M (ISM)		
Date:	11/04/2004	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
3-Nitrotoluene	0.09	J

ASYsb-052 (Discrete)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Benz(a)anthracene	0.031	
Benzo(a)pyrene	0.034	
Benzo(b)fluoranthene	0.055	
Benzo(ghi)perylene	0.019	
Benzo(k)fluoranthene	0.027	
Chrysene	0.036	
Fluoranthene	0.049	
Indeno(1,2,3-cd)pyrene	0.019	
Phenanthrene	0.018	
Pyrene	0.04	

ASYsb-050 (Discrete)		
Date:	04/07/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Fluoranthene	0.0098	

ASYsb-056 (Discrete)		
Date:	04/07/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Anthracene	0.019	
Benz(a)anthracene	0.084	
Benzo(a)pyrene	0.11	
Benzo(b)fluoranthene	0.14	
Benzo(ghi)perylene	0.083	
Benzo(k)fluoranthene	0.04	
Chrysene	0.096	
Dibenz(a,h)anthracene	0.021	
Fluoranthene	0.14	
Indeno(1,2,3-cd)pyrene	0.078	
Naphthalene	0.02	
Phenanthrene	0.043	
Pyrene	0.12	

ASYss-011M (ISM)		
Date:	11/03/2004	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
2-Methylnaphthalene	0.033	J
4-Methylphenol	0.015	J
Anthracene	0.012	J
Benz(a)anthracene	0.073	
Benzo(a)pyrene	0.1	
Benzo(b)fluoranthene	0.12	
Benzo(ghi)perylene	0.079	
Benzo(k)fluoranthene	0.079	
Bis(2-ethylhexyl)phthalate	**1.5**	
Butyl benzyl phthalate	**0.24**	
Chrysene	0.12	
Fluoranthene	0.12	
Indeno(1,2,3-cd)pyrene	0.068	
Naphthalene	0.028	J
Phenanthrene	0.059	
Phenol	0.0083	J
Pyrene	0.14	

ASYsb-053 (Discrete)		
Date:	04/07/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Benz(a)anthracene	0.024	
Benzo(a)pyrene	0.028	
Benzo(b)fluoranthene	0.042	
Benzo(ghi)perylene	0.019	
Benzo(k)fluoranthene	0.017	
Chrysene	0.032	
Fluoranthene	0.045	
Indeno(1,2,3-cd)pyrene	0.018	
Naphthalene	0.024	
Phenanthrene	0.025	
Pyrene	0.037	

ASYsb-054 (Discrete)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Benz(a)anthracene	0.033	J
Benzo(a)pyrene	0.038	J
Benzo(b)fluoranthene	0.053	J
Benzo(ghi)perylene	0.019	J
Benzo(k)fluoranthene	0.025	J
Bis(2-ethylhexyl)phthalate	**0.028**	**J**
Chrysene	0.03	J
Di-n-butyl phthalate	**0.026**	**J**
Fluoranthene	0.037	J
Indeno(1,2,3-cd)pyrene	0.018	J
Pyrene	0.033	J

ASYsb-060 (Discrete)		
Date:	03/30/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
3-Nitrotoluene	**0.17**	**J**
Benzo(b)fluoranthene	0.026	
Fluoranthene	0.01	

ASYsb-057 (Discrete)		
Date:	04/07/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Benz(a)anthracene	0.034	J
Benzo(a)pyrene	0.036	J
Benzo(b)fluoranthene	0.055	J
Benzo(ghi)perylene	0.028	J
Benzo(k)fluoranthene	0.02	J
Chrysene	0.039	J
Fluoranthene	0.056	J
Indeno(1,2,3-cd)pyrene	0.022	J
Phenanthrene	0.02	J
Pyrene	0.042	J

ASYsb-063 (Discrete)		
Date:	04/07/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
HMX	**0.016**	**J**
Tetryl	0.013	J
Acenaphthene	0.0096	
Acenaphthylene	0.023	
Anthracene	0.046	
Benz(a)anthracene	0.24	
Benzo(a)pyrene	0.27	
Benzo(b)fluoranthene	0.44	
Benzo(ghi)perylene	0.2	
Benzo(k)fluoranthene	0.14	
Chrysene	0.28	
Dibenz(a,h)anthracene	0.046	
Fluoranthene	0.51	
Fluorene	0.012	
Indeno(1,2,3-cd)pyrene	0.18	
Naphthalene	0.011	
Phenanthrene	0.14	
Pyrene	0.42	

ASYsb-058 (Discrete)		
Date:	04/07/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Benz(a)anthracene	0.011	
Benzo(b)fluoranthene	0.016	
Fluoranthene	0.016	
Pyrene	0.014	

ASYss-027M (ISM)		
Date:	11/03/2004	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Nitrocellulose	1	
2-Methylnaphthalene	0.012	J
Acenaphthene	0.018	J
Acenaphthylene	0.013	J
Anthracene	0.048	
Benz(a)anthracene	0.29	
Benzo(a)pyrene	0.32	
Benzo(b)fluoranthene	0.45	
Benzo(ghi)perylene	0.23	
Benzo(k)fluoranthene	0.16	
Chrysene	0.33	
Dibenz(a,h)anthracene	0.052	
Dibenzofuran	0.011	J
Fluoranthene	0.59	
Fluorene	0.018	J
Indeno(1,2,3-cd)pyrene	0.18	
Naphthalene	0.013	J
Phenanthrene	0.21	
Pyrene	0.55	

LEGEND:

⊏ ⊐	DEMOLISHED BUILDING
═	ASPHALT ROAD
╌	GRAVEL ROAD
┼	RAILROAD TRACKS
×	FENCE LINE
🟦	SURFACE WATER
⌀	TELEPHONE POLE
╌	ELEVATION CONTOURS
〰	VEGETATION
▬ ▪ ▬	MUNITIONS RESPONSE SITE BOUNDARY
⚠	SURFACE SOIL
▲	SOIL BORING
⯁	GEOTECHNICAL BORING
●	GROUNDWATER MONITORING WELL
🟧	ACTIVE STORAGE AREA
⬜	INACTIVE AREA
🟦	ISM SAMPLING AREA
🟨	ISM SAMPLING AREA WITH FWCUG EXCEEDANCE
ASY-sb	DISCRETE LOCATION WITH FWCUG EXCEEDANCE
Barium 160	INDICATES MAXIMUM DETECTION OF INDIVIDUAL SRC PER MEDIA AND SAMPLE TYPE (i.e., DISCRETE AND ISM)
Cobalt 21	CONCENTRATION EXCEEDS FWCUG (HI=1/TARGET RISK OF 10^{-5})
J	CONCENTRATION IS AN ESTIMATE

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5-4 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.

ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

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P. HOLM	REV. 2/04-30-14	/08042/DWGS/K61ASY-FIG5-6

Figure 5-6. Concentrations of Organic SRCs in Surface Soil Samples at the Central Area of Atlas Scrap Yard

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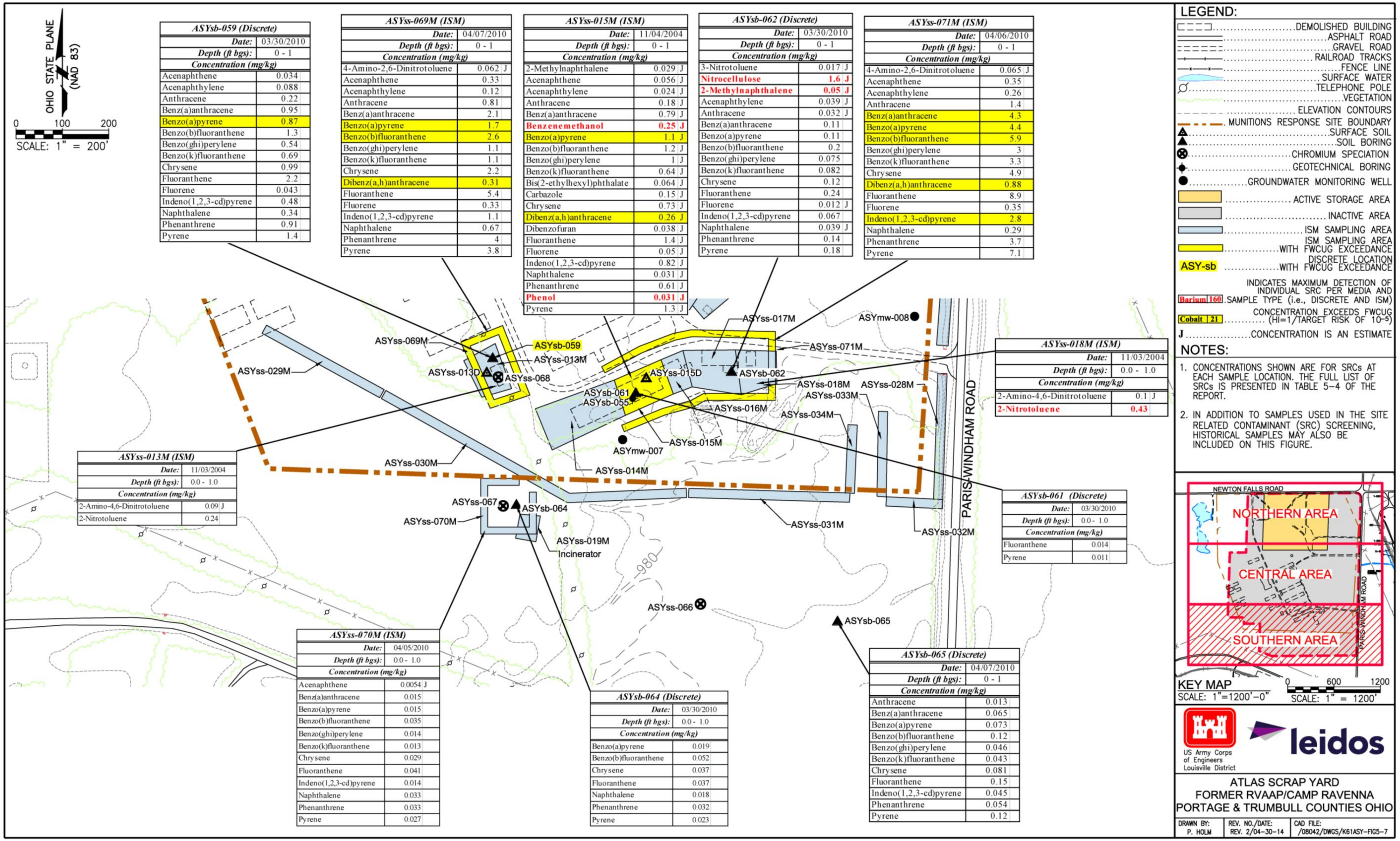

ASYsb-059 (Discrete)

Date:	03/30/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Acenaphthene	0.034
Acenaphthylene	0.088
Anthracene	0.22
Benz(a)anthracene	0.95
Benzo(a)pyrene	0.87
Benzo(b)fluoranthene	1.3
Benzo(ghi)perylene	0.54
Benzo(k)fluoranthene	0.69
Chrysene	0.99
Fluoranthene	2.2
Fluorene	0.043
Indeno(1,2,3-cd)pyrene	0.48
Naphthalene	0.34
Phenanthrene	0.91
Pyrene	1.4

ASYss-069M (ISM)

Date:	04/07/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
4-Amino-2,6-Dinitrotoluene	0.062 J
Acenaphthene	0.33
Acenaphthylene	0.12
Anthracene	0.81
Benz(a)anthracene	2.1
Benzo(a)pyrene	1.7
Benzo(b)fluoranthene	2.6
Benzo(ghi)perylene	1.1
Benzo(k)fluoranthene	1.1
Chrysene	2.2
Dibenz(a,h)anthracene	0.31
Fluoranthene	5.4
Fluorene	0.33
Indeno(1,2,3-cd)pyrene	1.1
Naphthalene	0.67
Phenanthrene	4
Pyrene	3.8

ASYss-015M (ISM)

Date:	11/04/2004
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
2-Methylnaphthalene	0.029 J
Acenaphthene	0.056 J
Acenaphthylene	0.024 J
Anthracene	0.18 J
Benz(a)anthracene	0.79 J
Benzenemethanol	**0.25 J**
Benzo(a)pyrene	1.1 J
Benzo(b)fluoranthene	1.2 J
Benzo(ghi)perylene	1 J
Benzo(k)fluoranthene	0.64 J
Bis(2-ethylhexyl)phthalate	0.064 J
Carbazole	0.15 J
Chrysene	0.73 J
Dibenz(a,h)anthracene	0.26 J
Dibenzofuran	0.038 J
Fluoranthene	1.4 J
Fluorene	0.05 J
Indeno(1,2,3-cd)pyrene	0.82 J
Naphthalene	0.031 J
Phenanthrene	0.61 J
Phenol	**0.031 J**
Pyrene	1.3 J

ASYsb-062 (Discrete)

Date:	03/30/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
3-Nitrotoluene	0.017 J
Nitrocellulose	**1.6 J**
2-Methylnaphthalene	**0.05 J**
Acenaphthylene	0.039 J
Anthracene	0.032 J
Benz(a)anthracene	0.11
Benzo(a)pyrene	0.11
Benzo(b)fluoranthene	0.2
Benzo(ghi)perylene	0.075
Benzo(k)fluoranthene	0.082
Chrysene	0.12
Fluoranthene	0.24
Fluorene	0.012 J
Indeno(1,2,3-cd)pyrene	0.067
Naphthalene	0.039 J
Phenanthrene	0.14
Pyrene	0.18

ASYss-071M (ISM)

Date:	04/06/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
4-Amino-2,6-Dinitrotoluene	0.065 J
Acenaphthene	0.35
Acenaphthylene	0.26
Anthracene	1.4
Benz(a)anthracene	4.3
Benzo(a)pyrene	4.4
Benzo(b)fluoranthene	5.9
Benzo(ghi)perylene	3
Benzo(k)fluoranthene	3.3
Chrysene	4.9
Dibenz(a,h)anthracene	0.88
Fluoranthene	8.9
Fluorene	0.35
Indeno(1,2,3-cd)pyrene	2.8
Naphthalene	0.29
Phenanthrene	3.7
Pyrene	7.1

ASYss-018M (ISM)

Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
2-Amino-4,6-Dinitrotoluene	0.1 J
2-Nitrotoluene	**0.43**

ASYss-013M (ISM)

Date:	11/03/2004
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
2-Amino-4,6-Dinitrotoluene	0.09 J
2-Nitrotoluene	0.24

ASYsb-061 (Discrete)

Date:	03/30/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Fluoranthene	0.014
Pyrene	0.011

ASYss-070M (ISM)

Date:	04/05/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Acenaphthene	0.0054 J
Benz(a)anthracene	0.015
Benzo(a)pyrene	0.015
Benzo(b)fluoranthene	0.035
Benzo(ghi)perylene	0.014
Benzo(k)fluoranthene	0.013
Chrysene	0.029
Fluoranthene	0.041
Indeno(1,2,3-cd)pyrene	0.014
Naphthalene	0.033
Phenanthrene	0.033
Pyrene	0.027

ASYsb-064 (Discrete)

Date:	03/30/2010
Depth (ft bgs):	0.0 - 1.0
Concentration (mg/kg)	
Benzo(a)pyrene	0.019
Benzo(b)fluoranthene	0.052
Chrysene	0.037
Fluoranthene	0.037
Naphthalene	0.018
Phenanthrene	0.032
Pyrene	0.023

ASYsb-065 (Discrete)

Date:	04/07/2010
Depth (ft bgs):	0 - 1
Concentration (mg/kg)	
Anthracene	0.013
Benz(a)anthracene	0.065
Benzo(a)pyrene	0.073
Benzo(b)fluoranthene	0.12
Benzo(ghi)perylene	0.046
Benzo(k)fluoranthene	0.043
Chrysene	0.081
Fluoranthene	0.15
Indeno(1,2,3-cd)pyrene	0.045
Phenanthrene	0.054
Pyrene	0.12

LEGEND:

- ⌐- - -⌐ .... DEMOLISHED BUILDING
- ═ .... ASPHALT ROAD
- - - - .... GRAVEL ROAD
- ─┼─┼─ .... RAILROAD TRACKS
- ─x─x─ .... FENCE LINE
- .... SURFACE WATER
- ⌀ .... TELEPHONE POLE
- .... VEGETATION
- - - - .... ELEVATION CONTOURS
- ▬ ▪ ▪ ▬ . MUNITIONS RESPONSE SITE BOUNDARY
- △ .... SURFACE SOIL
- ▲ .... SOIL BORING
- ⊗ .... CHROMIUM SPECIATION
- ⌖ .... GEOTECHNICAL BORING
- ● .... GROUNDWATER MONITORING WELL
- .... ACTIVE STORAGE AREA
- .... INACTIVE AREA
- .... ISM SAMPLING AREA
- .... ISM SAMPLING AREA WITH FWCUG EXCEEDANCE
- ASY-sb .... DISCRETE LOCATION WITH FWCUG EXCEEDANCE
- Barium 160 . INDICATES MAXIMUM DETECTION OF INDIVIDUAL SRC PER MEDIA AND SAMPLE TYPE (i.e., DISCRETE AND ISM)
- Cobalt 21 .... CONCENTRATION EXCEEDS FWCUG (HI=1/TARGET RISK OF 10^{-5})
- J .... CONCENTRATION IS AN ESTIMATE

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5-4 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.

US Army Corps
of Engineers
Louisville District

leidos

ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

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Figure 5-7. Concentrations of Organic SRCs in Surface Soil Samples at the Southern Area of Atlas Scrap Yard

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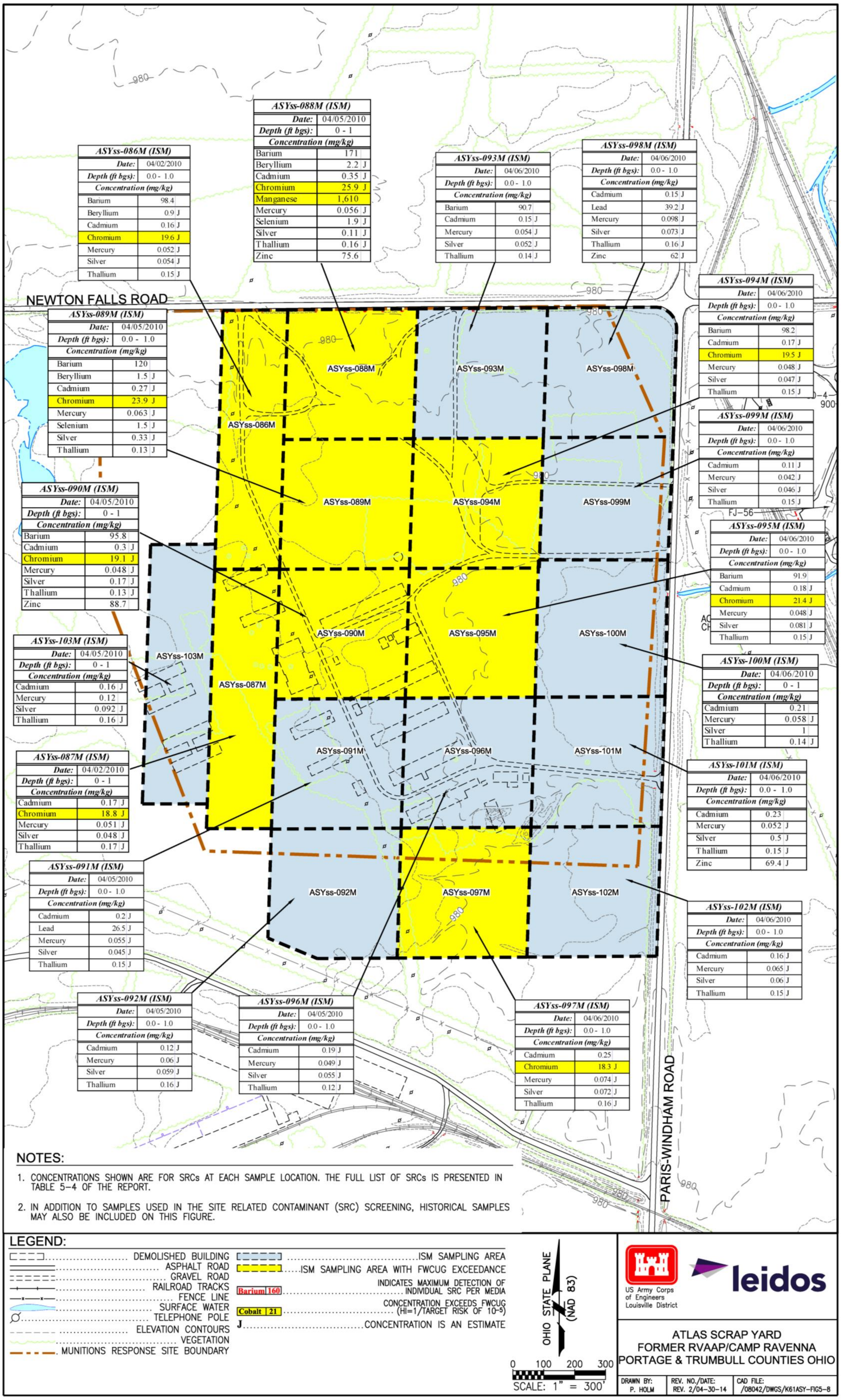

ASYss-088M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	171	
Beryllium	2.2	J
Cadmium	0.35	J
Chromium	25.9	J
Manganese	1,610	
Mercury	0.056	J
Selenium	1.9	J
Silver	0.11	J
Thallium	0.16	J
Zinc	75.6	

ASYss-086M (ISM)		
Date:	04/02/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	98.4	
Beryllium	0.9	J
Cadmium	0.16	J
Chromium	19.6	J
Mercury	0.052	J
Silver	0.054	J
Thallium	0.15	J

ASYss-093M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	90.7	
Cadmium	0.15	J
Mercury	0.054	J
Silver	0.052	J
Thallium	0.14	J

ASYss-098M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Cadmium	0.15	J
Lead	39.2	J
Mercury	0.098	J
Silver	0.073	J
Thallium	0.16	J
Zinc	62	J

ASYss-094M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	98.2	
Cadmium	0.17	J
Chromium	19.5	J
Mercury	0.048	J
Silver	0.047	J
Thallium	0.15	J

ASYss-089M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	120	
Beryllium	1.5	J
Cadmium	0.27	J
Chromium	23.9	J
Mercury	0.063	J
Selenium	1.5	J
Silver	0.33	J
Thallium	0.13	J

ASYss-099M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Cadmium	0.11	J
Mercury	0.042	J
Silver	0.046	J
Thallium	0.15	J

ASYss-090M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	95.8	
Cadmium	0.3	J
Chromium	19.1	J
Mercury	0.048	J
Silver	0.17	J
Thallium	0.13	J
Zinc	88.7	

ASYss-095M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Barium	91.9	
Cadmium	0.18	J
Chromium	21.4	J
Mercury	0.048	J
Silver	0.081	J
Thallium	0.15	J

ASYss-103M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Cadmium	0.16	J
Mercury	0.12	
Silver	0.092	J
Thallium	0.16	J

ASYss-100M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Cadmium	0.21	
Mercury	0.058	J
Silver	1	
Thallium	0.14	J

ASYss-087M (ISM)		
Date:	04/02/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Cadmium	0.17	J
Chromium	18.8	J
Mercury	0.051	J
Silver	0.048	J
Thallium	0.17	J

ASYss-101M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Cadmium	0.23	
Mercury	0.052	J
Silver	0.5	J
Thallium	0.15	J
Zinc	69.4	J

ASYss-091M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Cadmium	0.2	J
Lead	26.5	J
Mercury	0.055	J
Silver	0.045	J
Thallium	0.15	J

ASYss-102M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Cadmium	0.16	J
Mercury	0.065	J
Silver	0.06	J
Thallium	0.15	J

ASYss-092M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Cadmium	0.12	J
Mercury	0.06	J
Silver	0.059	J
Thallium	0.16	J

ASYss-096M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Cadmium	0.19	J
Mercury	0.049	J
Silver	0.055	J
Thallium	0.12	J

ASYss-097M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0.0 - 1.0	
Concentration (mg/kg)		
Cadmium	0.25	
Chromium	18.3	J
Mercury	0.074	J
Silver	0.072	J
Thallium	0.16	J

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5–4 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.

Figure 5-8. Concentrations of Inorganic SRCs in Grid ISM Surface Soil Samples

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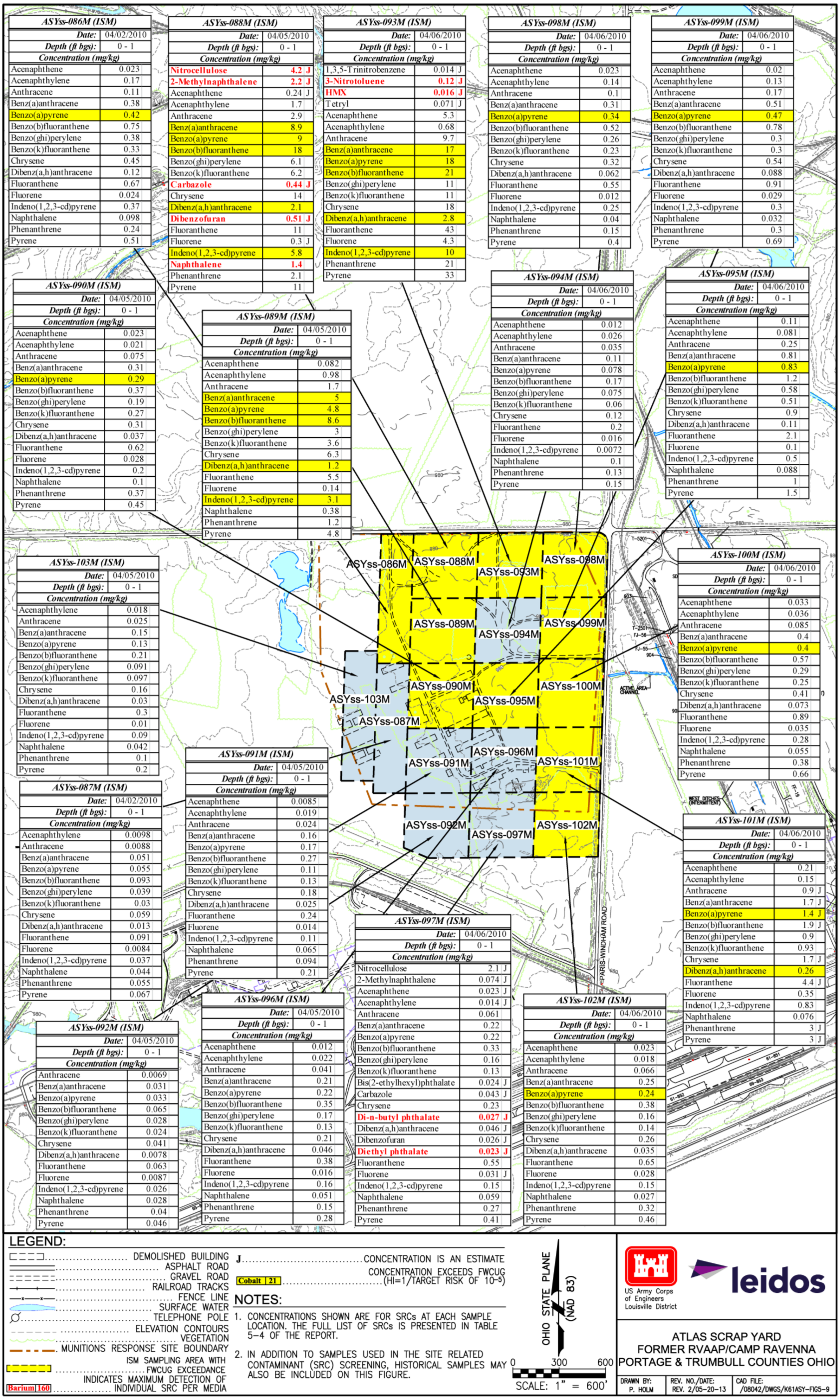

ASYss-086M (ISM)		
Date:	04/02/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.023	
Acenaphthylene	0.17	
Anthracene	0.11	
Benz(a)anthracene	0.38	
Benzo(a)pyrene	0.42	
Benzo(b)fluoranthene	0.75	
Benzo(ghi)perylene	0.38	
Benzo(k)fluoranthene	0.33	
Chrysene	0.45	
Dibenz(a,h)anthracene	0.12	
Fluoranthene	0.67	
Fluorene	0.024	
Indeno(1,2,3-cd)pyrene	0.37	
Naphthalene	0.098	
Phenanthrene	0.24	
Pyrene	0.51	

ASYss-088M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Nitrocellulose	**4.2**	**J**
2-Methylnaphthalene	**2.2**	**J**
Acenaphthene	0.24	J
Acenaphthylene	1.7	
Anthracene	2.9	
Benz(a)anthracene	8.9	
Benzo(a)pyrene	9	
Benzo(b)fluoranthene	18	
Benzo(ghi)perylene	6.1	
Benzo(k)fluoranthene	6.2	
Carbazole	**0.44**	**J**
Chrysene	14	
Dibenz(a,h)anthracene	2.1	
Dibenzofuran	**0.51**	**J**
Fluoranthene	11	
Fluorene	0.3	J
Indeno(1,2,3-cd)pyrene	5.8	
Naphthalene	**1.4**	
Phenanthrene	2.1	
Pyrene	11	

ASYss-093M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
1,3,5-Trinitrobenzene	0.014	J
3-Nitrotoluene	**0.12**	**J**
HMX	**0.016**	**J**
Tetryl	0.071	J
Acenaphthene	5.3	
Acenaphthylene	0.68	
Anthracene	9.7	
Benz(a)anthracene	17	
Benzo(a)pyrene	18	
Benzo(b)fluoranthene	21	
Benzo(ghi)perylene	11	
Benzo(k)fluoranthene	11	
Chrysene	18	
Dibenz(a,h)anthracene	2.8	
Fluoranthene	43	
Fluorene	4.3	
Indeno(1,2,3-cd)pyrene	10	
Phenanthrene	21	
Pyrene	33	

ASYss-098M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.023	
Acenaphthylene	0.14	
Anthracene	0.1	
Benz(a)anthracene	0.31	
Benzo(a)pyrene	0.34	
Benzo(b)fluoranthene	0.52	
Benzo(ghi)perylene	0.26	
Benzo(k)fluoranthene	0.23	
Chrysene	0.32	
Dibenz(a,h)anthracene	0.062	
Fluoranthene	0.55	
Fluorene	0.012	
Indeno(1,2,3-cd)pyrene	0.25	
Naphthalene	0.04	
Phenanthrene	0.15	
Pyrene	0.4	

ASYss-099M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.02	
Acenaphthylene	0.13	
Anthracene	0.17	
Benz(a)anthracene	0.51	
Benzo(a)pyrene	0.47	
Benzo(b)fluoranthene	0.78	
Benzo(ghi)perylene	0.3	
Benzo(k)fluoranthene	0.3	
Chrysene	0.54	
Dibenz(a,h)anthracene	0.088	
Fluoranthene	0.91	
Fluorene	0.029	
Indeno(1,2,3-cd)pyrene	0.3	
Naphthalene	0.032	
Phenanthrene	0.3	
Pyrene	0.69	

ASYss-090M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.023	
Acenaphthylene	0.021	
Anthracene	0.075	
Benz(a)anthracene	0.31	
Benzo(a)pyrene	0.29	
Benzo(b)fluoranthene	0.37	
Benzo(ghi)perylene	0.19	
Benzo(k)fluoranthene	0.27	
Chrysene	0.31	
Dibenz(a,h)anthracene	0.037	
Fluoranthene	0.62	
Fluorene	0.028	
Indeno(1,2,3-cd)pyrene	0.2	
Naphthalene	0.1	
Phenanthrene	0.37	
Pyrene	0.45	

ASYss-089M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.082	
Acenaphthylene	0.98	
Anthracene	1.7	
Benz(a)anthracene	5	
Benzo(a)pyrene	4.8	
Benzo(b)fluoranthene	8.6	
Benzo(ghi)perylene	3	
Benzo(k)fluoranthene	3.6	
Chrysene	6.3	
Dibenz(a,h)anthracene	1.2	
Fluoranthene	5.5	
Fluorene	0.14	
Indeno(1,2,3-cd)pyrene	3.1	
Naphthalene	0.38	
Phenanthrene	1.2	
Pyrene	4.8	

ASYss-094M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.012	
Acenaphthylene	0.026	
Anthracene	0.035	
Benz(a)anthracene	0.11	
Benzo(a)pyrene	0.078	
Benzo(b)fluoranthene	0.17	
Benzo(ghi)perylene	0.075	
Benzo(k)fluoranthene	0.06	
Chrysene	0.12	
Fluoranthene	0.2	
Fluorene	0.016	
Indeno(1,2,3-cd)pyrene	0.0072	
Naphthalene	0.1	
Phenanthrene	0.13	
Pyrene	0.15	

ASYss-095M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.11	
Acenaphthylene	0.081	
Anthracene	0.25	
Benz(a)anthracene	0.81	
Benzo(a)pyrene	0.83	
Benzo(b)fluoranthene	1.2	
Benzo(ghi)perylene	0.58	
Benzo(k)fluoranthene	0.51	
Chrysene	0.9	
Dibenz(a,h)anthracene	0.11	
Fluoranthene	2.1	
Fluorene	0.1	
Indeno(1,2,3-cd)pyrene	0.5	
Naphthalene	0.088	
Phenanthrene	1	
Pyrene	1.5	

ASYss-103M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthylene	0.018	
Anthracene	0.025	
Benz(a)anthracene	0.15	
Benzo(a)pyrene	0.13	
Benzo(b)fluoranthene	0.21	
Benzo(ghi)perylene	0.091	
Benzo(k)fluoranthene	0.097	
Chrysene	0.16	
Dibenz(a,h)anthracene	0.03	
Fluoranthene	0.3	
Fluorene	0.01	
Indeno(1,2,3-cd)pyrene	0.09	
Naphthalene	0.042	
Phenanthrene	0.1	
Pyrene	0.2	

ASYss-100M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.033	
Acenaphthylene	0.036	
Anthracene	0.085	
Benz(a)anthracene	0.4	
Benzo(a)pyrene	0.4	
Benzo(b)fluoranthene	0.57	
Benzo(ghi)perylene	0.29	
Benzo(k)fluoranthene	0.25	
Chrysene	0.41	
Dibenz(a,h)anthracene	0.073	
Fluoranthene	0.89	
Fluorene	0.035	
Indeno(1,2,3-cd)pyrene	0.28	
Naphthalene	0.055	
Phenanthrene	0.38	
Pyrene	0.66	

ASYss-091M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.0085	
Acenaphthylene	0.019	
Anthracene	0.024	
Benz(a)anthracene	0.16	
Benzo(a)pyrene	0.17	
Benzo(b)fluoranthene	0.27	
Benzo(ghi)perylene	0.11	
Benzo(k)fluoranthene	0.13	
Chrysene	0.18	
Dibenz(a,h)anthracene	0.025	
Fluoranthene	0.24	
Fluorene	0.014	
Indeno(1,2,3-cd)pyrene	0.11	
Naphthalene	0.065	
Phenanthrene	0.094	
Pyrene	0.21	

ASYss-087M (ISM)		
Date:	04/02/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthylene	0.0098	
Anthracene	0.0088	
Benz(a)anthracene	0.051	
Benzo(a)pyrene	0.055	
Benzo(b)fluoranthene	0.093	
Benzo(ghi)perylene	0.039	
Benzo(k)fluoranthene	0.03	
Chrysene	0.059	
Dibenz(a,h)anthracene	0.013	
Fluoranthene	0.091	
Fluorene	0.0084	
Indeno(1,2,3-cd)pyrene	0.037	
Naphthalene	0.044	
Phenanthrene	0.055	
Pyrene	0.067	

ASYss-101M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.21	
Acenaphthylene	0.15	
Anthracene	0.9	J
Benz(a)anthracene	1.7	J
Benzo(a)pyrene	1.4	J
Benzo(b)fluoranthene	1.9	J
Benzo(ghi)perylene	0.9	
Benzo(k)fluoranthene	0.93	
Chrysene	1.7	J
Dibenz(a,h)anthracene	0.26	
Fluoranthene	4.4	J
Fluorene	0.35	
Indeno(1,2,3-cd)pyrene	0.83	
Naphthalene	0.076	
Phenanthrene	3	J
Pyrene	3	J

ASYss-097M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Nitrocellulose	2.1	J
2-Methylnaphthalene	0.074	J
Acenaphthene	0.023	J
Acenaphthylene	0.014	J
Anthracene	0.061	
Benz(a)anthracene	0.22	
Benzo(a)pyrene	0.22	
Benzo(b)fluoranthene	0.33	
Benzo(ghi)perylene	0.16	
Benzo(k)fluoranthene	0.13	
Bis(2-ethylhexyl)phthalate	0.024	J
Carbazole	0.043	J
Chrysene	0.23	
Di-n-butyl phthalate	**0.027**	**J**
Dibenz(a,h)anthracene	0.046	J
Dibenzofuran	0.026	J
Diethyl phthalate	**0.023**	**J**
Fluoranthene	0.55	
Fluorene	0.031	J
Indeno(1,2,3-cd)pyrene	0.15	
Naphthalene	0.059	
Phenanthrene	0.27	
Pyrene	0.41	

ASYss-096M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.012	
Acenaphthylene	0.022	
Anthracene	0.041	
Benz(a)anthracene	0.21	
Benzo(a)pyrene	0.22	
Benzo(b)fluoranthene	0.35	
Benzo(ghi)perylene	0.17	
Benzo(k)fluoranthene	0.13	
Chrysene	0.21	
Dibenz(a,h)anthracene	0.046	
Fluoranthene	0.38	
Fluorene	0.016	
Indeno(1,2,3-cd)pyrene	0.16	
Naphthalene	0.051	
Phenanthrene	0.15	
Pyrene	0.28	

ASYss-102M (ISM)		
Date:	04/06/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.023	
Acenaphthylene	0.018	
Anthracene	0.066	
Benz(a)anthracene	0.25	
Benzo(a)pyrene	0.24	
Benzo(b)fluoranthene	0.38	
Benzo(ghi)perylene	0.16	
Benzo(k)fluoranthene	0.14	
Chrysene	0.26	
Dibenz(a,h)anthracene	0.035	
Fluoranthene	0.65	
Fluorene	0.028	
Indeno(1,2,3-cd)pyrene	0.15	
Naphthalene	0.027	
Phenanthrene	0.32	
Pyrene	0.46	

ASYss-092M (ISM)		
Date:	04/05/2010	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Anthracene	0.0069	
Benz(a)anthracene	0.031	
Benzo(a)pyrene	0.033	
Benzo(b)fluoranthene	0.065	
Benzo(ghi)perylene	0.028	
Benzo(k)fluoranthene	0.024	
Chrysene	0.041	
Dibenz(a,h)anthracene	0.0078	
Fluoranthene	0.063	
Fluorene	0.0087	
Indeno(1,2,3-cd)pyrene	0.026	
Naphthalene	0.028	
Phenanthrene	0.04	
Pyrene	0.046	

LEGEND:

⊏⊐	DEMOLISHED BUILDING
═	ASPHALT ROAD
‐ ‐ ‐	GRAVEL ROAD
─┼─	RAILROAD TRACKS
─x─	FENCE LINE
▬	SURFACE WATER
Ø	TELEPHONE POLE
‐ ‐ ‐	ELEVATION CONTOURS
〰	VEGETATION
▬ ‐ ‐ ▬	MUNITIONS RESPONSE SITE BOUNDARY
▭	ISM SAMPLING AREA WITH FWCUG EXCEEDANCE
Barium | 160	INDICATES MAXIMUM DETECTION OF INDIVIDUAL SRC PER MEDIA
J	CONCENTRATION IS AN ESTIMATE
Cobalt | 21	CONCENTRATION EXCEEDS FWCUG (HI=1/TARGET RISK OF 10^{-5})

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5-4 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.

US Army Corps of Engineers
Louisville District

leidos

ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

DRAWN BY:	REV. NO./DATE:	CAD FILE:
P. HOLM	REV. 2/05-20-13	/08042/DWGS/K61ASY-FIG5-9

Figure 5-9. Concentrations of Organic SRCs in Grid ISM Surface Soil Samples

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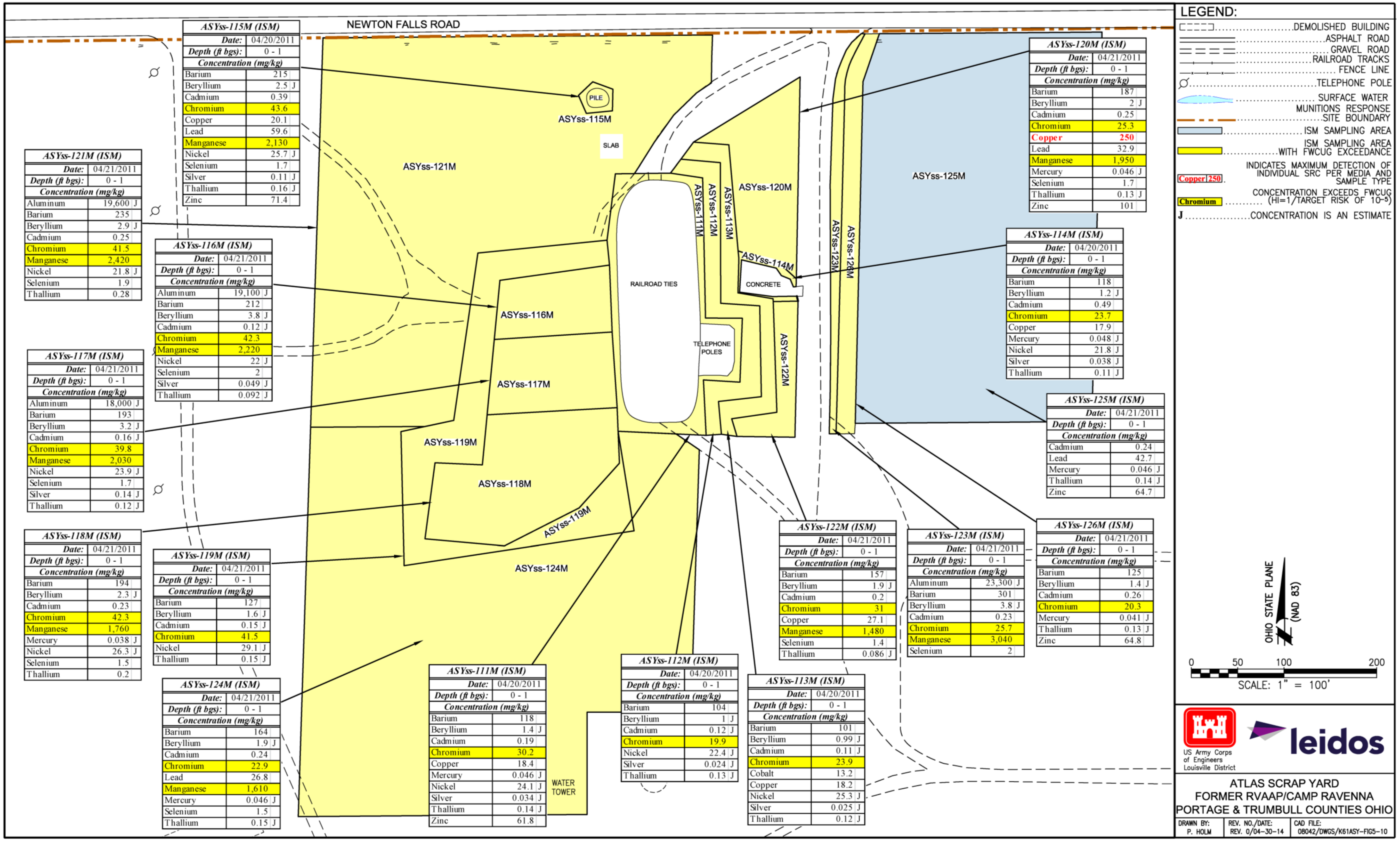

ASYss-115M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	215	
Beryllium	2.5	J
Cadmium	0.39	
Chromium	43.6	
Copper	20.1	
Lead	59.6	
Manganese	2,130	
Nickel	25.7	J
Selenium	1.7	
Silver	0.11	J
Thallium	0.16	J
Zinc	71.4	

ASYss-121M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	19,600	J
Barium	235	
Beryllium	2.9	J
Cadmium	0.25	
Chromium	41.5	
Manganese	2,420	
Nickel	21.8	J
Selenium	1.9	
Thallium	0.28	

ASYss-116M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	19,100	J
Barium	212	
Beryllium	3.8	J
Cadmium	0.12	J
Chromium	42.3	
Manganese	2,220	
Nickel	22	J
Selenium	2	
Silver	0.049	J
Thallium	0.092	J

ASYss-117M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	18,000	J
Barium	193	
Beryllium	3.2	J
Cadmium	0.16	J
Chromium	39.8	
Manganese	2,030	
Nickel	23.9	J
Selenium	1.7	
Silver	0.14	J
Thallium	0.12	J

ASYss-118M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	194	
Beryllium	2.3	J
Cadmium	0.23	
Chromium	42.3	
Manganese	1,760	
Mercury	0.038	J
Nickel	26.3	J
Selenium	1.5	
Thallium	0.2	

ASYss-119M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	127	
Beryllium	1.6	J
Cadmium	0.15	J
Chromium	41.5	
Nickel	29.1	J
Thallium	0.15	J

ASYss-124M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	164	
Beryllium	1.9	J
Cadmium	0.24	
Chromium	22.9	
Lead	26.8	
Manganese	1,610	
Mercury	0.046	J
Selenium	1.5	
Thallium	0.15	J

ASYss-111M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	118	
Beryllium	1.4	J
Cadmium	0.19	
Chromium	30.2	
Copper	18.4	
Mercury	0.046	J
Nickel	24.1	J
Silver	0.034	J
Thallium	0.14	J
Zinc	61.8	

ASYss-112M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	104	
Beryllium	1	J
Cadmium	0.12	J
Chromium	19.9	
Nickel	22.4	J
Silver	0.024	J
Thallium	0.13	J

ASYss-113M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	101	
Beryllium	0.99	J
Cadmium	0.11	J
Chromium	23.9	
Cobalt	13.2	
Copper	18.2	
Nickel	25.3	J
Silver	0.025	J
Thallium	0.12	J

ASYss-122M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	157	
Beryllium	1.9	J
Cadmium	0.2	
Chromium	31	
Copper	27.1	
Manganese	1,480	
Selenium	1.4	
Thallium	0.086	J

ASYss-123M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Aluminum	23,300	J
Barium	301	
Beryllium	3.8	J
Cadmium	0.23	
Chromium	25.7	
Manganese	3,040	
Selenium	2	

ASYss-126M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	125	
Beryllium	1.4	J
Cadmium	0.26	
Chromium	20.3	
Mercury	0.041	J
Thallium	0.13	J
Zinc	64.8	

ASYss-120M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	187	
Beryllium	2	J
Cadmium	0.25	
Chromium	25.3	
Copper	250	
Lead	32.9	
Manganese	1,950	
Mercury	0.046	J
Selenium	1.7	
Thallium	0.13	J
Zinc	101	

ASYss-114M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Barium	118	
Beryllium	1.2	J
Cadmium	0.49	
Chromium	23.7	
Copper	17.9	
Mercury	0.048	J
Nickel	21.8	J
Silver	0.038	J
Thallium	0.11	J

ASYss-125M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Cadmium	0.24	
Lead	42.7	
Mercury	0.046	J
Thallium	0.14	J
Zinc	64.7	

Figure 5-10. Concentrations of Inorganic SRCs in Active Storage Area ISM Surface Soil Samples

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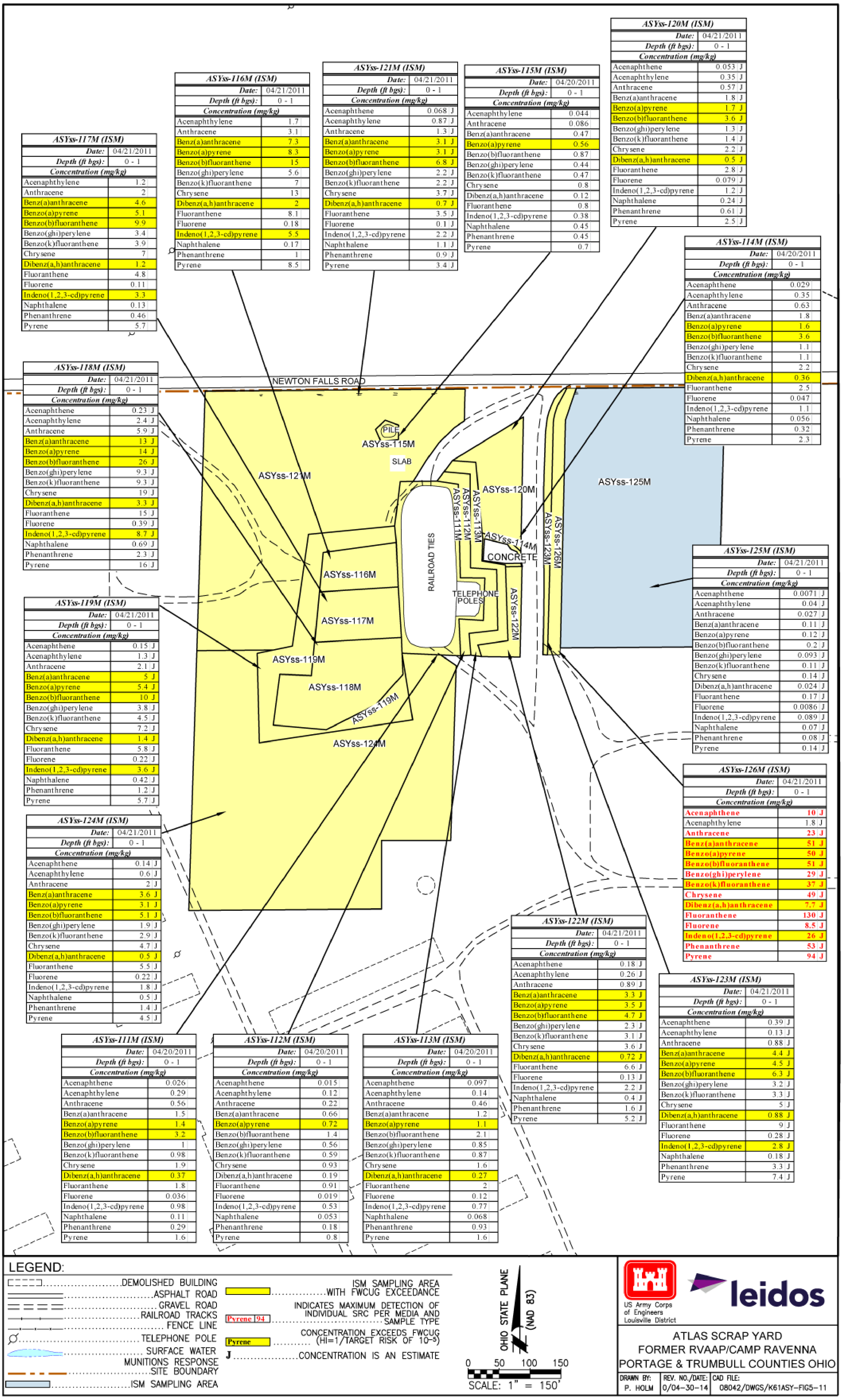

ASYss-120M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.053	J
Acenaphthylene	0.35	J
Anthracene	0.57	J
Benz(a)anthracene	1.8	J
Benzo(a)pyrene	1.7	J
Benzo(b)fluoranthene	3.6	J
Benzo(ghi)perylene	1.3	J
Benzo(k)fluoranthene	1.4	J
Chrysene	2.2	J
Dibenz(a,h)anthracene	0.5	J
Fluoranthene	2.8	J
Fluorene	0.079	J
Indeno(1,2,3-cd)pyrene	1.2	J
Naphthalene	0.24	J
Phenanthrene	0.61	J
Pyrene	2.5	J

ASYss-121M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.068	J
Acenaphthylene	0.87	J
Anthracene	1.3	J
Benz(a)anthracene	3.1	J
Benzo(a)pyrene	3.1	J
Benzo(b)fluoranthene	6.8	J
Benzo(ghi)perylene	2.2	J
Benzo(k)fluoranthene	2.2	J
Chrysene	3.7	J
Dibenz(a,h)anthracene	0.7	J
Fluoranthene	3.5	J
Fluorene	0.1	J
Indeno(1,2,3-cd)pyrene	2.2	J
Naphthalene	1.1	J
Phenanthrene	0.9	J
Pyrene	3.4	J

ASYss-115M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthylene	0.044	
Anthracene	0.086	
Benz(a)anthracene	0.47	
Benzo(a)pyrene	0.56	
Benzo(b)fluoranthene	0.87	
Benzo(ghi)perylene	0.44	
Benzo(k)fluoranthene	0.47	
Chrysene	0.8	
Dibenz(a,h)anthracene	0.12	
Fluoranthene	0.8	
Indeno(1,2,3-cd)pyrene	0.38	
Naphthalene	0.45	
Phenanthrene	0.45	
Pyrene	0.7	

ASYss-116M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthylene	1.7	
Anthracene	3.1	
Benz(a)anthracene	7.3	
Benzo(a)pyrene	8.3	
Benzo(b)fluoranthene	15	
Benzo(ghi)perylene	5.6	
Benzo(k)fluoranthene	7	
Chrysene	13	
Dibenz(a,h)anthracene	2	
Fluoranthene	8.1	
Fluorene	0.18	
Indeno(1,2,3-cd)pyrene	5.5	
Naphthalene	0.17	
Phenanthrene	1	
Pyrene	8.5	

ASYss-117M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthylene	1.2	
Anthracene	2	
Benz(a)anthracene	4.6	
Benzo(a)pyrene	5.1	
Benzo(b)fluoranthene	9.9	
Benzo(ghi)perylene	3.4	
Benzo(k)fluoranthene	3.9	
Chrysene	7	
Dibenz(a,h)anthracene	1.2	
Fluoranthene	4.8	
Fluorene	0.11	
Indeno(1,2,3-cd)pyrene	3.3	
Naphthalene	0.13	
Phenanthrene	0.46	
Pyrene	5.7	

ASYss-114M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.029	
Acenaphthylene	0.35	
Anthracene	0.63	
Benz(a)anthracene	1.8	
Benzo(a)pyrene	1.6	
Benzo(b)fluoranthene	3.6	
Benzo(ghi)perylene	1.1	
Benzo(k)fluoranthene	1.1	
Chrysene	2.2	
Dibenz(a,h)anthracene	0.36	
Fluoranthene	2.5	
Fluorene	0.047	
Indeno(1,2,3-cd)pyrene	1.1	
Naphthalene	0.056	
Phenanthrene	0.32	
Pyrene	2.3	

ASYss-118M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.23	J
Acenaphthylene	2.4	J
Anthracene	5.9	J
Benz(a)anthracene	13	J
Benzo(a)pyrene	14	J
Benzo(b)fluoranthene	26	J
Benzo(ghi)perylene	9.3	J
Benzo(k)fluoranthene	9.3	J
Chrysene	19	J
Dibenz(a,h)anthracene	3.3	J
Fluoranthene	15	J
Fluorene	0.39	J
Indeno(1,2,3-cd)pyrene	8.7	J
Naphthalene	0.69	J
Phenanthrene	2.3	J
Pyrene	16	J

ASYss-125M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.0071	J
Acenaphthylene	0.04	J
Anthracene	0.027	J
Benz(a)anthracene	0.11	J
Benzo(a)pyrene	0.12	J
Benzo(b)fluoranthene	0.2	J
Benzo(ghi)perylene	0.093	J
Benzo(k)fluoranthene	0.11	J
Chrysene	0.14	J
Dibenz(a,h)anthracene	0.024	J
Fluoranthene	0.17	J
Fluorene	0.0086	J
Indeno(1,2,3-cd)pyrene	0.089	J
Naphthalene	0.07	J
Phenanthrene	0.08	J
Pyrene	0.14	J

ASYss-119M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.15	J
Acenaphthylene	1.3	J
Anthracene	2.1	J
Benz(a)anthracene	5	J
Benzo(a)pyrene	5.4	J
Benzo(b)fluoranthene	10	J
Benzo(ghi)perylene	3.8	J
Benzo(k)fluoranthene	4.5	J
Chrysene	7.2	J
Dibenz(a,h)anthracene	1.4	J
Fluoranthene	5.8	J
Fluorene	0.22	J
Indeno(1,2,3-cd)pyrene	3.6	J
Naphthalene	0.42	J
Phenanthrene	1.2	J
Pyrene	5.7	J

ASYss-126M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	**10**	**J**
Acenaphthylene	1.8	J
Anthracene	**23**	**J**
Benz(a)anthracene	**51**	**J**
Benzo(a)pyrene	**50**	**J**
Benzo(b)fluoranthene	**51**	**J**
Benzo(ghi)perylene	**29**	**J**
Benzo(k)fluoranthene	**37**	**J**
Chrysene	**49**	**J**
Dibenz(a,h)anthracene	**7.7**	**J**
Fluoranthene	**130**	**J**
Fluorene	**8.5**	**J**
Indeno(1,2,3-cd)pyrene	**26**	**J**
Phenanthrene	**53**	**J**
Pyrene	**94**	**J**

ASYss-124M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.14	J
Acenaphthylene	0.6	J
Anthracene	2	J
Benz(a)anthracene	3.6	J
Benzo(a)pyrene	3.1	J
Benzo(b)fluoranthene	5.1	J
Benzo(ghi)perylene	1.9	J
Benzo(k)fluoranthene	2.9	J
Chrysene	4.7	J
Dibenz(a,h)anthracene	0.5	J
Fluoranthene	5.5	J
Fluorene	0.22	J
Indeno(1,2,3-cd)pyrene	1.8	J
Naphthalene	0.5	J
Phenanthrene	1.4	J
Pyrene	4.5	J

ASYss-122M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.18	J
Acenaphthylene	0.26	J
Anthracene	0.89	J
Benz(a)anthracene	3.3	J
Benzo(a)pyrene	3.5	J
Benzo(b)fluoranthene	4.7	J
Benzo(ghi)perylene	2.3	J
Benzo(k)fluoranthene	3.1	J
Chrysene	3.6	J
Dibenz(a,h)anthracene	0.72	J
Fluoranthene	6.6	J
Fluorene	0.13	J
Indeno(1,2,3-cd)pyrene	2.2	J
Naphthalene	0.4	J
Phenanthrene	1.6	J
Pyrene	5.2	J

ASYss-123M (ISM)		
Date:	04/21/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.39	J
Acenaphthylene	0.13	J
Anthracene	0.88	J
Benz(a)anthracene	4.4	J
Benzo(a)pyrene	4.5	J
Benzo(b)fluoranthene	6.3	J
Benzo(ghi)perylene	3.2	J
Benzo(k)fluoranthene	3.3	J
Chrysene	5	J
Dibenz(a,h)anthracene	0.88	J
Fluoranthene	9	J
Fluorene	0.28	J
Indeno(1,2,3-cd)pyrene	2.8	J
Naphthalene	0.18	J
Phenanthrene	3.3	J
Pyrene	7.4	J

ASYss-111M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.026	
Acenaphthylene	0.29	
Anthracene	0.56	
Benz(a)anthracene	1.5	
Benzo(a)pyrene	1.4	
Benzo(b)fluoranthene	3.2	
Benzo(ghi)perylene	1	
Benzo(k)fluoranthene	0.98	
Chrysene	1.9	
Dibenz(a,h)anthracene	0.37	
Fluoranthene	1.8	
Fluorene	0.036	
Indeno(1,2,3-cd)pyrene	0.98	
Naphthalene	0.11	
Phenanthrene	0.29	
Pyrene	1.6	

ASYss-112M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.015	
Acenaphthylene	0.12	
Anthracene	0.22	
Benz(a)anthracene	0.66	
Benzo(a)pyrene	0.72	
Benzo(b)fluoranthene	1.4	
Benzo(ghi)perylene	0.56	
Benzo(k)fluoranthene	0.59	
Chrysene	0.93	
Dibenz(a,h)anthracene	0.19	
Fluoranthene	0.91	
Fluorene	0.019	
Indeno(1,2,3-cd)pyrene	0.53	
Naphthalene	0.053	
Phenanthrene	0.18	
Pyrene	0.8	

ASYss-113M (ISM)		
Date:	04/20/2011	
Depth (ft bgs):	0 - 1	
Concentration (mg/kg)		
Acenaphthene	0.097	
Acenaphthylene	0.14	
Anthracene	0.46	
Benz(a)anthracene	1.2	
Benzo(a)pyrene	1.1	
Benzo(b)fluoranthene	2.1	
Benzo(ghi)perylene	0.85	
Benzo(k)fluoranthene	0.87	
Chrysene	1.6	
Dibenz(a,h)anthracene	0.27	
Fluoranthene	2	
Fluorene	0.12	
Indeno(1,2,3-cd)pyrene	0.77	
Naphthalene	0.068	
Phenanthrene	0.93	
Pyrene	1.6	

Figure 5-11. Concentrations of Organic SRCs in Active Storage Area ISM Surface Soil Samples

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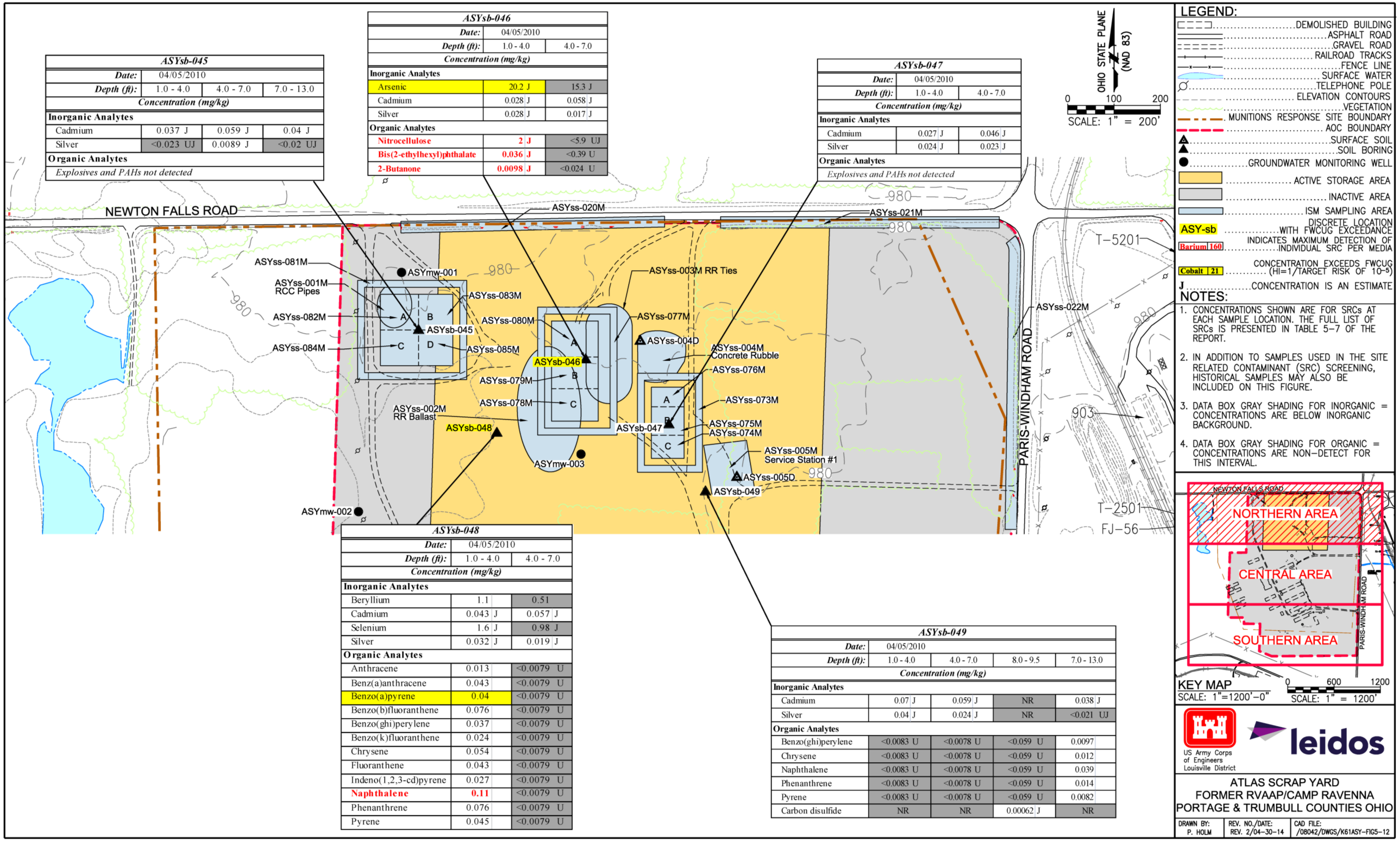

ASYsb-045			
Date:	04/05/2010		
Depth (ft):	1.0 - 4.0	4.0 - 7.0	7.0 - 13.0
Concentration (mg/kg)			
Inorganic Analytes			
Cadmium	0.037 J	0.059 J	0.04 J
Silver	<0.023 UJ	0.0089 J	<0.02 UJ
Organic Analytes			
Explosives and PAHs not detected			

ASYsb-046		
Date:	04/05/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Arsenic	20.2 J	15.3 J
Cadmium	0.028 J	0.058 J
Silver	0.028 J	0.017 J
Organic Analytes		
Nitrocellulose	**2 J**	<5.9 UJ
Bis(2-ethylhexyl)phthalate	**0.036 J**	<0.39 U
2-Butanone	**0.0098 J**	<0.024 U

ASYsb-047		
Date:	04/05/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.027 J	0.046 J
Silver	0.024 J	0.023 J
Organic Analytes		
Explosives and PAHs not detected		

ASYsb-048		
Date:	04/05/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Beryllium	1.1	0.51
Cadmium	0.043 J	0.057 J
Selenium	1.6 J	0.98 J
Silver	0.032 J	0.019 J
Organic Analytes		
Anthracene	0.013	<0.0079 U
Benz(a)anthracene	0.043	<0.0079 U
Benzo(a)pyrene	0.04	<0.0079 U
Benzo(b)fluoranthene	0.076	<0.0079 U
Benzo(ghi)perylene	0.037	<0.0079 U
Benzo(k)fluoranthene	0.024	<0.0079 U
Chrysene	0.054	<0.0079 U
Fluoranthene	0.043	<0.0079 U
Indeno(1,2,3-cd)pyrene	0.027	<0.0079 U
Naphthalene	**0.11**	<0.0079 U
Phenanthrene	0.076	<0.0079 U
Pyrene	0.045	<0.0079 U

ASYsb-049				
Date:	04/05/2010			
Depth (ft):	1.0 - 4.0	4.0 - 7.0	8.0 - 9.5	7.0 - 13.0
Concentration (mg/kg)				
Inorganic Analytes				
Cadmium	0.07 J	0.059 J	NR	0.038 J
Silver	0.04 J	0.024 J	NR	<0.021 UJ
Organic Analytes				
Benzo(ghi)perylene	<0.0083 U	<0.0078 U	<0.059 U	0.0097
Chrysene	<0.0083 U	<0.0078 U	<0.059 U	0.012
Naphthalene	<0.0083 U	<0.0078 U	<0.059 U	0.039
Phenanthrene	<0.0083 U	<0.0078 U	<0.059 U	0.014
Pyrene	<0.0083 U	<0.0078 U	<0.059 U	0.0082
Carbon disulfide	NR	NR	0.00062 J	NR

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5-7 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.
3. DATA BOX GRAY SHADING FOR INORGANIC = CONCENTRATIONS ARE BELOW INORGANIC BACKGROUND.
4. DATA BOX GRAY SHADING FOR ORGANIC = CONCENTRATIONS ARE NON-DETECT FOR THIS INTERVAL.

ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

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Figure 5-12. Concentrations of SRCs in Subsurface Soil Samples at the Northern Area of Atlas Scrap Yard

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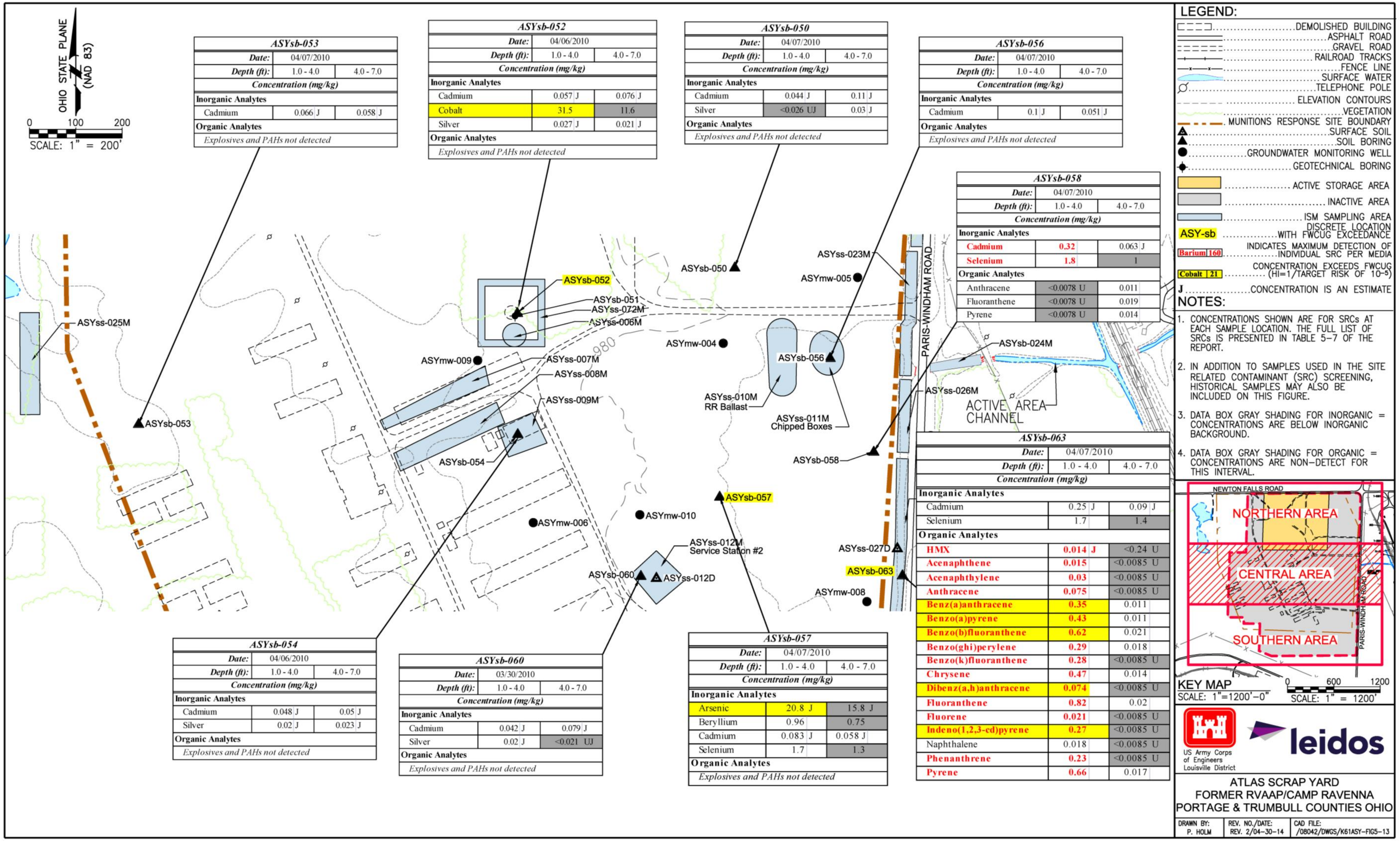

ASYsb-053		
Date:	04/07/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.066 J	0.058 J
Organic Analytes		
Explosives and PAHs not detected		

ASYsb-052		
Date:	04/06/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.057 J	0.076 J
Cobalt	31.5	11.6
Silver	0.027 J	0.021 J
Organic Analytes		
Explosives and PAHs not detected		

ASYsb-050		
Date:	04/07/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.044 J	0.11 J
Silver	<0.026 UJ	0.03 J
Organic Analytes		
Explosives and PAHs not detected		

ASYsb-056		
Date:	04/07/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.1 J	0.051 J
Organic Analytes		
Explosives and PAHs not detected		

ASYsb-058		
Date:	04/07/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	**0.32**	0.063 J
Selenium	**1.8**	1
Organic Analytes		
Anthracene	<0.0078 U	0.011
Fluoranthene	<0.0078 U	0.019
Pyrene	<0.0078 U	0.014

ASYsb-063		
Date:	04/07/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.25 J	0.09 J
Selenium	1.7	1.4
Organic Analytes		
HMX	**0.014 J**	<0.24 U
Acenaphthene	**0.015**	<0.0085 U
Acenaphthylene	**0.03**	<0.0085 U
Anthracene	**0.075**	<0.0085 U
Benz(a)anthracene	**0.35**	0.011
Benzo(a)pyrene	**0.43**	0.011
Benzo(b)fluoranthene	**0.62**	0.021
Benzo(ghi)perylene	**0.29**	0.018
Benzo(k)fluoranthene	**0.28**	<0.0085 U
Chrysene	**0.47**	0.014
Dibenz(a,h)anthracene	**0.074**	<0.0085 U
Fluoranthene	**0.82**	0.02
Fluorene	**0.021**	<0.0085 U
Indeno(1,2,3-cd)pyrene	**0.27**	<0.0085 U
Naphthalene	0.018	<0.0085 U
Phenanthrene	**0.23**	<0.0085 U
Pyrene	**0.66**	0.017

ASYsb-054		
Date:	04/06/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.048 J	0.05 J
Silver	0.02 J	0.023 J
Organic Analytes		
Explosives and PAHs not detected		

ASYsb-060		
Date:	03/30/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.042 J	0.079 J
Silver	0.02 J	<0.021 UJ
Organic Analytes		
Explosives and PAHs not detected		

ASYsb-057		
Date:	04/07/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Arsenic	20.8 J	15.8 J
Beryllium	0.96	0.75
Cadmium	0.083 J	0.058 J
Selenium	1.7	1.3
Organic Analytes		
Explosives and PAHs not detected		

LEGEND:

⊏ ⊐	DEMOLISHED BUILDING
═	ASPHALT ROAD
╌	GRAVEL ROAD
┼	RAILROAD TRACKS
—x—	FENCE LINE
▬	SURFACE WATER
⌀	TELEPHONE POLE
– –	ELEVATION CONTOURS
~	VEGETATION
▬ ▪ ▬	MUNITIONS RESPONSE SITE BOUNDARY
△	SURFACE SOIL
▲	SOIL BORING
●	GROUNDWATER MONITORING WELL
◆	GEOTECHNICAL BORING
🟨	ACTIVE STORAGE AREA
▨	INACTIVE AREA
▭	ISM SAMPLING AREA
ASY-sb	DISCRETE LOCATION WITH FWCUG EXCEEDANCE
Barium 160	INDICATES MAXIMUM DETECTION OF INDIVIDUAL SRC PER MEDIA
Cobalt 21	CONCENTRATION EXCEEDS FWCUG (HI=1/TARGET RISK OF 10^{-5})
J	CONCENTRATION IS AN ESTIMATE

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5–7 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.
3. DATA BOX GRAY SHADING FOR INORGANIC = CONCENTRATIONS ARE BELOW INORGANIC BACKGROUND.
4. DATA BOX GRAY SHADING FOR ORGANIC = CONCENTRATIONS ARE NON–DETECT FOR THIS INTERVAL.

US Army Corps of Engineers Louisville District

leidos

ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

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Figure 5-13. Concentrations of SRCs in Subsurface Soil Samples at the Central Area of Atlas Scrap Yard

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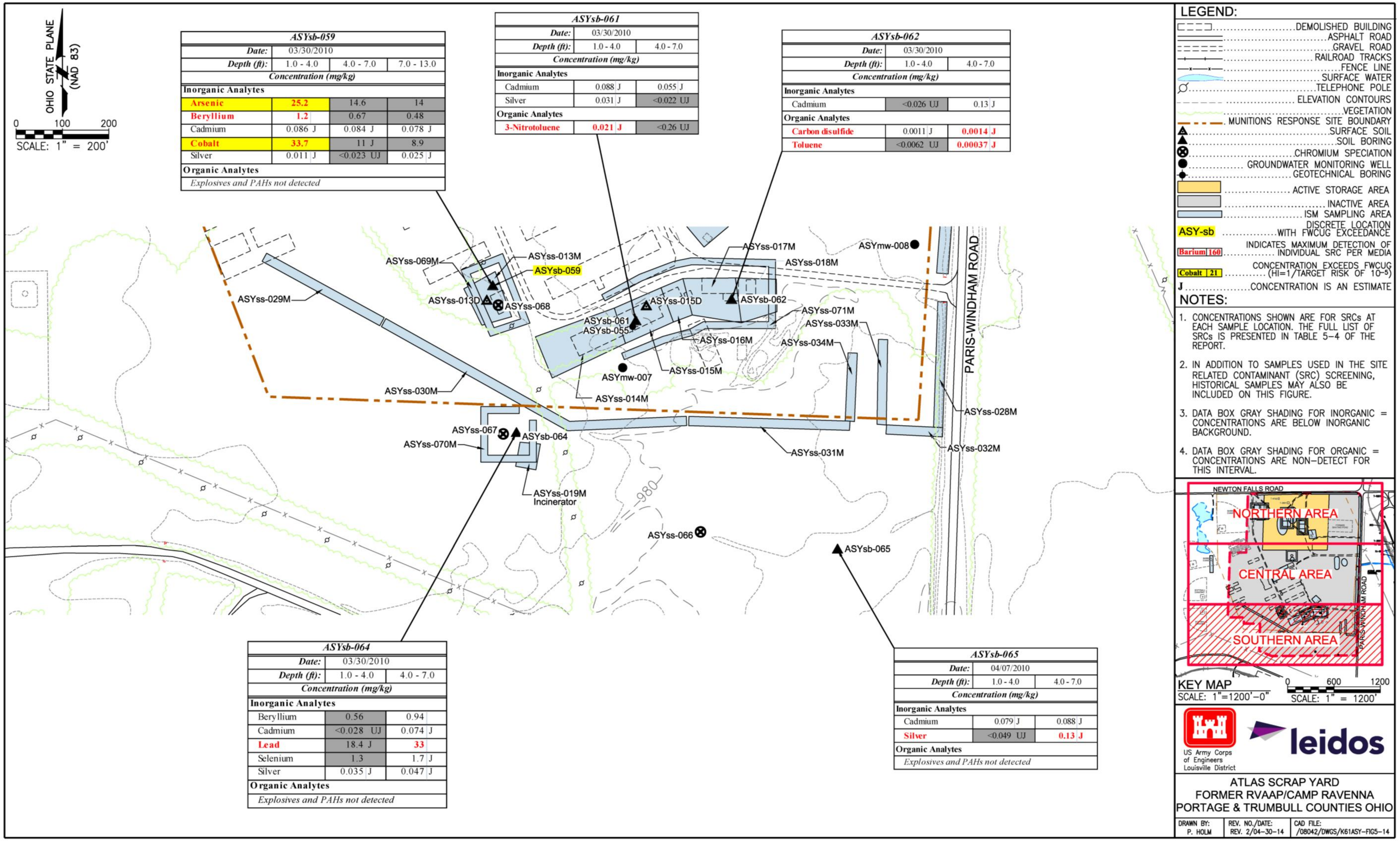

ASYsb-059

Date:	03/30/2010		
Depth (ft):	1.0 - 4.0	4.0 - 7.0	7.0 - 13.0
Concentration (mg/kg)			
Inorganic Analytes			
Arsenic	**25.2**	14.6	14
Beryllium	**1.2**	0.67	0.48
Cadmium	0.086 J	0.084 J	0.078 J
Cobalt	**33.7**	11 J	8.9
Silver	0.011 J	<0.023 UJ	0.025 J
Organic Analytes			
Explosives and PAHs not detected			

ASYsb-061

Date:	03/30/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.088 J	0.055 J
Silver	0.031 J	<0.022 UJ
Organic Analytes		
3-Nitrotoluene	**0.021 J**	<0.26 UJ

ASYsb-062

Date:	03/30/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	<0.026 UJ	0.13 J
Organic Analytes		
Carbon disulfide	0.0011 J	**0.0014 J**
Toluene	<0.0062 UJ	**0.00037 J**

ASYsb-064

Date:	03/30/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Beryllium	0.56	0.94
Cadmium	<0.028 UJ	0.074 J
Lead	18.4 J	**33**
Selenium	1.3	1.7 J
Silver	0.035 J	0.047 J
Organic Analytes		
Explosives and PAHs not detected		

ASYsb-065

Date:	04/07/2010	
Depth (ft):	1.0 - 4.0	4.0 - 7.0
Concentration (mg/kg)		
Inorganic Analytes		
Cadmium	0.079 J	0.088 J
Silver	<0.049 UJ	**0.13 J**
Organic Analytes		
Explosives and PAHs not detected		

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs IS PRESENTED IN TABLE 5-4 OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.
3. DATA BOX GRAY SHADING FOR INORGANIC = CONCENTRATIONS ARE BELOW INORGANIC BACKGROUND.
4. DATA BOX GRAY SHADING FOR ORGANIC = CONCENTRATIONS ARE NON-DETECT FOR THIS INTERVAL.

Figure 5-14. Concentrations of SRCs in Subsurface Soil Samples at the Southern Area of Atlas Scrap Yard

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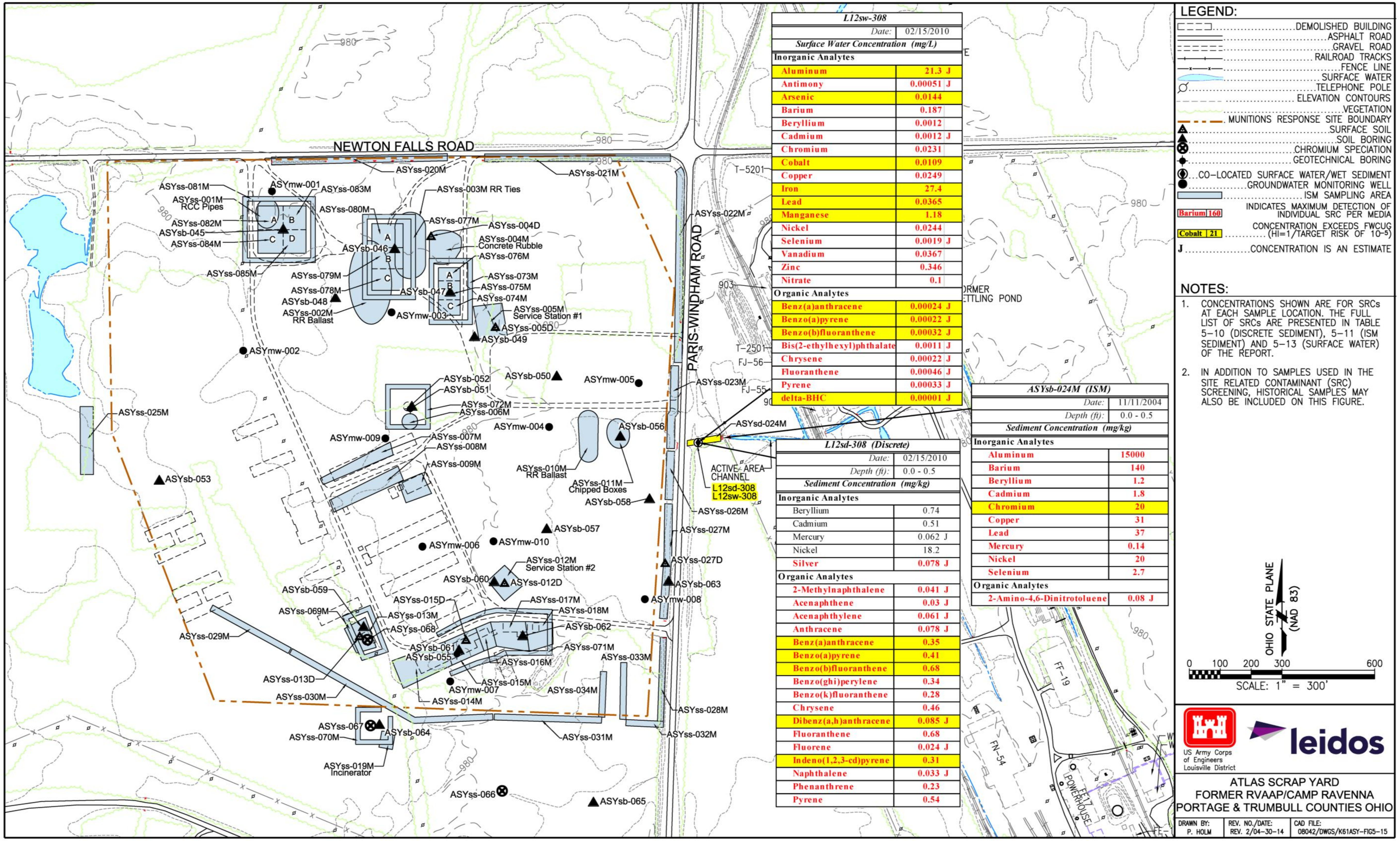

L12sw-308	
Date:	02/15/2010
Surface Water Concentration (mg/L)	
Inorganic Analytes	
Aluminum	**21.3 J**
Antimony	**0.00051 J**
Arsenic	**0.0144**
Barium	**0.187**
Beryllium	**0.0012**
Cadmium	**0.0012 J**
Chromium	**0.0231**
Cobalt	**0.0109**
Copper	**0.0249**
Iron	**27.4**
Lead	**0.0365**
Manganese	**1.18**
Nickel	**0.0244**
Selenium	**0.0019 J**
Vanadium	**0.0367**
Zinc	**0.346**
Nitrate	**0.1**
Organic Analytes	
Benz(a)anthracene	**0.00024 J**
Benzo(a)pyrene	**0.00022 J**
Benzo(b)fluoranthene	**0.00032 J**
Bis(2-ethylhexyl)phthalate	**0.0011 J**
Chrysene	**0.00022 J**
Fluoranthene	**0.00046 J**
Pyrene	**0.00033 J**
delta-BHC	**0.00001 J**

ASYsb-024M (ISM)	
Date:	11/11/2004
Depth (ft):	0.0 - 0.5
Sediment Concentration (mg/kg)	
Inorganic Analytes	
Aluminum	**15000**
Barium	**140**
Beryllium	**1.2**
Cadmium	**1.8**
Chromium	**20**
Copper	**31**
Lead	**37**
Mercury	**0.14**
Nickel	**20**
Selenium	**2.7**
Organic Analytes	
2-Amino-4,6-Dinitrotoluene	**0.08 J**

L12sd-308 (Discrete)	
Date:	02/15/2010
Depth (ft):	0.0 - 0.5
Sediment Concentration (mg/kg)	
Inorganic Analytes	
Beryllium	0.74
Cadmium	0.51
Mercury	0.062 J
Nickel	18.2
Silver	**0.078 J**
Organic Analytes	
2-Methylnaphthalene	**0.041 J**
Acenaphthene	**0.03 J**
Acenaphthylene	**0.061 J**
Anthracene	**0.078 J**
Benz(a)anthracene	**0.35**
Benzo(a)pyrene	**0.41**
Benzo(b)fluoranthene	**0.68**
Benzo(ghi)perylene	**0.34**
Benzo(k)fluoranthene	**0.28**
Chrysene	**0.46**
Dibenz(a,h)anthracene	**0.085 J**
Fluoranthene	**0.68**
Fluorene	**0.024 J**
Indeno(1,2,3-cd)pyrene	**0.31**
Naphthalene	**0.033 J**
Phenanthrene	**0.23**
Pyrene	**0.54**

LEGEND:

⊏⊐	DEMOLISHED BUILDING
═	ASPHALT ROAD
┅	GRAVEL ROAD
┼	RAILROAD TRACKS
×—	FENCE LINE
▬	SURFACE WATER
⌀	TELEPHONE POLE
┄	ELEVATION CONTOURS
〰	VEGETATION
━ ━	MUNITIONS RESPONSE SITE BOUNDARY
⚠	SURFACE SOIL
▲	SOIL BORING
⊗	CHROMIUM SPECIATION
✦	GEOTECHNICAL BORING
◉	CO-LOCATED SURFACE WATER/WET SEDIMENT
●	GROUNDWATER MONITORING WELL
▭	ISM SAMPLING AREA
Barium 160	INDICATES MAXIMUM DETECTION OF INDIVIDUAL SRC PER MEDIA
Cobalt 21	CONCENTRATION EXCEEDS FWCUG (HI=1/TARGET RISK OF 10^{-5})
J	CONCENTRATION IS AN ESTIMATE

NOTES:

1. CONCENTRATIONS SHOWN ARE FOR SRCs AT EACH SAMPLE LOCATION. THE FULL LIST OF SRCs ARE PRESENTED IN TABLE 5–10 (DISCRETE SEDIMENT), 5–11 (ISM SEDIMENT) AND 5–13 (SURFACE WATER) OF THE REPORT.
2. IN ADDITION TO SAMPLES USED IN THE SITE RELATED CONTAMINANT (SRC) SCREENING, HISTORICAL SAMPLES MAY ALSO BE INCLUDED ON THIS FIGURE.

OHIO STATE PLANE (NAD 83)

0 100 200 300 600
SCALE: 1" = 300'

US Army Corps of Engineers
Louisville District

leidos

ATLAS SCRAP YARD
FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES OHIO

DRAWN BY:	REV. NO./DATE:	CAD FILE:
P. HOLM	REV. 2/04-30-14	08042/DWGS/K61ASY-FIG5-15

Figure 5-15. Concentrations of SRCs in Sediment and Surface Water Samples

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6.0 CONTAMINANT FATE AND TRANSPORT

Contaminant fate and transport modeling assesses the potential for SRCs to leach from surface soil, subsurface soil, and sediment sources at Atlas Scrap Yard and impact groundwater beneath the sources and downgradient receptor locations. Modeling results were included in the decision-making process to determine whether remedial actions of sources may be necessary to protect groundwater resources. Surface water transport pathways were evaluated in the HHRA and ERA and are presented in Sections 7.2 and 7.3, respectively. A summary of the principles of contaminant fate and transport are presented in this section along with the results of the modeling.

Section 6.1 describes the physical and chemical properties of SRCs found in soil and sediment at the AOC. Section 6.2 presents a conceptual model for contaminant fate and transport that considers AOC topography, hydrogeology, contaminant sources, and release mechanisms. Section 6.3 presents a soil screening analysis. Section 6.4 presents a sediment screening analysis to identify SRCs with the potential to migrate from soil and sediment to groundwater as initial CMCOPCs. Section 6.5 describes fate and transport modeling of final CMCOPCs and presents CMCOCs. Section 6.6 presents a summary and conclusions of the fate and transport analysis.

6.1 PHYSICAL AND CHEMICAL PROPERTIES OF SITE-RELATED CONTAMINANTS

Surface and subsurface soil SRCs (including 16 inorganic chemicals and 40 organic chemicals) and sediment SRCs (including 11 inorganic chemicals and 18 organic chemicals) were detailed in Section 5.0 and are summarized below:

- Inorganic SRCs in surface and subsurface soil: aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, and zinc.
- Inorganic SRCs in sediment: aluminum, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, and silver.
- Organic SRCs in surface and subsurface soil: 1,3,5-trinitrobenzene (TNB); 2,6-DNT; 2-amino-4,6-DNT; 2-methylnaphthalene; 2-nitrotoluene; 2-butanone; 3-nitrotoluene; 4-amino-2,6-DNT; 4-methylphenol; acenaphthene; acenaphthylene; acetone; anthracene; benz(a)anthracene; benzenemethanol; benzo(a)pyrene; benzo(b)fluoranthene; benzo(ghi)perylene; benzo(k)fluoranthene; bis(2-ethylhexyl)phthalate; butyl benzyl phthalate; carbazole; carbon disulfide; chrysene; di-n-butyl phthalate; dibenz(a,h)anthracene; dibenzofuran; diethyl phthalate; fluoranthene; fluorene; HMX; indeno(1,2,3-cd)pyrene; naphthalene; nitrocellulose; PCB-1260; phenanthrene; phenol; pyrene; tetryl; and toluene.
- Organic SRCs in sediment: 2-amino-4,6-DNT; 2-methylnaphthalene; acenaphthene; acenaphthylene; anthracene; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(ghi)perylene; benzo(k)fluoranthene; chrysene; dibenz(a,h)anthracene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; naphthalene; phenanthrene; and pyrene.

Chemicals released into the environment are susceptible to several degradation pathways, including hydrolysis, oxidation, reduction, isomerization, photolysis, photo-oxidation, biotransformation, and biodegradation. Transformed products resulting from these processes may behave differently than their parent chemical in the environment.

Chemical migration is governed by the physical and chemical properties and the surface and subsurface media through which chemicals are transferred. In general, chemicals and structures with similar physical and chemical characteristics will show similar patterns of transformation, transport, or attenuation in the environment. Solubility, vapor pressure data, chemical partitioning coefficients, degradation rates, and Henry's Law Constant (HLC) provide information that can be used to evaluate contaminant mobility in the environment. Partitioning coefficients are used to assess relative affinities of chemicals for solution or solid phase adsorption. However, the synergistic effects of multiple migrating chemicals and complexity of soil/water interactions, including pH and oxidation-reduction potential, grain size, and clay mineral variability, are typically unknown.

The physical properties of the chemicals defined as SRCs in surface and subsurface soil are summarized in Tables E-1 and E-2 in Appendix E. These properties are used to assess the anticipated behavior of each chemical under environmental conditions. The physical properties of the chemicals defined as SRCs detected in soil and sediment are summarized in Section 6.1.1 through Section 6.1.5.

6.1.1 Chemical Factors Affecting Fate and Transport

The water solubility of a chemical is a measure of the saturated concentration of the chemical in water at a given temperature and pressure. The tendency for a chemical to be transported by groundwater is directly related to its solubility and inversely related to its tendencies to adsorb to soil and volatilize from water (OGE 1988). Chemicals with high water solubilities tend to desorb from soil, are less likely to volatilize from water, and are susceptible to biodegradation. The water solubility of a chemical varies with temperature, pH, and the presence of other dissolved chemicals (including organic carbon and humic acids).

The octanol-water partition coefficient (K_{ow}) can be used to estimate the tendency for a chemical to partition between environmental phases of different polarity. The K_{ow} is a laboratory-determined ratio of the concentration of a chemical in the n-octanol phase of a two-phase system to the concentration in the water phase. Chemicals with log K_{ow} values less than one are highly hydrophilic, while chemicals with log K_{ow} values greater than four will partition to soil particles (Lyman et al. 1990).

The water/organic carbon partition coefficient (K_{oc}) is a measure of the tendency of an organic chemical to partition between water and organic carbon in soil. The K_{oc} is defined as the ratio of the absorbed chemical per unit weight of organic carbon to the aqueous solute concentration.

This coefficient can be used to estimate the degree to which an organic chemical will adsorb to soil and thus not migrate with groundwater. The higher the K_{oc} value, the greater is the tendency of the chemical to partition into soil (OGE 1988). The soil/water partitioning coefficient (K_d) is calculated by multiplying the K_{oc} value by the fraction of organic carbon in the soil.

Vapor pressure is a measure of the pressure at which a chemical and its vapor are in equilibrium. The value can be used to determine the extent to which a chemical would travel in air, as well as the rate of volatilization from soil and solution (OGE 1988). In general, chemicals with vapor pressures lower than 10^{-7} mm mercury will not be present in the atmosphere or air spaces in soil in significant amounts, while chemicals with vapor pressures higher than 10^{-2} mm mercury will exist primarily in the air (Dragun 1988).

The HLC value for a chemical is a measure of the ratio of the chemical's vapor pressure to its aqueous solubility. The HLC value can be used to make general predictions about a chemical's tendency to volatilize from water. Chemicals with HLC values less than 10^{-7} atm-m^3/mol will generally volatilize slowly, while chemicals with a HLC greater than 10^{-3} atm-m^3/mol will volatilize rapidly (Lyman et al. 1990).

6.1.2 Biodegradation

Organic chemicals with differing chemical structures will biodegrade at different rates. Primary biodegradation consists of any biologically induced structural change in an organic chemical. Complete biodegradation is the biologically mediated degradation of an organic chemical into carbon dioxide, water, oxygen, and other metabolic inorganic products (Dragun 1988). The first order biodegradation rate of an organic chemical is proportional to the concentration:

$$-dC/dt = kC \qquad \text{(Equation 6-1)}$$

Where:

C = concentration
t = time
k = biodegradation rate constant = $\ln 2 / t_{1/2}$
$t_{1/2}$ = biodegradation half-life

The biodegradation half-life is the time necessary for half of the chemical to degrade. The biodegradation rate of an organic chemical generally depends on the presence and population size of soil microorganisms that are capable of degrading the chemical.

6.1.3 Inorganic Chemicals

Inorganic chemicals detected in soil and sediment samples are associated with the aqueous phase and leachable metal ions on soil particles. The transport of this material from unsaturated soil to the underlying water table is controlled by the physical processes of precipitation percolation, chemical interaction with the soil, and downward transport of metal ions by continued percolation. The chemistry of inorganic chemical interactions with percolating precipitation and varying soil conditions is complex and includes numerous chemical transformations that may result in altered oxidation states, including ion exchange, adsorption, precipitation, or complexation. These chemical reactions, which are affected by environmental conditions (pH, oxidation/reduction conditions, type and amount of organic matter, clay content, and the presence of hydrous oxides), may act to enhance or reduce the mobility and toxicity of metal ions. In general, these reactions are reversible and add to the variability commonly observed in distributions of inorganic chemicals in soil.

The chemical form of an inorganic chemical determines its solubility and mobility in the environment; however, chemical speciation is complex and difficult to delineate in routine laboratory analysis. Inorganic chemicals in soil are commonly found in several forms, including dissolved concentrations in soil pore water, metal ions occupying exchange sites on inorganic soil constituents (adsorbed to inorganic soil constituents), metal ions associated with insoluble organic matter, precipitated inorganic chemicals as pure or mixed solids, and metal ions present in the structure of primary or secondary minerals.

The dissolved (aqueous) fraction and its equilibrium sorbed fraction are important when considering the migration potential of inorganic chemicals through soil. Of the inorganic chemicals that are likely to form, chlorides, nitrates, and nitrites are commonly the most soluble. Sulfate, carbonate, and hydroxides generally have low to moderate solubility. Soluble chemicals are transported in aqueous forms subject to attenuation, whereas less soluble chemicals remain as a precipitate and limit the overall dissolution of metal ions. The solubility of the metal ions is also regulated by ambient chemical conditions, including pH and oxidation/reduction.

The attenuation of metal ions in the environment can be estimated numerically using the retardation factor (R), dispersion in higher flow systems (high conductivity environments), and diffusion in low conductivity environments. R defines the extent to which the velocity of the contaminant is slowed, which is largely derived from the soil/water K_d. R is calculated using the following equation:

$$R = 1 + (K_d \rho_b)/\theta_w \qquad \text{(Equation 6-2)}$$

Where:

ρ_b = the soil bulk dry density (g/cm^3)
θ_w = soil moisture content (dimensionless)

Metal ion concentrations in the environment do not attenuate by natural or biological degradation because of low volatility and solubility of the ions. Inorganic chemicals may be biotransformed or bioconcentrated through microbial activity.

6.1.4 Organic Chemicals

Organic chemicals, such as SVOCs or VOCs, may be transformed or degraded in the environment by processes including hydrolysis, oxidation/reduction, photolysis, volatilization, biodegradation, or biotransformation. The half-life of organic chemicals in transport media can vary from minutes to years, depending on environmental conditions and chemical structures. Some types of organic chemicals are very stable, and degradation rates can be very slow. Organic degradation may either enhance (by producing more toxic byproducts) or reduce (reducing concentrations) the toxicity of a chemical in the environment.

6.1.5 Explosives – Related Chemicals

Several explosive compounds were detected in soil and sediment at Atlas Scrap Yard. Microbiological and photochemical transformation may affect the fate and transport of explosive compounds in the environment. For example, based on the results of culture studies involving the removal of 2,4,6-Trinitrotoluene (TNT) by activated sludge microorganisms, it has been concluded that TNT undergoes biotransformation but not biodegradation (USABRDL 1989). Biotransformation of TNT occurs when the nitro groups are reduced by microbial reduction, typically under anaerobic conditions. Beneficial bacteria in these reactions include Pseudomonas, Escherichia, Bacillus, Citrobacter, Enterobacter, Klebseilla, Veillonella, and Clostridium (USACHPPM 2000). It has been found that anaerobic metabolism occurs in two stages (Funk et al. 1993). The first stage is the reductive stage in which TNT is reduced to its amino derivatives. In the second stage, degradation to non-aromatic products begins after the third nitro group is reduced.

The biotransformation rate of TNT has been found to be rapid at most sites (ERDC 2007) and may be increased with the presence of carbon (USACHPPM 2000). Fungi and photolysis can also biotransform TNT. 1,3,5-TNB, 4,6-dinitroanthranil, 2,4,6-trinitrobezadehyde, and 2,4,6-trinitrobenzonitrite are the predominant transformation products due to photolysis of TNT (USACHPPM 2000). The biotransformation pathway for TNT is shown in Figure E-1 in Appendix E (Kaplan and Kaplan 1982).

Biotransformation of 2,4-DNT has been systematically studied in laboratory cell cultures. The biotransformation pathway is shown in Figure E-2 in Appendix E (McCormick et al. 1978). The reduction products include the amino and azoxy derivatives as observed with TNT biotransformation. As with TNT and DNT, the principal mode of microbial transformation of the nitroaromatic chemicals TNB and 1,3-dinitrobenzene is reduction of nitro groups to form amino groups. TNB is a photolytic product of TNT but will not undergo further photolysis. TNB will also resist hydrolysis. TNB primarily breaks down through microbial degradation (USACHPPM 2001b).

Tetryl may undergo biotransformation, hydrolysis, and photodegradation to produce several different products, such as N-methylpicramide and 4-amino-N-methyl-N,2,6-trinitroaniline (USACE 1994). Nitrocellulose is an aliphatic nitrate ester that will gelatinize when mixed with nitroglycerin. Nitrocellulose occurs as a fibrous solid that can act as a sorbent that will dissolve in water under highly basic conditions with high temperatures. Nitrocellulose can undergo denitrification as a degradation pathway. Degradation of nitrocellulose to non-reactive nitrocellulose has been observed under methanogenic and fungus-mediated reducing conditions (USACE 2006).

Limited information exists regarding biotransformation or biodegradation of cyclotrimethylenetrinitramine (RDX) and HMX. RDX has a natural degradation rate, typically in the range of months, but may take years in more arid environments (ERDC 2007). One pilot study evaluated the treatment of pink water waste using an anaerobic fluidized-bed granular activated carbon bioreactor (USACE 2004). The study indicated RDX biodegrades in the presence of ethanol. Such data may be useful for evaluating potential use of enhanced bioremediation as a remedial option. Figure E-3 in Appendix E shows the biotransformation pathway for RDX (McCormick et al. 1981). A conservative biodegradation rate of 5.00E-04 per day was used for RDX (ANRCP 1999). Biotransformation of HMX, primarily by anaerobic degradation (ERDC 2007), occurs at a slow rate in the environment (USACHPPM 2001a). HMX degrades at a slower rate than RDX (ERDC 2007). HMX is primarily broken down by photolysis and has a photolytic rate constant of 0.15 days (USEPA 1988). Breakdown products of HMX include nitrate, nitrite, and formaldehyde (USACHPPM 2001a). Figure E-4 in Appendix E shows the biotransformation pathway for HMX (ATSDR 1997).

6.2 CONCEPTUAL MODEL FOR FATE AND TRANSPORT

The CSM, which defines the framework for fate and transport modeling, describes conditions at Atlas Scrap Yard, including the contaminant sources, surficial and subsurface hydrogeologic conditions, contaminant migration and pathways, and contaminant release mechanisms.

AOC conditions described in Sections 2.0 through 5.0 include contaminant source information, the surrounding geologic and hydrologic conditions, and the magnitude of SRCs and their current spatial distribution. Information from the preliminary CSM presented in Section 3.7 and the nature and extent evaluation in Section 5.0 was used to develop the CSM for fate and transport modeling by identifying SRCs and migration pathways. The CSM is based on information and data collected for historical investigations, this RI Report, and informed assumptions about the AOC. Assumptions contained in the CSM are reiterated throughout this section. The better the information and the greater the accuracy of the assumptions, the more accurately the CSM describes the AOC; therefore, the more reliable the fate and transport modeling predictions can be. A summary of the salient elements of the CSM that apply to fate and transport modeling are summarized in the following sections.

6.2.1 Contaminant Sources

Some primary contaminant sources are still located at the AOC. These include parking areas made up of slag and asphalt gravel, stockpiled railroad ties, concrete debris, and other stockpiled building demolition material. Secondary sources (contaminated media) identified in previous investigations are further evaluated in this report. Another potential secondary source of contamination at the AOC is contaminated sediment within the drainage ditch along Paris-Windham Road, which may have been deposited during a storm event, which has potential to leach contaminants to the groundwater.

6.2.2 Hydrogeology

A description of regional and AOC-specific geology and hydrology are provided in Sections 3.3.3 and 3.4.2, respectively, and are summarized below.

- The topography at Atlas Scrap Yard ranges from approximately 986 ft amsl near the northwestern boundary of the AOC to approximately 976 ft amsl near the central eastern boundary of the AOC. Surface water drainage associated with heavy rainfall events would follow the topography (Figure 3-1). Most of the surface runoff flows overland and drains into drainage ditches that run parallel to roads bordering the AOC that flow to the north and to the east.
- Soil beneath the AOC consists of silty clay tills with trace gravel, with sand content generally increasing with depth, as observed in subsurface borings installed during the PBA08 RI (Appendix A). Bedrock was encountered at 19-29 ft bgs during monitoring well installation under the Characterization of 14 AOCs (MKM 2007).
- Ten groundwater monitoring wells were installed at the AOC to an average depth of 24 ft bgs. Monitoring wells ASYmw-007, ASYmw-008, and ASYmw-010 were screened in unconsolidated zone groundwater, while ASYmw-001 through ASYmw-006 and ASYmw-009 were screened in the Sharon Sandstone, based on observations in the soil.
- The potentiometric surface shows the groundwater flow pattern from east to west. The average horizontal hydraulic gradient is 0.0046 ft/ft (Figure 3-1).
- Water level elevations at the AOC ranged from 967.54-973.63 ft amsl with the highest elevation at the unconsolidated well ASYmw-008 (Figure 3-1). Potentiometric data indicate the groundwater table occurs within the unconsolidated soil throughout the AOC.

6.2.3 Contaminant Release Mechanisms and Migration Pathways

Based on the information presented above, the following contaminant release mechanisms and migration pathways have been identified at the AOC:

- Contaminant leaching from soil to the water table (vertical migration) and lateral transport to downgradient receptors [i.e., unnamed tributary to Sand Creek (flowing northwest) and unnamed tributary to the Mahoning River flowing southwest)];
- Contaminated sediment transported to potential downstream receptors;
- Contaminated surface water migrating to potential downstream receptors; and
- Contaminated sediment within wet ditches and deposited on ditch banks as a secondary source of leaching to the water table (vertical migration) and lateral transport to potential downgradient receptors [i.e., unnamed tributary to Cobbs Ponds (flowing northeast)].

The first of these pathways, which considers a primary groundwater transport pathway, is treated explicitly in this fate and transport section. Sediment and surface water transport pathways were evaluated in the HHRA and ERA and are presented in Sections 7.2 and 7.3, respectively. The fourth pathway listed above, which considers a secondary groundwater transport pathway, was evaluated using the sediment screening analysis presented in Section 6.4.

One of the principal migration pathways at the AOC is percolation through the unsaturated soil to the water table (i.e., vertical leaching of contaminants from soil into groundwater). However, because of the very heterogeneous nature of the unconsolidated glacial material, groundwater flow patterns within the unconsolidated soil are difficult to predict. Precipitation that does not leave the AOC as surface runoff percolates into the subsurface. Some of the percolating water leaves this environment via evapotranspiration after little or no vertical migration.

The remainder of the water percolates into the water table. As discussed in Section 6.2.4, the rate of percolation is controlled by soil cover, ground slope, saturated conductivity of the soil, and meteorological conditions. Figure 6-1 illustrates the contaminant migration conceptual model.

Once the contaminant leachate percolates through the soil and reaches the water table, it migrates with the local groundwater and discharges at the downgradient receptors. Groundwater flow likely occurs along preferential pathways (e.g., sand seams, channel deposits, or other stratigraphic discontinuities) having higher permeabilities. For inorganic chemicals, lateral migration through groundwater will be very limited due to their high retardation by the bedrock material (USACE 2003a).

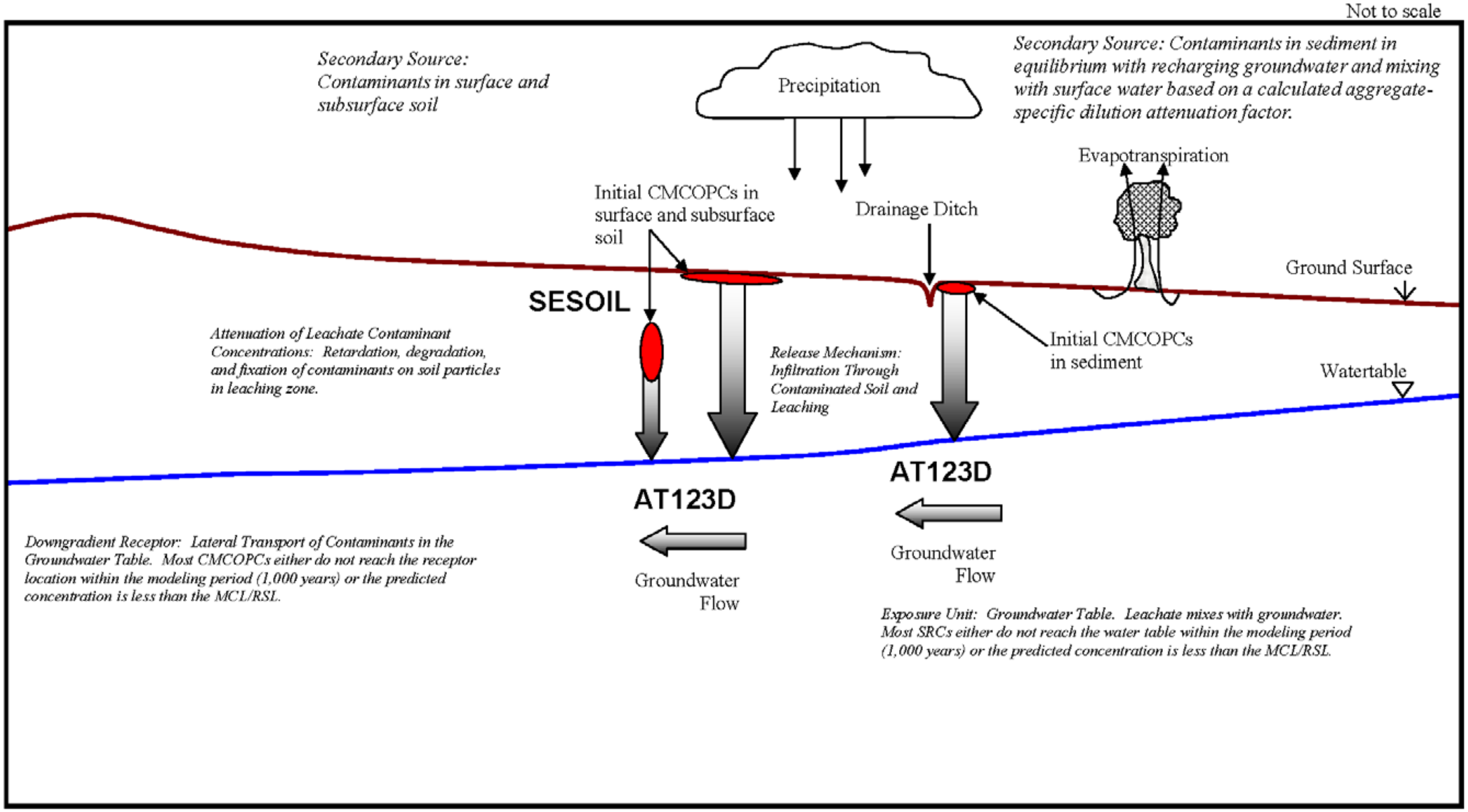
Additional factors that affect the leaching rate include a chemical's solubility, sorption capacity (expressed by the K_d), and the amount of percolation. Insoluble chemicals will precipitate out of the solution in the subsurface or remain in insoluble forms with little leaching.

Another factor that affects whether a chemical will reach the water table through percolation of precipitation is the chemical’s rate of decay. Most organic compounds decay at characteristic rates proportional to the chemical’s half-life. For a given percolation rate, those chemicals with long half-lives have a greater potential for contaminating groundwater than those with shorter half-lives. For this analysis, the rate of decay/half-life was not considered.

Contaminant releases through gaseous emissions and airborne particulates are not significant at Atlas Scrap Yard. The AOC is vegetated, located in a humid temperate climate, and soil moisture is typically high, which prevents dust borne contaminant migration. SRCs generally exhibit low volatility, which limits the production of gaseous emissions. Therefore, there is likely little to no gaseous emission, and contaminant levels in the air pathway are minor to nonexistent.

6.2.4 Water Budget

The potential for contaminant transport begins with precipitation. Percolation is the driving mechanism for leaching of soil contaminants to groundwater. The actual amount of rainwater available for flow and percolation to groundwater is highly variable and depends upon soil type and climatic conditions. A water balance calculation can be used as a tool to quantitatively account for all components of the hydrologic cycle. The quantified elements of the water balance are used for inputs to the soil leaching and groundwater transport models discussed later.



Secondary Source: Contaminants in surface and subsurface soil

Secondary Source: Contaminants in sediment in equilibrium with recharging groundwater and mixing with surface water based on a calculated aggregate-specific dilution attenuation factor.

Attenuation of Leachate Contaminant Concentrations: Retardation, degradation, and fixation of contaminants on soil particles in leaching zone.

Release Mechanism: Infiltration Through Contaminated Soil and Leaching

Downgradient Receptor: Lateral Transport of Contaminants in the Groundwater Table. Most CMCOPCs either do not reach the receptor location within the modeling period (1,000 years) or the predicted concentration is less than the MCL/RSL.

Exposure Unit: Groundwater Table. Leachate mixes with groundwater. Most SRCs either do not reach the water table within the modeling period (1,000 years) or the predicted concentration is less than the MCL/RSL.

Figure 6-1. Contaminant Migration Conceptual Model

The components of a simple steady-state water balance model include precipitation, evapotranspiration, surface runoff, and groundwater recharge or percolation. These terms are defined as follows:

$$P = ET + Sr + q \qquad \text{(Equation 6-3)}$$

or

$$\text{Rainwater available for flow} = Sr + q = P - ET \qquad \text{(Equation 6-4)}$$

Where:

P = precipitation
ET = evapotranspiration
Sr = surface runoff
q = groundwater recharge or percolation

It is expected that loss of runoff also occurs in the form of evaporation. The remaining water, after runoff and evaporation, is available for percolation which includes loss to the atmosphere by evapotranspiration. The water balance estimations were developed using the Hydrologic Evaluation of Landfill Performance (HELP) model (USEPA 1994). See Table E-3 in Appendix E for parameters used in the HELP model to develop the water budget estimates used in the evaluation. Calculations using precipitation and temperature data for a 100-year period were generated synthetically using coefficients for Cleveland, Ohio (e.g., the nearest weather station to Camp Ravenna with HELP model coefficients).

The annual average water balance estimates indicate an evapotranspiration of 28% (10.3 inches) of total precipitation (37 inches). The remaining 72% (27 inches) of rainwater is available for surface water runoff and percolation to groundwater. Of the 72% (27 inches) of water available for runoff or percolation, groundwater recharge (percolation) accounts for 13% (3.6 inches), and surface runoff (along downgradient topography to nearest surface water bodies) accounts for the remaining 87% (23 inches).

6.3 SOIL SCREENING ANALYSIS

Soil screening analyses are screening evaluations performed to identify SRCs with the potential to leach to groundwater as CMCOPCs. The five steps for the soil leachability analysis are illustrated in Figure 6-2.

6.3.1 Soil Screening Analysis

The first step of the soil screening analysis is the development of SRCs, as presented Section 5.0. A summary of SRCs identified for soil and sediment is presented in Section 6.1.

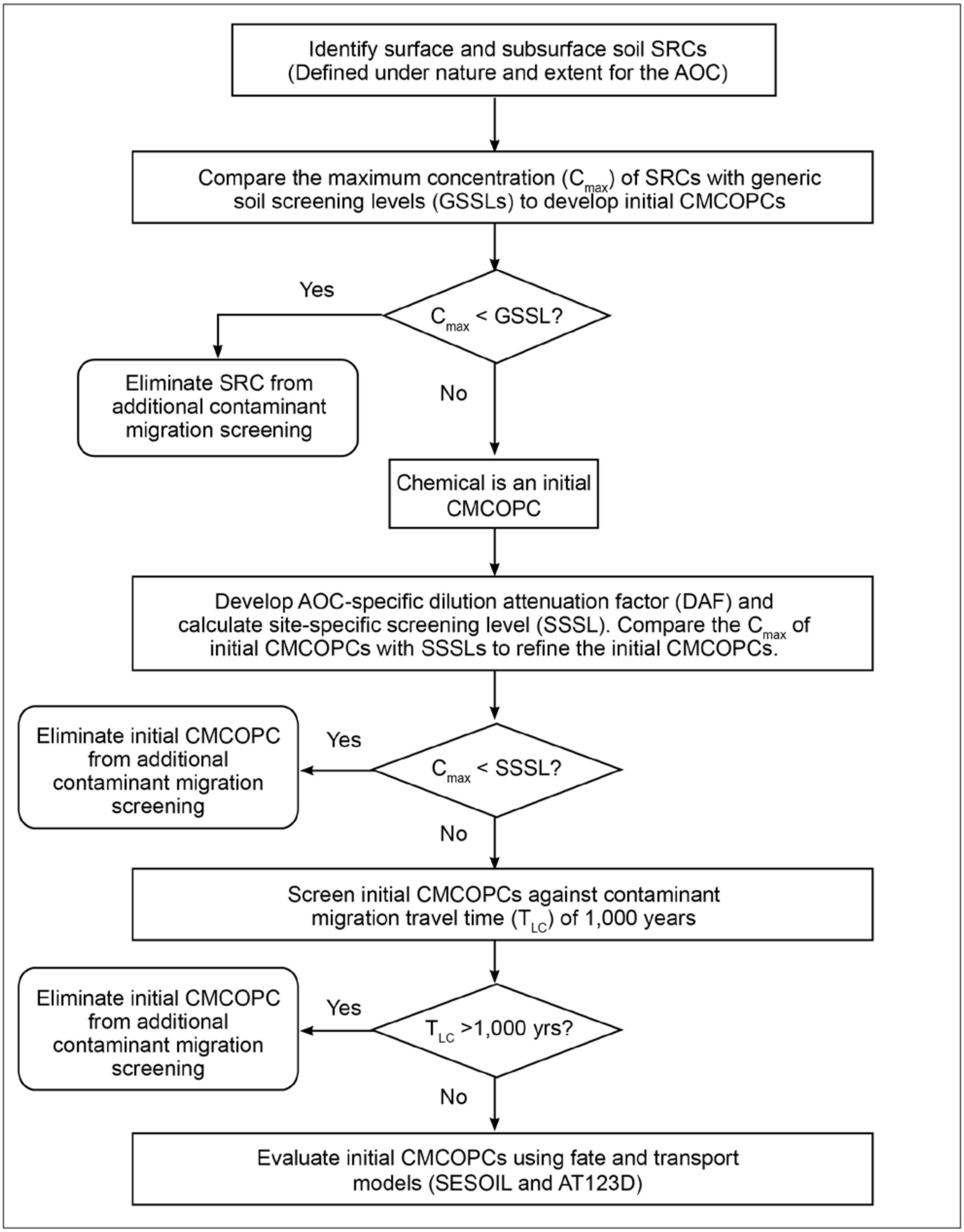
The second step of the soil screening process (Figure 6-2) involves comparing the maximum concentrations of the SRCs with maximum contaminant level (MCL)-based Generic Soil Screening Levels (GSSLs), which were developed for Superfund sites for contaminant migration to groundwater (USEPA 1996b, USEPA 2012). The GSSL is defined as the concentration of a chemical in soil that represents a level of contamination below which there is no concern for impacts to groundwater under CERCLA, provided conditions associated with USEPA risk-based Soil Screening Levels (SSLs) are met.

Generally, if chemical concentrations in soil fall below the GSSL, and there are no groundwater receptors of concern or anticipated exposures, then no further study or action is warranted for that chemical. If the GSSL for a chemical is not available, the USEPA risk-based Soil Screening Level (SSL) for groundwater migration, dated November 2012 (USEPA 2012), will be obtained from the USEPA RSL website and used. If neither the GSSL nor the USEPA risk-based SSL for a chemical is available, then no further evaluation of the chemical is performed and it is eliminated from the list of the initial CMCOPCs. However, some chemicals have been assigned surrogates by risk assessors if the chemical without an SSL is similar to another chemical with an SSL. Surrogates used for this analysis include acenaphthene for acenaphthylene and pyrene for benzo(ghi)perylene and phenanthrene.

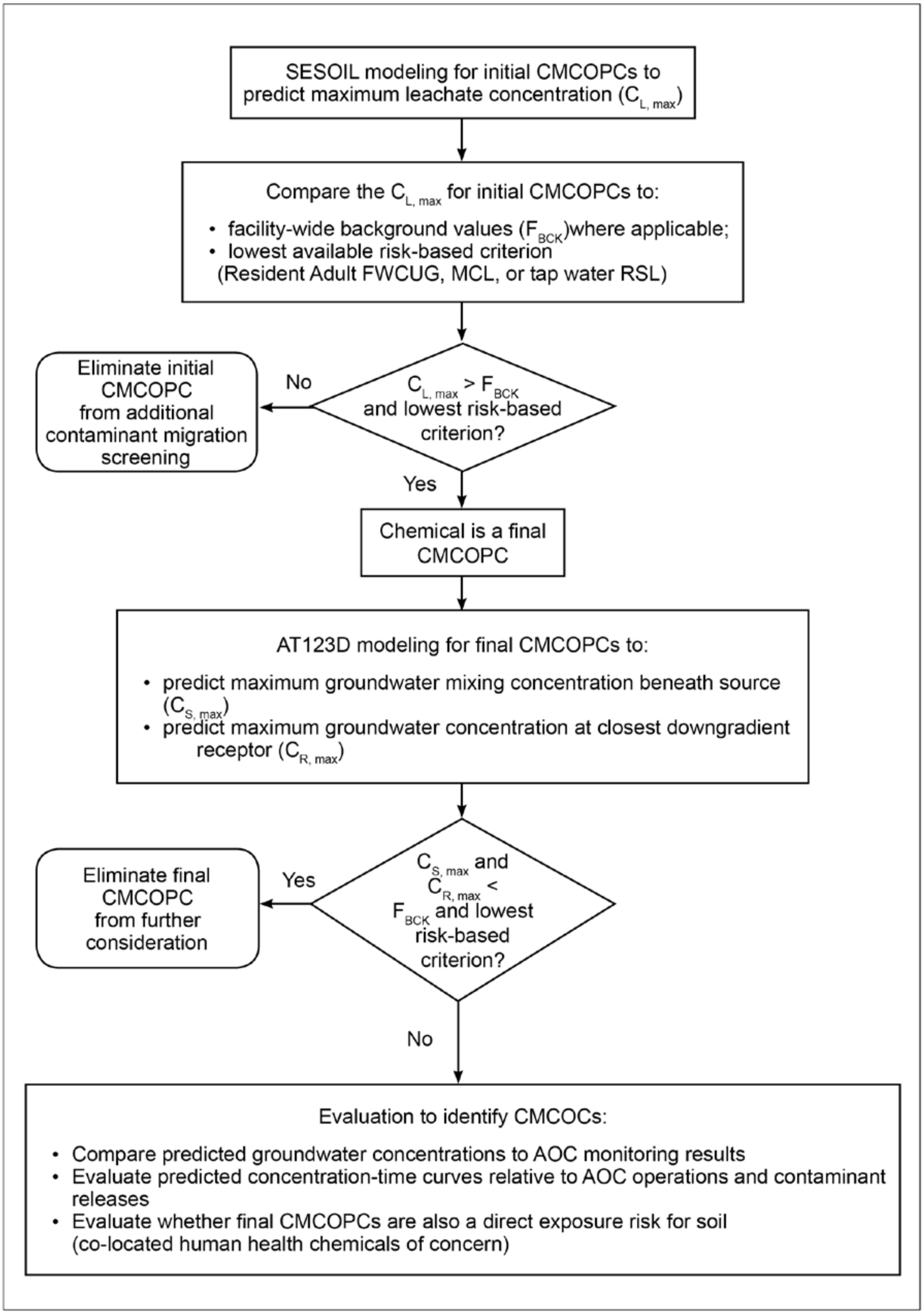
One soil SRC, carbazole, was eliminated as an initial CMCOPC because it does not have an associated GSSL or USEPA risk-based SSL. Because this constituent does not have an associated USEPA RSL or MCL, an AOC-specific SSL could not be calculated. Carbazole was detected in 4 of 14 soil samples at a maximum concentration of 0.44 mg/kg. Carbazole is an SVOC with a relatively high K_{oc} value (9.16E+03 L/kg); therefore, this compound has the tendency to partition into soil and is not likely to pose a risk to groundwater. Carbazole was not detected in groundwater samples collected at Atlas Scrap Yard under the 2009 FWGWMP (EQM 2010).

The initial CMCOPC screen, as presented in Table E-4 in Appendix E, eliminates one inorganic SRC and 17 organic SRCs from further consideration. There were 15 inorganic and 23 organic SRCs carried forward to the third step of the soil CMCOPC screening process.

The third step of the soil screening process (Figure 6-2) involves comparing the maximum chemical concentrations with the Site-specific Soil Screening Levels (SSSLs). The SSSL is defined as the GSSL (or the USEPA risk-based SSL for groundwater protection if a GSSL is not available) multiplied by the AOC-specific Dilution Attenuation Factor (DAF). Direct partitioning is used to derive the GSSLs, assuming groundwater is in contact with the chemicals in soil and the groundwater concentration is equal to the leachate concentration. However, as leachate moves through soil, chemical concentrations are attenuated by adsorption and degradation. When the leachate reaches the water table, dilution by groundwater further reduces leachate concentrations. This concentration reduction can be expressed by a DAF. DAFs can vary based on AOC-specific characteristics (e.g., hydrogeologic properties, contaminated source area, depth to contamination). As described in the *Soil Screening Guidance: Technical Background Document* (USEPA 1996b), chemical dilution in groundwater is estimated at each AOC from an AOC-specific DAF. The DAF, which is defined as the ratio of soil leachate concentration to receptor point concentration, is minimally equal to one. Dilution in groundwater is derived from a simple mixing zone equation (Equation 6-5) and relies upon estimation of the mixing zone depth (Equation 6-6).



1 **Figure 6-2. Initial CMCOPCs Identified in Soil Screening Analysis for SESOIL Evaluation**



1 **Figure 6-2. Initial CMCOPCs Identified in Soil Screening Analysis for SESOIL Evaluation (continued)**

$$\mathrm{DAF} = 1 + \frac{(\mathrm{K} \times i \times \mathrm{d})}{(\mathrm{q} \times \mathrm{L})} \qquad \text{(Equation 6-5)}$$

Where:

DAF = dilution attenuation factor
K = aquifer hydraulic conductivity (m/yr)
i = horizontal hydraulic gradient (m/m)
q = percolation rate (m/yr)
L = source length parallel to groundwater flow (m)
d = mixing zone depth (m) (which is defined below)

$$\mathrm{d} = \sqrt{0.0112 \times \mathrm{L}^2} + \mathrm{d_a} \times \left[1 - \exp\left(\frac{-\mathrm{L} \times \mathrm{I}}{\mathrm{K} \times i \times \mathrm{d_a}}\right)\right] \qquad \text{(Equation 6-6)}$$

Where:

d_a = aquifer thickness (m)
$d \le d_a$

As stated above, if the aquifer thickness is less than the calculated mixing zone depth, then the aquifer thickness is used for “d” in the DAF calculation. The DAF calculation for the AOC is presented in Table E-5 in Appendix E. It should be noted that the purpose of this screen is not to identify the chemicals that may pose risk at downgradient locations, but to target those chemicals that pose the greatest problem if they migrate from the AOC.

Based on this screening and an AOC-specific DAF of 1.51, aluminum, acenaphthene, bis(2-ethylhexyl)phthalate, and fluorene were eliminated from further consideration. All the remaining SRCs exceeded their published or calculated GSSL multiplied by the respective DAF and were identified as the initial CMCOPCs, based on leaching to groundwater. The SRCs identified as initial CMCOPCs are presented in Table E-6 in Appendix E.

The fourth step of the soil screening process (Figure 6-2) involves eliminating initial CMCOPCs identified in the SSSL evaluation which require more than 1,000 years to leach through the unsaturated zone before reaching the water table from further consideration. A period of 1,000 years was conservatively selected to evaluate eventual migration of the contaminant front to the water table despite uncertainties in vadose zone hydraulic parameters and groundwater recharge over time. Additionally, USACE suggests a screening value of 1,000 years be used due to the high uncertainty associated with predicting conditions beyond that time frame (USACE 2003a). Therefore, the initial CMCOPCs at the selected sources were screened against a travel time of greater than 1,000 years. The travel time in this screen is the time required for a CMCOPC to migrate vertically from the base of the soil interval detected above the background concentration to the water table. This distance is the leaching zone evaluated in Table E-7 of Appendix E, which may vary across the AOC based on the varying depths of soil sample concentrations above the facility-wide background concentrations and the elevation of the water table.

The estimated travel time for each initial CMCOPC to reach the water table is determined using the following equations:

$$T = \frac{Lz \times R}{V_p} \qquad \text{(Equation 6-7)}$$

Where:

T = leachate travel time (year)
Lz = thickness of attenuation zone (ft)
R = retardation factor (dimensionless) (Equation 6-2)
V_p = porewater velocity (ft/year)

and

$$V_p = \frac{q}{\theta_w} \qquad \text{(Equation 6-8)}$$

Where:

q = percolation rate (ft/year)
θ_w = fraction of total porosity that is filled by water

If the travel time for a chemical from a source area exceeded 1,000 years, then the chemical was eliminated from the list of initial CMCOPCs. Twelve inorganic and six organic SRCs were eliminated from further consideration based on their travel times exceeding 1,000 years. Initial CMCOPCs with travel times less than 1,000 years were retained for further evaluation (Appendix E, Table E-7). The constituents selected for further evaluation with Seasonal Soil Compartment Model (SESOIL) modeling are listed in Table 6-1.

In the fifth step (Figure 6-2), the initial CMCOPCs were further evaluated using fate and transport models provided in Section 6.5.

6.3.2 Limitations and Assumptions of Soil Screening Analysis

It is important to recognize that acceptable soil concentrations for individual chemicals are highly AOC-specific. The GSSLs used in this screening are based on a number of default assumptions chosen to be protective of human health for most AOC conditions (USEPA 1996b). These GSSLs are expected to be more conservative than SSSLs based on AOC conditions. The conservative assumptions included in this analysis are: (1) no adsorption in the unsaturated zone or in the aquifer; (2) no biological or chemical degradation in the soil or aquifer; and (3) contamination is uniformly distributed throughout the source. However, the GSSL does not incorporate existing contamination already present within the aquifer.

Table 6-1. Initial CMCOPCs Evaluated with SESOIL Modeling

SRCs	Maximum Concentrations (mg/kg)	ISM Area or Discrete Sample Location	Sample Depth (ft bgs)	Leachate Modeling? (Yes/No)
Inorganic Chemicals				
Selenium	2.90E+00	ASYss-084M-5758-SO	0.0 - 1.0	Yes
Silver	5.20E+00	ASYss-018M-SO	0.0 - 1.0	Yes
Organic Chemicals - Explosive				
2,6-Dinitrotoluene	1.30E-01	ASYss-076M-5750-SO	0.0 - 1.0	Yes
2-Amino-4,6-Dinitrotoluene	1.00E-01	ASYss-018M-SO	0.0 - 1.0	Yes
4-Amino-2,6-Dinitrotoluene	2.10E-01	ASYss-080M-5754-SO	0.0 - 1.0	Yes
2-Nitrotoluene	4.30E-01	ASYss-018M-SO	0.0 - 1.0	Yes
3-Nitrotoluene	1.20E-01	ASYss-093M-5767-SO	0.0 - 1.0	Yes
Organic Chemicals - Semi-volatile				
2-Methylnaphthalene	2.20E+00	ASYss-088M-5756-SO	0.0 - 1.0	Yes
Benz(a)anthracene	1.70E+01	ASYss-078M-5752-SO	0.0 - 1.0	Yes
Benzo(a)pyrene	2.00E+01	ASYss-080M-5754-SO	0.0 - 1.0	Yes
Benzo(b)fluoranthene	3.70E+01	ASYss-078M-5752-SO	0.0 - 1.0	Yes
Dibenz(a,h)anthracene	5.10E+00	ASYss-080M-5754-SO	0.0 - 1.0	Yes
Indeno(1,2,3-cd)pyrene	1.30E+01	ASYss-080M-5754-SO	0.0 - 1.0	Yes
Naphthalene	1.40E+00	ASYss-088M-5756-SO	0.0 - 1.0	Yes

ft bgs = Feet below ground surface,
ISM = Incremental Sampling Method.
mg/kg = Milligrams per kilogram.
SRC = Site-related contaminant.

6.4 SEDIMENT SCREENING ANALYSIS

Sediment SRCs were developed in Section 5.0 and are presented in Section 6.1. The purpose of this screening analysis is to identify CMCOPCs based on contaminant migration from sediment to groundwater. Any identified CMCOPCs are modeled with Analytical Transient 1-, 2-, 3- Dimensional (AT123D) to a downgradient receptor if present. The four steps for the sediment screening analysis are illustrated in Figure 6-3.

As there were no co-located sediment and surface water data for Atlas Scrap Yard, the sample-specific DAF was calculated based on sediment and surface water concentration data from location L12-308, which was collected from the drainage ditch along Paris-Windham Road. Sediment SRCs were screened by developing leachate concentrations assuming equilibrium between sediment and groundwater. The predicted leachate concentrations were diluted based on a sample-specific DAF calculated by dividing the calculated leachate concentrations by the co-located surface water concentrations. The DAF was calculated for each chemical that was detected in the sediment and surface water at the same sample location. The calculated DAF was then used to calculate the maximum groundwater concentration, considering dilution for sediment SRCs. The lowest DAF calculated for the sample area was used for sediment SRCs that did not have a sample-specific DAF. The DAFs calculated for each chemical are shown in Table 6-2.

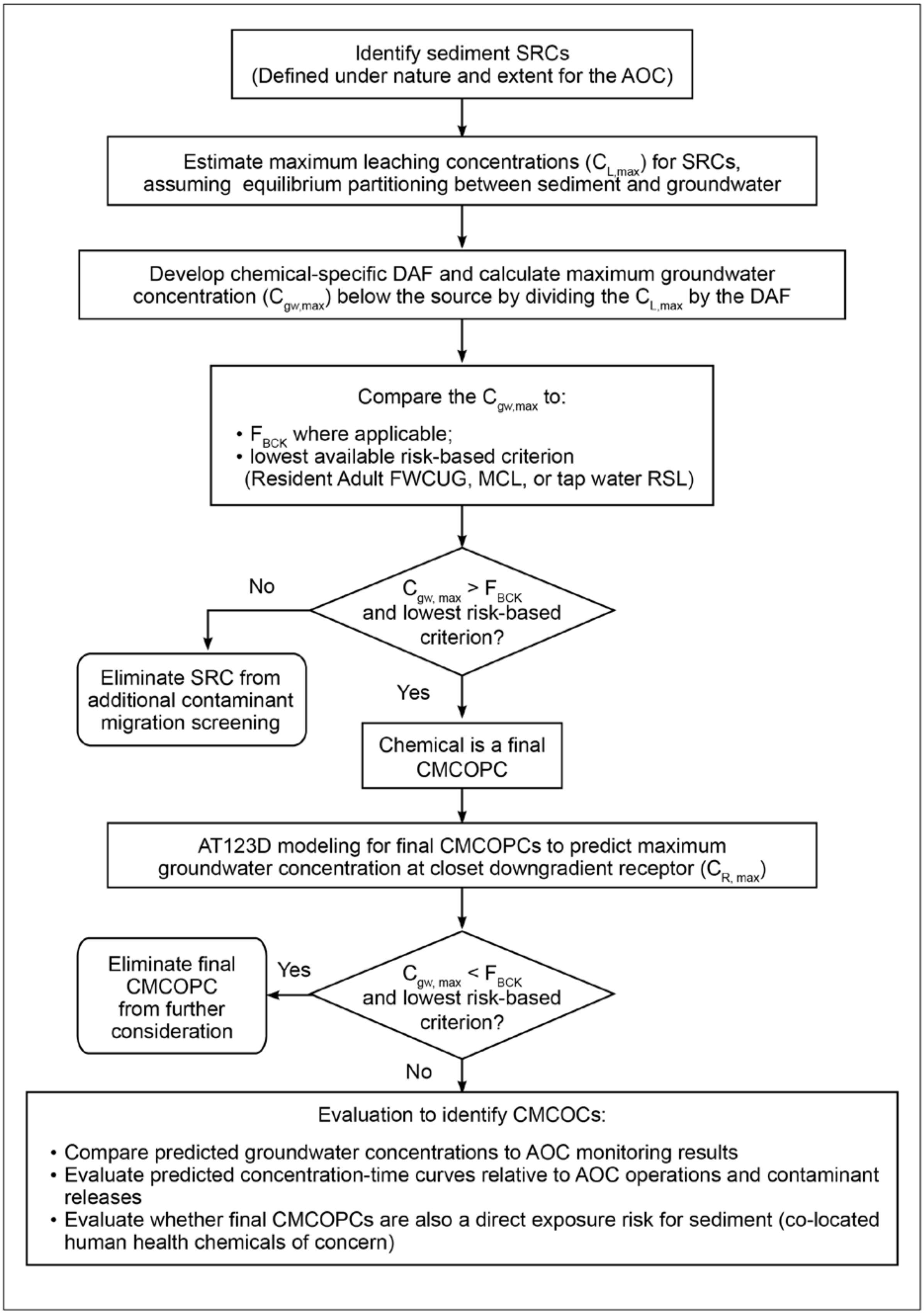
This sediment screening analysis assumed that the sediment concentration and recharging groundwater concentration were in equilibrium and a sample-specific DAF for each chemical was used for dilution in the aquifer. Based on this screening analysis, five inorganic SRCs (aluminum, beryllium, cadmium, nickel, and silver) and 11 organic SRCs [2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene] did not exceed the risk-based screening criteria and were eliminated from further evaluation. The remaining SRCs [barium, chromium, copper, lead, mercury, selenium, 2-amino-4,6-DNT; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene] were evaluated with AT123D models, described in Section 6.5. See Table E-8 in Appendix E for the results of the sediment screening analysis.

6.5 FATE AND TRANSPORT MODELING

Contaminant fate and transport modeling represents the fifth step in the fate and transport screening and evaluation process (Figure 6-2). SESOIL modeling was performed for chemicals identified as initial CMCOPCs from the soil screening analysis presented in Section 6.3 and summarized in Table 6-1. SESOIL modeling was performed to predict chemical concentrations in the leachate immediately beneath the selected source areas and just above the water table. If the predicted maximum leachate concentration of an initial CMCOPC was higher than the facility-wide background concentration and the lowest risk-based screening value (Resident Adult FWCUG, MCL, or RSL), the CMCOPC was further evaluated using the AT123D model to predict future maximum concentrations in groundwater beneath the source, as well as at downgradient receptor locations, if applicable. The downgradient receptor location (if required) is the closest surface water body feature downgradient of the source areas that is connected to the groundwater. The predicted concentrations of CMCOPCs in groundwater beneath the source were compared to available groundwater monitoring results for the AOC to validate modeling results and provide WOE for identifying or eliminating CMCOCs.

6.5.1 Modeling Approach

Contaminant transport includes the movement of water and dissolved material from the source areas to groundwater. This occurs as rainwater infiltrates from the surface and percolates through the area of contamination, its surrounding soil, and into the saturated zone. The downward movement of water, driven by gravitational potential, capillary pressure, and other components of total fluid potential mobilizes the contaminants and carries them through the soil into the mixing zone with the water table. Lateral transport within the shallow bedrock is controlled by the groundwater gradient. Vertical transport (evaluated with the SESOIL model) through the overburden to the water table and horizontal transport (evaluated with the AT123D model) through the shallow bedrock to downgradient receptor locations are illustrated in Figure 6-1.



1 **Figure 6-3. AOC Fate and Transport Modeling Approach – Sediment**

Table 6-2. Calculated Sample-specific DAFs for Atlas Scrap Yard

Analyte	Sediment Concentration (mg/kg)	Sediment and Surface Water Sample Location	K_d (L/kg)	Reference	Maximum Groundwater Concentration (mg/L)[a]	Co-located Surface Water Concentration (mg/L)	DAF[b]
Inorganic Chemicals							
Beryllium	7.40E-01	L12sd-308/L12sw-308	7.90E+02	c	9.37E-04	1.20E-03	1
Cadmium	5.10E-01	L12sd-308/L12sw-308	7.50E+01	c	6.80E-03	1.20E-03	6
Nickel	1.82E+01	L12sd-308/L12sw-308	6.50E+01	c	2.80E-01	2.44E-02	11
Organic chemicals - Semi-volatile							
Benz(a)anthracene	3.50E-01	L12sd-308/L12sw-308	1.77E+05	d	1.98E-06	2.40E-04	1
Benzo(a)pyrene	4.10E-01	L12sd-308/L12sw-308	5.87E+05	d	6.98E-07	2.20E-04	1
Benzo(b)fluoranthene	6.80E-01	L12sd-308/L12sw-308	5.99E+05	d	1.13E-06	3.20E-04	1
Chrysene	4.60E-01	L12sd-308/L12sw-308	1.81E+05	d	2.55E-06	2.20E-04	1
Fluoranthene	6.80E-01	L12sd-308/L12sw-308	5.55E+04	d	1.23E-05	4.60E-04	1
Pyrene	5.40E-01	L12sd-308/L12sw-308	5.43E+04	d	9.94E-06	3.30E-04	1

As there were no co-located sediment and surface water data for Atlas Scrap Yard, the sample-specific DAF was calculated based on sediment and surface water concentration data from location L12-308 near Atlas Scrap Yard. Sample data for location L12-308 was taken on 2/15/2010. Sediment samples were taken from a depth of 0.0-0.5 ft bgs.

[a] Maximum groundwater concentration = maximum sediment concentration divided by the distribution coefficient.

[b] DAFs were calculated by dividing the calculated groundwater concentration by the co-located surface water concentration.

[c] USEPA 1996b. *Soil Screening Guidance: Technical Background Document*. Office of Solid Waste and Emergency Response, Washington, D.C. May 1996.

[d] USEPA 2012. EPA Regional Screening Level. Website: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm (November 2012).

DAF = Dilution Attenuation Factor.
Kd = Distribution Coefficient.
L/kg = Liters per kilogram.
mg/kg = Milligrams per kilogram.
mg/L =Milligrams per liter.

The output of the contaminant fate and transport modeling is presented as the expected maximum concentration of modeled contaminants at the selected receptor locations. For SESOIL, the receptor location is the groundwater table beneath the source area. For this analysis, seven ISM sampling locations were considered as sources of contamination based on the results of the soil screening analysis. A separate SESOIL analysis was performed for each initial CMCOPC listed in Table 6-1 and is presented in Figure 6-4.

The predicted maximum leachate concentration just above the water table, observed in the SESOIL results, was compared against its applicable RVAAP facility-wide background concentration, as well as RVAAP FWCUGs for the Resident Adult, MCL, and RSL. If the predicted maximum leachate concentration of an initial CMCOPC was higher than the facility-wide background concentration, and the lowest risk-based screening value (Resident Adult FWCUG, MCL, or RSL), the CMCOPC was further evaluated using the AT123D model to predict future maximum concentrations in groundwater beneath the source, as well as at downgradient receptor locations, if applicable.

If a predicted maximum leachate concentration was lower than the screening criteria, the chemical was no longer considered a CMCOPC.

For chemicals identified as CMCOPCs, maximum concentrations predicted by AT123D in groundwater directly below the source areas and at the downgradient receptor locations were compared to the applicable RVAAP facility-wide background concentrations, as well as RVAAP FWCUGs for the Resident Adult, MCL, and RSL. If the predicted maximum concentration of a CMCOPC was higher than its facility-wide background concentration and the lowest risk-based screening value (Resident Adult FWCUG, MCL, or RSL), the chemical was retained as a CMCOC. If the predicted maximum concentration of a CMCOPC in groundwater directly below the source areas and at the downgradient receptor location was lower than the screening criteria, the chemical is not considered a CMCOC.

CMCOCs identified by modeling results were evaluated with respect to WOE for retaining or eliminating CMCOCs from further consideration as a basis for potential soil or sediment remedial actions. Lines of evidence include validation of modeling results using available AOC-specific groundwater monitoring data. Modeled timelines for potential leaching and lateral transport were evaluated with respect to estimated times for contaminant releases during former RVAAP operations to determine if peak leaching concentrations would likely have occurred in the past. Some CMCOCs present at or below RVAAP soil or sediment background concentrations may have predicted leachate or groundwater concentrations exceeding risk-based criteria due to conservative model assumptions; therefore, these were also identified and considered in the evaluation. Additionally, identified CMCOCs were compared to COCs identified in the HHRA to determine if they had an associated risk related to direct exposure to soil or sediment or if CMCOCs and COCs were co-located and may be addressed simultaneously under a potential remedial action.

6.5.2 Model Applications

The SESOIL model (GSC 1998) used for leachate modeling, when applicable, estimates pollutant concentrations in the soil profile following introduction via direct application and/or interaction with transport media. The AT123D model (DOE 1992) is an analytical groundwater pollutant fate and transport model. It computes the spatial-temporal concentration distribution of waste in the aquifer system and predicts the transient spread of a contaminant plume through a groundwater aquifer. The application of both of these models is discussed in the following subsections.

6.5.2.1 SESOIL Modeling

The SESOIL model defines the soil column as compartments extending from the ground surface through the unsaturated zone and to the upper level of the saturated soil zone or top of bedrock. Processes simulated in SESOIL are categorized in three cycles: the hydrologic cycle, sedimentation cycle, and pollutant cycle. Each cycle is a separate submodule in the SESOIL code. The hydrologic cycle includes rainfall, surface runoff, percolation, soil-water content, evapotranspiration, and groundwater recharge. The sediment washload cycle includes erosion and sediment transport.

The pollutant cycle includes convective transport, volatilization, adsorption/desorption, and degradation/decay. A chemical in SESOIL can partition in up to four phases (liquid, adsorbed, air, and pure). Data requirements for SESOIL are not extensive and utilize a minimum of AOC-specific soil and chemical parameters and monthly or seasonal meteorological values as input.

The SESOIL model output includes pollutant concentrations at various soil depths and pollutant loss from the unsaturated soil zone in terms of surface runoff, percolation to groundwater, volatilization, and degradation. The mathematical representations in SESOIL generally consider the rate at which the modeled processes occur, the interaction of different processes with each other, and the initial conditions of the waste area and the surrounding subsurface matrix material.

The input data for SESOIL can be grouped into four data types: climatic, chemical, soil, and application. There are 61 separate parameters contained in these four data groups. Wherever possible, AOC-specific parameter values were used for modeling. However, certain parameters were not available for the source areas and were estimated based on pertinent scientific literature, geochemical investigations, and checks for consistency between model results and historical data. Conservative estimates were used when a range of values existed or parameter values were not available.

6.5.2.2 Climate Data

The climatic data file of SESOIL consists of an array of mean monthly temperature, mean monthly cloud cover fraction, average monthly relative humidity, average monthly reflectivity of the earth’s surface (i.e., shortwave albedo), average daily evapotranspiration, monthly precipitation, mean number of storm events per month, mean duration of rainfall, and mean length of rainy season. The climatic data are presented in Table E-9 of Appendix E. The dataset was taken from the Youngstown

National Weather Service Office weather station at the Youngstown–Warren Regional Airport in Vienna, Ohio, as it was determined to be most appropriate in corresponding to the latitude and the longitude at Camp Ravenna.

Climate data from the Youngstown weather station did not have all of the necessary climatic parameters for the HELP model simulation. Accordingly, the water balance evaluation presented in Section 6.2.4 was based on the nearest available weather station data with all necessary coefficients stored within the HELP model (Cleveland, Ohio). Inputs for the SESOIL model (Youngstown station) and HELP model (Cleveland station) produced virtually the same recharge rate (9.40 cm/yr for Cleveland and 9.42 cm/yr for Youngstown) for each location. Therefore, the use of the two different weather station datasets did not impact modeling results.

6.5.2.3 Chemical Data

The pollutant fate cycle of SESOIL focuses on various chemical transport and transformation processes that may occur in the soil zone. These processes include volatilization/diffusion, adsorption/desorption, cation exchange, biodegradation and hydrolysis, and metal complexation. The chemical-specific parameters used for SESOIL are presented in Appendix E (Table E-10). The distribution coefficients (K_ds) for inorganic chemicals were obtained from the *Soil Screening Guidance: Technical Background Document*, assuming a neutral pH of 7, unless otherwise stated (USEPA 1996b). The K_ds for organic chemicals were estimated from organic, carbon-based K_{oc} using the relationship $K_d = (f_{oc})(K_{oc})$, where f_{oc} = mass fraction of the organic carbon soil content obtained from AOC-specific measurements. K_{oc} values were obtained from *Soil Screening Guidance: Technical Background Document* (USEPA 1996b), unless otherwise stated. In general, biodegradation rates are not applicable for inorganic CMCOPCs and biodegradation was not considered for the organic chemicals in this evaluation.

6.5.2.4 Soil Data

The soil data file of SESOIL contains input parameters describing the physical characteristics of the subsurface soil and is presented in Table 6-3. These parameters include soil bulk density, intrinsic permeability, soil disconnectedness index, soil porosity, organic carbon content, and cation exchange capacity. AOC-specific data were used from geotechnical samples collected at the AOC during the PBA08 RI (Table 5-4). There is, however, no measurement method for the soil disconnectedness index or a measured value of the Freundlich exponent. Soil disconnectedness index is a parameter that relates the soil permeability to the moisture content. Thus, SESOIL default values were used for these two parameters.

An average intrinsic permeability for the vadose zone, representing the unconsolidated zone above the water table, was calibrated using the percolation rate of 9.42 cm/yr (3.6 inches/year) as the calibration target. The model was calibrated against the percolation rate by varying the intrinsic permeability and keeping all other AOC-specific geotechnical parameters fixed. The final hydrogeologic parameter values used in this modeling are shown in Table 6-3. The soil porosity was set to the AOC-specific value. The intrinsic permeability, calibrated in SESOIL to the percolation rate (determined from a water balance estimated in HELP), was found to match the AOC-specific measurements from geotechnical samples.

The soil disconnectedness index replaces the moisture retention curves (or characteristic curves) used by other unsaturated zone leaching models. SESOIL's User Guide defines this parameter to be the exponent relating the "wetting" and "drying" time-dependent permeability of soil to its saturated permeability (Hetrick and Scott 1993). This "one variable" approach of using soil disconnectedness index in SESOIL simplifies the data estimation process and reduces computational time. In addition, this parameter was calibrated for four different soil types ranging from sandy loam to clay (Hetrick et. al. 1986), and calibrated values fell within the default range specified in the SESOIL's User Guide.

6.5.2.5 Source Terms

Analytical data from surface and subsurface soil collected at the AOC were used as source terms for SESOIL modeling. All the samples collected at different depth intervals were compiled to provide a detailed loading option for the SESOIL model. The maximum soil concentrations for each CMCOPC, listed in Table 6-1, were used as source term concentrations for the SESOIL model.

6.5.2.6 Application Data

Four different layering schemes were developed for sample locations within the AOC due to varying thicknesses of the loading and leaching zones that are based on varying soil sample and groundwater depths throughout the AOC. Leaching zone thicknesses are based on distance from the deepest detection of a CMCOC to the water table based on the potentiometric surface map (Figure 3-1). Details of the model layers utilized in this modeling are presented in Table E-11 in Appendix E.

Each model was arranged in four layers. The top layer (Layer 1) for each model consisted of the loading zone. Layer 1 in all layering schemes was 0-1.0 ft bgs.

The thicknesses of Layers 2 and 3 varied between the models for each chemical but served as a leaching zone in each. The fourth layer (Layer 4) was 0.5 ft thick and did not contain sublayers. Layer 4 was included just above the water table to read output results at the water table/vadose zone interface (i.e., leachate concentration entering groundwater).

For the selenium model, Layers 2 and 3 served as a leaching zone in the 13-ft thick vadose zone. For the 2,6-DNT; 4-amino-2,6-DNT; 2-methylnaphthalene; benz(a)anthracene; benzo(b)fluoranthene; benzo(a)pyrene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene models, Layers 2 and 3 served as a leaching zone in the 12-ft thick vadose zone. For the 3-nitrotoluene model, Layers 2 and 3 served as a leaching zone in the 10-ft thick vadose zone. For the 2-amino-4,6-DNT; 2-nitrotoluene; naphthalene; and silver models, Layers 2 and 3 served as a leaching zone in the 9-ft thick vadose zone. In each of these models, Layer 4 was included just above the water table to read output results at the water table/vadose zone interface (i.e., leachate concentration entering groundwater).

Table 6-3. Unit-specific Parameters Used in SESOIL and AT123D Modeling

Parameters	Symbol	Units	Value	Source for Value
SESOIL				
Percolation Rate (Recharge Rate)	q	m/year	9.42E-02	0.1 SESOIL precipitation for Youngstown, Ohio
Horizontal Area of Aggregate	A_p	cm^2	ISM Specific	Sample specific
Intrinsic Permeability	p	cm^2	1.05E-10	Calibrated from SESOIL model
Disconnectedness Index	c	unitless	11	Calibrated from SESOIL model
Freundlich Equation Exponent	n	unitless	1	SESOIL default
Fraction Organic Carbon	f_{oc}	unitless	2.60E-03	Average from the PBA08 RI Geotechnical Samples ASYSB-051-5684-SO, ASYSB-051-5685-SO, ASYSB-055-5700-SO, and ASYSB-055-5701-SO
Bulk Density	ρb	kg/L	1.75	
Moisture Content	w	wt %	19.6	
Water-filled Soil Porosity	θw	unitless	0.343	
Air-filled Soil Porosity	θa	unitless	0.016	
Porosity - total	n_T	unitless	0.359	
Vadose Zone Thickness	Vz	m	2.7-4.0	Average depth to water from potentiometric surface map (Figure 6-4)
Leaching Zone Thickness	Lz	m	2.4-3.7	Based on distance from the deepest detection of a CMCOC to the water table from potentiometric surface map (Figure 6-4)
AT123D				
Aquifer Thickness	h	m	6	Facility-wide assumption for the unconsolidated aquifer presented the Load Line 1 investigation (USACE 2003a)
Hydraulic Conductivity in Saturated Zone	K_S	cm/s	3.89E-04	Average from slug test results from Atlas Scrap Yard monitoring wells (MKM 2007)
Hydraulic Gradient	i	unitless	4.60E-03	Average gradient determined from Figure 6-4
Effective porosity	n_e	unitless	0.2	Assumed for sandstone (USEPA 1985)
Dispersivity, longitudinal	α_L	m	30	Assumed
Dispersivity, transverse	α_T	m	3	0.1 α_L
Dispersivity, vertical	α_V	m	0.3	0.01 α_L
Retardation factor	R	unitless	chemical-specific	Presented in Table E-7 in Appendix E

MKM 2007. Characterization of 14 AOCs at Ravenna Army Ammunition Plant (March 2007).

USACE 2003a. Phase II Remedial Investigation Report for the Load Line 1 at the Ravenna Army Ammunition Plant, Ravenna, Ohio. June 2003.

USEPA (United States Environmental Protection Agency) 1985. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water, Revised 1985 Parts 1 and 2, EPA/600/6-85/002. Office of Research and Development, Environmental Research Laboratory, Athens, Georgia. September 1985.

AT123D = Analytical Transient 1-,2-,3-Dimensional model.
cm^2 = Square centimeters.
CMCOC = Contaminant Migration Chemical of Concern.
cm/s = Centimeters per second.
FWGWMP = Facility-Wide Groundwater Monitoring Program.
ISM = Incremental Sampling Method.
kg/L = Kilograms per liter.
m = Meter.
m/yr = Meters per year.
PBA08 RI = Performance Based Acquisition 2008 Remedial Investigation.
SESOIL = Seasonal Soil Compartment Model.
wt % = Weight by percent.

6.5.3 SESOIL Modeling Results

SESOIL modeling was performed for initial CMCOPCs [2,6-DNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; 2-methylnaphthalene; 2-nitrotoluene; 3-nitrotoluene; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; indeno(1,2,3-cd)pyrene; naphthalene; selenium; and silver] that have the potential to reach the water table within 1,000 years based on the soil screening analysis results (Table 6-1). Table 6-4 presents the predicted peak leachate concentrations beneath the source areas relative to the discrete sample locations and ISM areas corresponding to the time of peak leachate concentrations. The Resident Adult FWCUGs, RVAAP facility-wide background concentrations, and MCL/RSL values for the CMCOPCs, if available, are also shown in this table for comparison purposes. Benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene were eliminated as a final CMCOPC based on the results of the SESOIL modeling, as the leachate below the source and just above the water table was below its screening criterion. The remaining SRCs were selected as final CMCOPCs. Figures E-5 through E-13 in Appendix E show the leachate mass flux versus time plots generated by SESOIL.

Selenium, silver, 2-nitrotoluene, 2,6-DNT, 2-amino-4,6-DNT, 3-nitrotoluene, 4-amino-2,6-DNT, 2-methylnaphthalene, and naphthalene were identified as the final soil CMCOPCs based on SESOIL results for each sample location within the AOC where the leachate concentration exceeded its screening criteria.

6.5.4 AT123D Modeling in the Saturated Zone

The fate and transport processes accounted for in the AT123D model include advection, dispersion, adsorption/retardation, and decay. This model can be used as a tool for estimating the dissolved concentration of a chemical in three dimensions in the groundwater, resulting from a mass release over a source area (point, line, area, or volume source). The model can handle instantaneous, as well as continuous, source loadings of CMCOPC concentrations. AT123D is frequently used by the scientific and technical community to perform quick and conservative estimates of groundwater plume movements in space and time. SESOIL and AT123D are linked in a software package (RISKPRO) so that mass loading to the groundwater predicted by SESOIL can be transferred directly to AT123D. Therefore, AT123D was chosen to predict the maximum concentration of contaminants in groundwater after mixing with the leachate and the future concentrations for the contaminants in groundwater at the receptor locations.

The hydrogeologic parameter values used in this modeling are shown in Table 6-3. Most of the parameters presented in this table are AOC-specific values, unless otherwise indicated. The chemical-specific parameters used for AT123D are presented in Appendix E (Table E-12). A discussion of model assumptions and limitations is presented in Section 6.5.6.

Selenium, silver, 2-nitrotoluene, 2,6-DNT, 2-amino-4,6-DNT, 3-nitrotoluene, 4-amino-2,6-DNT, 2-methylnaphthalene, and naphthalene were identified as the final soil CMCOPCs based on SESOIL results for each sample location within the AOC where the leachate concentration exceeded its screening criteria.

Barium, chromium, copper, lead, mercury, selenium, 2-amino-4,6-DNT; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene were identified as final CMCOPCs based on the sediment screening analysis. Figure 6-5 presents the locations of the soil and sediment samples where the final CMCOPCs exist. Figures E-14 through E-35 show the predicted concentration versus time curves based on AT123D modeling.

6.5.5 AT123D Modeling Results

Results of AT123D modeling for final soil and sediment CMCOPCs are shown in Table 6-5. The results show predicted groundwater concentrations for CMCOPCs beneath the source area and at the selected downgradient receptor locations [i.e., unnamed tributary to Sand Creek (flowing northwest), unnamed tributary to Cobbs Ponds (flowing northeast) and an unnamed tributary to the Mahoning River (flowing southwest)]. Observed groundwater concentrations from AOC monitoring wells are included in Table 6-5; however, it should be noted that these wells may not exist near the sample location with the maximum concentration and should not be considered in direct correlation. The observed groundwater concentrations were added for comparison, not for screening criteria. The distances to the downgradient receptors were based on the distance along the groundwater flow direction to the closest surface water body.

Based on the flow direction shown in Figure 3-1, the unnamed tributary to Sand Creek was chosen as the downgradient receptor for ISM areas ASYss-084M-SO (selenium), ASYss-088M-SO (naphthalene and 2-methylnaphthalene), and ASYss-093M-SO (3-nitrotoluene) at a distance of 2,560 ft; 2,720 ft; and 2,880 ft, respectively. The unnamed tributary to the Mahoning River was selected as the downgradient receptor for ASYss-018M-SO (2-nitrotoluene, 2-amino-4,6-DNT, and silver) at a distance of 2,720 ft. The unnamed tributary to Cobbs Ponds was also considered as a receptor for the areas where the final CMCOPCs existed in soil because it was closer than the unnamed tributary to Sand Creek. Multiple receptors were considered because a groundwater divide occurs in this vicinity and even though Figure 3-1 shows a westerly flow direction, the facility-wide potentiometric surface shows an easterly flow direction. The unnamed tributary to Cobbs Ponds was the downgradient receptor for the sediment sample locations at a distance of 2,080 ft.

For final soil CMCOPCs, the maximum predicted concentrations of selenium and silver in groundwater were not predicted to exceed the screening criteria beneath the source area and were eliminated as CMCOCs. The maximum predicted concentrations of 2-nitrotoluene, 3-nitrotoluene, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-methylnaphthalene, and naphthalene were predicted to exceed the screening criteria in groundwater beneath the source area and were; therefore, modeled to the downgradient receptors [i.e., unnamed tributary to Sand Creek (flowing northwest) and unnamed tributary to the Mahoning River (flowing southwest)]. The identified sediment CMCOPCs [barium, chromium, copper, lead, mercury, selenium, 2-amino-4,6-DNT; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene;

indeno(1,2,3-cd)pyrene; and naphthalene] were also predicted by analytical solutions to exceed screening criteria in groundwater beneath their source and were retained for lateral transport modeling to downgradient receptors [i.e., unnamed tributary to Cobbs Ponds (flowing northeast)].

Lateral transport modeling showed the maximum predicted concentrations of final soil CMCOPCs did not exceed the screening criteria at their downgradient receptor location [i.e., unnamed tributary to Sand Creek (flowing northwest) and unnamed tributary to the Mahoning River (flowing southwest)]. Likewise, maximum predicted concentrations of final sediment CMCOPCs did not exceed screening criteria at their downgradient receptor [i.e., unnamed tributary to Cobbs Ponds (flowing northeast)]. However, the seven final soil CMCOPCs (2-nitrotoluene, 3-nitrotoluene, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-methylnaphthalene, and naphthalene) and the 13 final sediment CMCOPCs [barium, chromium, copper, lead, mercury, selenium, 2-amino-4,6-DNT; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene] exceeded screening criteria in groundwater beneath their respective source areas and were retained for further evaluation.

6.5.6 Limitations/Assumptions

In general, a conservative modeling approach was used, which may overestimate the contaminant concentration in the leachate for migration from observed soil concentrations. Listed below are important assumptions used in this analysis:

- Chemical and biological degradation rates for organic CMCOPCs were not considered in the SESOIL and AT123D models.
- Using K_d and R to describe the reaction term of the transport equation assumes that an equilibrium relationship exists between the solid-phase and solution-phase concentrations and that the relationship is linear and reversible.
- Since AOC-specific data are not available, the K_d and K_{oc} values used in this analysis for all CMCOPCs represent literature or calculated values and may not represent conditions at the AOC.
- The K_d for inorganic chemicals used here assumed a pH of 6.8 [i.e., the middle value in the USEPA’s evaluation presented in the soil screening guidance document (USEPA 1996b)]. The K_d for inorganic chemicals varies with pH (generally decreasing with decreasing pH, although there are few exceptions); therefore, if AOC-specific pH measurements are greater or less than 6.8, the K_d and calculated screening parameters (such as R) will deviate from those presented here.
- Flow and transport in the vadose zone is one-dimensional (i.e., only in the vertical direction).
- This modeling used the current soil concentrations that were collected approximately 65 years after historical operations were terminated at the AOC. Therefore, it does not account for constituents that have already leached to groundwater.
- Flow and transport are not affected by density variations.

- A realistic distribution of soil contamination was not considered. The maximum concentration value was used as the source term concentrations for SESOIL model layers; this is a highly conservative assumption that is expected to produce higher leachate concentrations for the CMCOPCs than the average condition. The horizontal distribution of soil contamination was assumed based on concentration levels from nearby sample locations as opposed to taking into account the entire area.
- The water balance represents an overall average rainwater recharge and assumes an even distribution of infiltration in the modeled area. An average water balance assumes some areas will have higher or lower recharge based on the heterogeneity of the soil and varying topography.

The inherent uncertainties associated with using these assumptions must be recognized. K_d values are highly sensitive to changes in the major chemistry of the solution phase. Therefore, it is important that the values be measured or estimated under conditions that will closely represent those of the contaminant plume. Deviations from actual AOC-specific parameter values from assumed literature values may significantly affect contaminant fate predictions. It is also important to note that the contaminant plume will change over time and will be affected by multiple solutes present at the AOC. The effects of heterogeneity and anisotropy are not addressed in these simulations.

The discrepancy between the contaminant concentrations measured in the field and the values predicted by the model could be investigated by performing sensitivity analyses on the model input parameters that have the most influence on the model predictions.

These parameters are: (1) biodegradation rate constants for organic chemicals; (2) saturated hydraulic conductivity; (3) soil porosity; (4) fraction of soil organic carbon-content (f_{oc}) for organic chemicals; (5) K_d for inorganic chemicals; and (6) longitudinal, transverse, and vertical dispersivity values. Generally, higher biodegradation rates will produce lower concentrations, and lower rates will produce higher concentrations for organic chemicals without impacting the results of the inorganic chemicals. Higher hydraulic conductivity and dispersivity causes higher advection and dispersion, thereby producing lower peaks near the source area, but increasing the migration distance. The reverse will be true with lower hydraulic conductivity and dispersivity values. Higher f_{oc} values have a similar effect on organic chemicals as higher K_d has on inorganic chemicals; they decrease chemical mobility and produce lower concentrations in groundwater.

AOC-specific groundwater data indicate the AT123D modeling results are conservative with respect to predicted concentrations of chemicals in groundwater beneath the sources. None of the final CMCOPCs in soil and sediment were detected in recent AOC groundwater samples collected from 2009-2012 (EQM 2010), except the metals (e.g., barium, chromium, copper, and lead) at concentrations below the screening criteria (Table 6-5). These data indicate soil and sediment sources are not currently impacting groundwater quality.

Table 6-4. Summary of SESOIL Modeling Results

Initial CMCOPC	Maximum Soil Concentration (mg/kg)	ISM Area or Discrete Sample Location	Maximum Depth of Contamination (ft bgs)	Depth to Groundwater (ft bgs)	Predicted ($C_{L, max}$) Beneath the Source (mg/L)	Time Required to Reach ($C_{L, max}$) (years)	MCL/RSL (mg/L)	Resident Farmer Adult FWCUG[a] (mg/L)	Facility-Wide Background Unconsolidated Groundwater (mg/L)	Final CMCOPC?[b] (Yes/No)
Inorganic Chemicals										
Selenium	**2.90E+00**	**ASYss-084M-5758-SO**	**1.0**	**13.0**	**8.83E-02**	**187**	**5.00E-02**	**None**	**0.00E+00**	**Yes**
Silver	**5.20E+00**	**ASYss-018M-SO**	**1.0**	**9.0**	**1.46E-01**	**209**	**7.10E-02**	**None**	**0.00E+00**	**Yes**
Organic Chemicals - Explosives										
2,6-Dinitrotoluene	**1.30E-01**	**ASYss-076M-5750-SO**	**1.0**	**12.0**	**1.39E-02**	**57**	**1.50E-02**	**1.22E-04**	**None**	**Yes**
2-Amino-4,6-Dinitrotoluene	**1.00E-01**	**ASYss-018M-SO**	**1.0**	**9.0**	**2.66E-02**	**23**	**3.00E-02**	**7.30E-04**	**None**	**Yes**
4-Amino-2,6-Dinitrotoluene	**2.10E-01**	**ASYss-080M-5754-SO**	**1.0**	**12.0**	**4.26E-02**	**30**	**3.00E-02**	**7.30E-04**	**None**	**Yes**
2-Nitrotoluene	**4.30E-01**	**ASYss-018M-SO**	**1.0**	**9.0**	**7.29E-02**	**28**	**2.70E-04**	**3.70E-04**	**None**	**Yes**
3-Nitrotoluene	**1.20E-01**	**ASYss-093M-5767-SO**	**1.0**	**10.0**	**2.41E-02**	**31**	**1.30E-03**	**None**	**None**	**Yes**
Organic Chemicals - Semi-volatiles										
2-Methylnaphthalene	**2.20E+00**	**ASYss-088M-5756-SO**	**1.0**	**12.0**	**4.80E-02**	**216**	**2.70E-02**	**None**	**None**	**Yes**
Benz(a)anthracene	1.70E+01	ASYss-078M-5752-SO	1.0	12.0	0.00E+00	>1000	2.90E-05	4.00E-06	None	No
Benzo(a)pyrene	2.00E+01	ASYss-080M-5754-SO	1.0	12.0	0.00E+00	>1000	2.00E-04	2.30E-07	None	No
Benzo(b)fluoranthene	3.70E+01	ASYss-078M-5752-SO	1.0	12.0	0.00E+00	>1000	2.90E-05	2.00E-06	None	No
Dibenz(a,h)anthracene	5.10E+00	ASYss-080M-5754-SO	1.0	12.0	0.00E+00	>1000	2.90E-06	1.50E-07	None	No
Indeno(1,2,3-cd)pyrene	1.30E+01	ASYss-080M-5754-SO	1.0	12.0	0.00E+00	>1000	2.90E-05	2.00E-06	None	No
Naphthalene	**1.40E+00**	**ASYss-088M-5756-SO**	**1.0**	**9.0**	**6.58E-02**	**102**	**1.40E-04**	**None**	**None**	**Yes**

[a] The Resident Adult FWCUG is based on a target risk of 10^{-6} and a Hazard Index of 0.1.

[b] The Final CMCOPC was identified comparing predicted maximum leachate concentration to MCL/RSL, Resident Adult FWCUGs, and facility-wide background concentrations. A constituent is a CMCOPC if its predicted leachate concentration exceeds its MCL/RSL within 1,000 years.

ft bgs = Feet below ground surface.
$C_{L, max}$ = maximum leachate concentration
CMCOPC = Contaminant migration chemical of potential concern.
FWCUG = Facility-Wide Cleanup Goal.
ISM = Incremental sampling method.
MCL = Maximum contaminant level.
mg/kg = Milligram per kilogram.
mg/L = Milligram per liter.
PCB = Polychlorinated biphenyl.
RSL = Regional Screening Level.
SESOIL = Seasonal soil compartment model.
Bold = CMCOPCs exceeding MCL/RSL, Resident Adult FWCUGs, and facility-wide background concentrations.

Table 6-5. Summary of AT123D Modeling Results

Final CMCOPC	Predicted Maximum Leachate Concentration[a] ($C_{L, max}$) (mg/L)	Predicted Maximum Groundwater Concentrations[b] Beneath the Source ($C_{S, max}$) (mg/L)	Predicted Maximum Groundwater Concentrations[b] at the Downgradient Receptor ($C_{R,max}$) (mg/L)	Distance to Downgradient Receptor (ft)	Observed Maximum Groundwater Concentration[c] (mg/L)	MCL/RSL (mg/L)	Resident Farmer Adult FWCUG[d] (mg/L)	Facility-Wide Background Unconsolidated Groundwater (mg/L)	Identified CMCOC for Further Evaluation?[e] (Yes/No)
Final CMCOPCs in Soil									
Inorganic Chemicals									
Selenium	8.83E-02	4.21E-02	0.00E+00	2,560	ND	5.00E-02	None	0.00E+00	No
Silver	1.46E-01	4.17E-02	0.00E+00	2,720	ND	7.10E-02	None	0.00E+00	No
Organic Chemicals – Explosives									
2,6-Dinitrotoluene	1.39E-02	4.00E-03	0.00E+00		ND	1.50E-02	1.22E-04	None	Yes
2-Amino-4,6-dinitrotoluene	2.66E-02	7.61E-03	4.12E-07	2,720	ND	3.00E-02	7.30E-04	None	Yes
2-Nitrotoluene	7.29E-02	2.04E-02	3.49E-08	2,720	ND	2.70E-04	3.70E-04	None	Yes
3-Nitrotoluene	2.41E-02	1.17E-02	1.92E-07	2,880	ND	1.30E-03	None	None	Yes
4-Amino-2,6-dinitrotoluene	4.26E-02	1.56E-02	3.63E-05	2080	ND	3.00E-02	7.30E-04	ND	Yes
Organic Chemicals – Semi-Volatile									
2-Methylnaphthalene	4.8E-02	2.92E-02	0.00E+00	2,720	ND	2.70E-02	None	None	Yes
Naphthalene	6.58E-02	3.00E-02	0.00E+00	2720	ND	1.40E-04	None	None	Yes
Final CMCOPCs in Sediment[f]									
Inorganic Chemicals									
Barium	3.41E+00	3.39E+00	0.00E+00	2,080	5.44E-02	2.00E+00	1.47E-03	0.00E+00	Yes
Chromium	1.05E+00	1.03E+00	0.00E+00	2,080	1.02E-02	1.00E-01	8.81E-03	7.30E-03	Yes
Copper	1.41E+00	1.39E+00	0.00E+00	2,080	1.25E-02	1.30E+00	None	0.00E+00	Yes
Lead	6.73E-02	6.69E-02	0.00E+00	2,080	5.30E-03	1.50E-02	None	0.00E+00	Yes
Mercury	2.69E-03	2.68E-03	0.00E+00	2,080	ND	2.00E-03	None	0.00E+00	Yes
Selenium	5.40E-01	5.38E-01	0.00E+00	2,080	ND	5.00E-02	None	0.00E+00	Yes
Organic Chemicals – Explosives									
2-Amino-4,6-Dinitrotoluene	1.09E-01	1.07E-01	0.00E+00	2,080	ND	3.00E-02	7.30E-04	None	Yes
Organic Chemicals – Semi-Volatile									
Benz(a)anthracene	7.61E-04	7.58E-04	0.00E+00	2,080	ND	2.90E-05	4.00E-06	None	Yes
Benzo(a)pyrene	2.68E-04	2.65E-04	0.00E+00	2,080	ND	2.00E-04	2.30E-07	None	Yes
Benzo(b)fluoranthene	4.36E-04	4.34E-04	0.00E+00	2,080	ND	2.90E-05	2.00E-06	None	Yes
Dibenz(a,h)anthracene	1.71E-05	1.69E-05	0.00E+00	2,080	ND	2.90E-06	1.50E-07	None	Yes
Indeno(1,2,3-cd)pyrene	6.11E-05	6.10E-05	0.00E+00	2,080	ND	2.90E-05	2.00E-06	None	Yes
Naphthalene	8.24E-03	8.21E-03	0.00E+00	2,080	ND	1.40E-04	None	None	Yes

[a] Represents SESOIL predicted maximum leachate concentration just above the water table.
[b] The predicted concentration was estimated using the results from SESOIL and applying AT123D model.
[c] Observed groundwater concentrations were reported in the *RVAAP Facility-wide Groundwater Monitoring Program 2009 Annual Report* (EQM 2010) and sampling events through 2012.
[d] The FWCUG is based on a target risk of 10^{-6} and a Hazard Index of 0.1.
[e] The CMCOC was identified comparing predicted concentration in groundwater to MCL/RSL, FWCUGs, and facility-wide background concentrations. A constituent is a CMCOC if its predicted concentration in groundwater exceeds all its screening criteria within 1,000 years.
[f] Maximum groundwater concentration = maximum sediment concentration divided by the distribution coefficient.

AT123D = Analytical Transient 1-,2-,3-Dimensional
$C_{L, max}$ = maximum leachate concentration.
$C_{R,max}$ = maximum groundwater mixing concentration at closest downgradient receptor
$C_{S, max}$ = maximum groundwater mixing concentration beneath source
CMCOC = Contaminant Migration Contaminant of Concern.
CMCOPC = Contaminant Migration Contaminant of Potential Concern.
ft = Feet.
FWCUG = Facility-Wide Cleanup Goal.
MCL = Maximum Contaminant Level.
mg/kg = Milligram per kilogram.
mg/L = Milligram per liter.
ND = Not detected.
RSL = Regional Screening Level.
SESOIL = Seasonal Soil Compartment Model.

Predictive modeling for seven final soil CMCOPCs (2-nitrotoluene, 3-nitrotoluene, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-methylnaphthalene, and naphthalene) indicated they may exceed the screening criteria in groundwater beneath their respective source areas. Naphthalene and 2-methylnaphthalene, and 2,6-DNT modeling results did not indicate breakthrough in groundwater beneath the source at concentrations above MCLs or RSLs until over 100 years in the future even under conservative model assumptions that assume no chemical degradation. These results indicate very high retardation in the soil matrices and it is likely these chemicals would degrade prior to mixing with groundwater.

The explosive compounds 2-nitrotoluene, 3-nitrotoluene, 2-amino-4,6-DNT, and 4-amino-2,6-DNT modeling results indicate concentrations in groundwater beneath the source areas would exceed MCLs or RSLs at about 30 years or less with peak concentrations occurring at approximately 50 years or less. Therefore, these chemicals should have already been detected in the existing groundwater. However, none of these explosive compounds have been detected in the AOC groundwater samples. Therefore, it may be concluded that the model predicted concentrations are highly conservative and would potentially be below their screening levels had site-specific biodegradation rates been determined and used by the groundwater models (SESOIL and AT123D). Considering activities at Atlas Scrap Yard occurred from1945-1970, detectable concentrations of chemicals near or above MCLs or RSLs are predicted by the models. However, the predicted concentrations are conservative based on current groundwater monitoring data for the AOC, in which none of these chemicals were detected except for the metals. All the metals detected in groundwater were detected at concentrations below screening criteria. These data indicate retardation and degradation are higher than accounted for by the modeling results and potential impacts to groundwater are mitigated by these factors. Predictive modeling for final sediment CMCOPCs [barium, chromium, copper, lead, mercury, selenium, 2-amino-4,6-DNT; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene] show peak concentrations in groundwater beneath the source would occur very quickly (< 20 years). Considering the timeline of Atlas Scrap Yard activities, peak concentrations likely occurred in the past and modeling results do not indicate potential future impacts.

None of the final soil CMCOPCs predicted to exceed screening criteria in groundwater beneath the sources were identified as COCs for soil in the HHRA (Section 7.0). Likewise, none of the sediment CMCOPCs modeled using AT123D were identified as COCs for sediment in the HHRA.

Based on review of the screening and modeling results, along with the WOE factors noted above, none of the identified CMCOCs are impacting groundwater at Atlas Scrap Yard and do not warrant further evaluation of source removal in an FS.

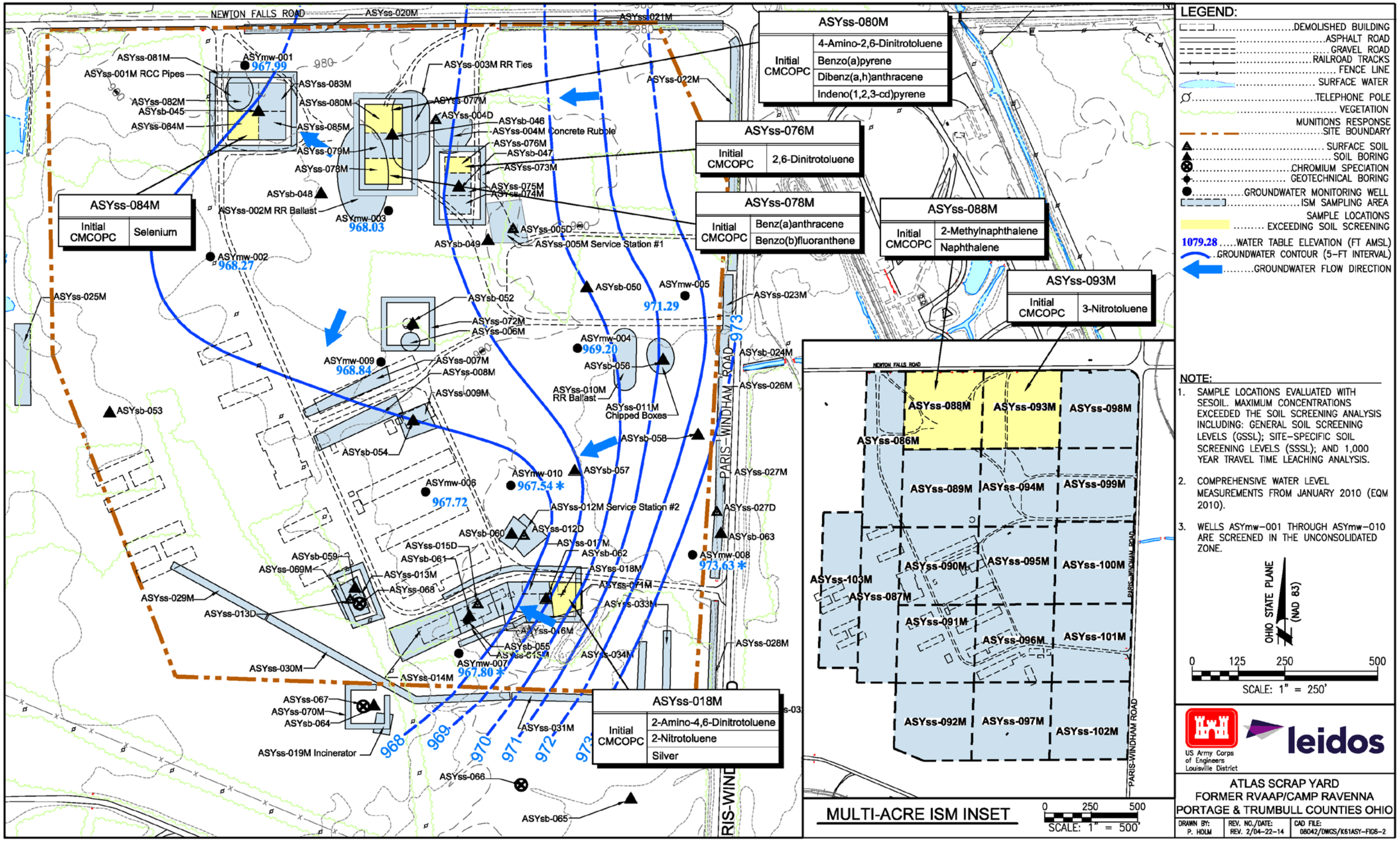
6.6 SUMMARY AND CONCLUSIONS

Inorganic and organic SRCs exist in surface soil, subsurface soil, and sediment at Atlas Scrap Yard. These SRCs were further evaluated to determine if residual concentrations in soil and sediment may potentially impact groundwater quality and warrant evaluation in an FS.

Evaluation of modeling results with respect to current AOC groundwater data and model limitations indicated identified soil SRCs are not currently impacting groundwater beneath the source areas and that predicted future impacts would be mitigated by factors such as chemical and biological degradation and lateral dispersivity. All SRCs identified in surface and subsurface soil at Atlas Scrap Yard were evaluated through the stepwise fate and transport evaluation and were eliminated as posing future impacts to groundwater.

A sediment screening analysis was performed for sediment samples at the AOC. An AOC-specific DAF was calculated using a co-located surface water and sediment concentrations for identified sediment SRCs. These DAFs were used in the sediment screening analysis to identify CMCOPCs for predictive modeling and further evaluation. Results for the sediment screening analysis and modeling eliminated all SRCs in sediment as posing future impacts to groundwater at Atlas Scrap Yard.

Based on review of the screening and modeling results, along with WOE factors, none of the identified CMCOCs for soil or sediment are impacting groundwater at Atlas Scrap Yard and do not warrant further evaluation of source removal in a FS.



NOTE:

1. SAMPLE LOCATIONS EVALUATED WITH SESOIL. MAXIMUM CONCENTRATIONS EXCEEDED THE SOIL SCREENING ANALYSIS INCLUDING: GENERAL SOIL SCREENING LEVELS (GSSL); SITE-SPECIFIC SOIL SCREENING LEVELS (SSSL); AND 1,000 YEAR TRAVEL TIME LEACHING ANALYSIS.
2. COMPREHENSIVE WATER LEVEL MEASUREMENTS FROM JANUARY 2010 (EQM 2010).
3. WELLS ASYmw-001 THROUGH ASYmw-010 ARE SCREENED IN THE UNCONSOLIDATED ZONE.

Figure 6-4. Initial CMCOPCs Identified in Soil Screening Analysis for SESOIL Evaluation

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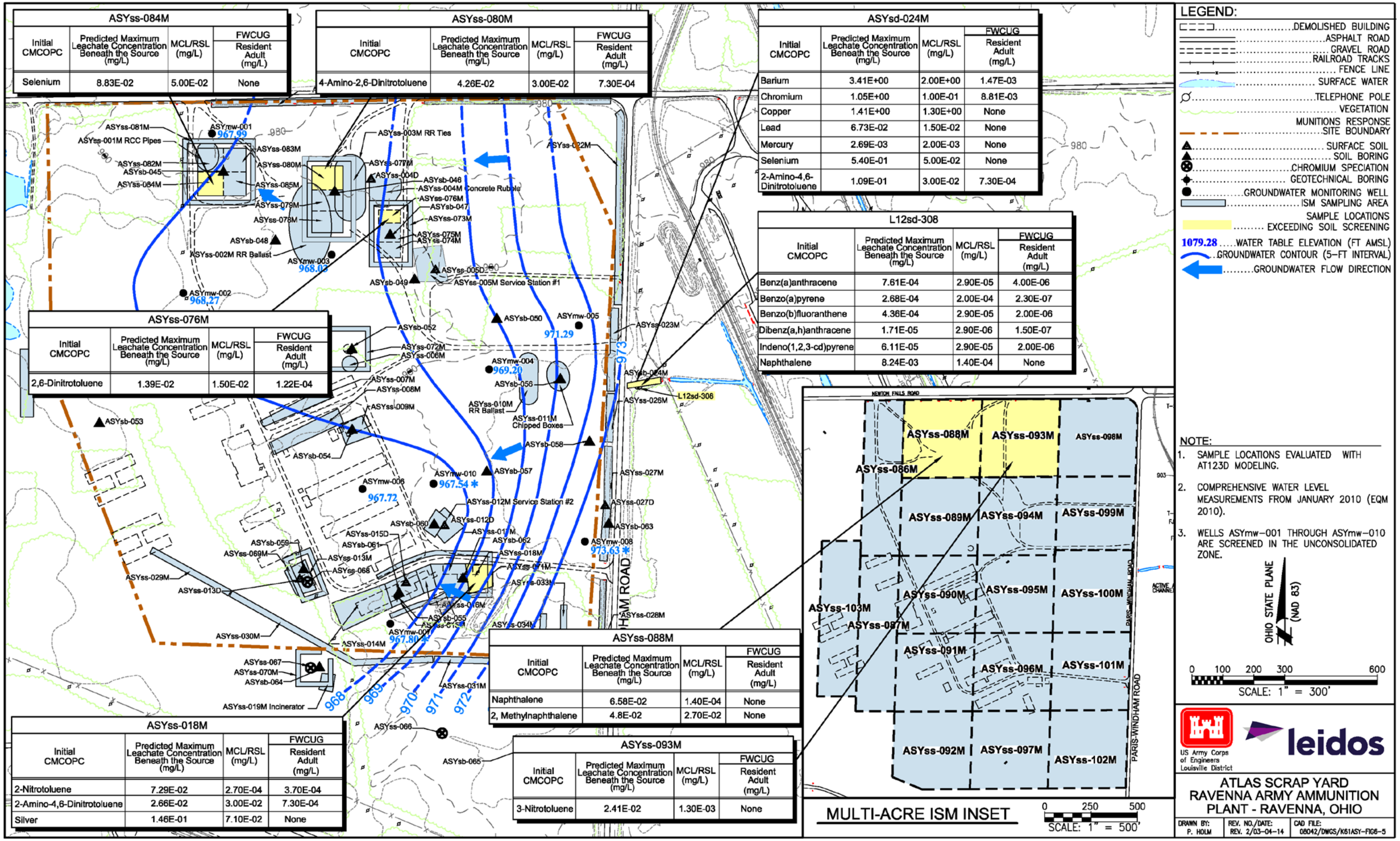

ASYss-084M

Initial CMCOPC	Predicted Maximum Leachate Concentration Beneath the Source (mg/L)	MCL/RSL (mg/L)	FWCUG Resident Adult (mg/L)
Selenium	8.83E-02	5.00E-02	None

ASYss-080M

Initial CMCOPC	Predicted Maximum Leachate Concentration Beneath the Source (mg/L)	MCL/RSL (mg/L)	FWCUG Resident Adult (mg/L)
4-Amino-2,6-Dinitrotoluene	4.26E-02	3.00E-02	7.30E-04

ASYsd-024M

Initial CMCOPC	Predicted Maximum Leachate Concentration Beneath the Source (mg/L)	MCL/RSL (mg/L)	FWCUG Resident Adult (mg/L)
Barium	3.41E+00	2.00E+00	1.47E-03
Chromium	1.05E+00	1.00E-01	8.81E-03
Copper	1.41E+00	1.30E+00	None
Lead	6.73E-02	1.50E-02	None
Mercury	2.69E-03	2.00E-03	None
Selenium	5.40E-01	5.00E-02	None
2-Amino-4,6-Dinitrotoluene	1.09E-01	3.00E-02	7.30E-04

L12sd-308

Initial CMCOPC	Predicted Maximum Leachate Concentration Beneath the Source (mg/L)	MCL/RSL (mg/L)	FWCUG Resident Adult (mg/L)
Benz(a)anthracene	7.61E-04	2.90E-05	4.00E-06
Benzo(a)pyrene	2.68E-04	2.00E-04	2.30E-07
Benzo(b)fluoranthene	4.36E-04	2.90E-05	2.00E-06
Dibenz(a,h)anthracene	1.71E-05	2.90E-06	1.50E-07
Indeno(1,2,3-cd)pyrene	6.11E-05	2.90E-05	2.00E-06
Naphthalene	8.24E-03	1.40E-04	None

ASYss-076M

Initial CMCOPC	Predicted Maximum Leachate Concentration Beneath the Source (mg/L)	MCL/RSL (mg/L)	FWCUG Resident Adult (mg/L)
2,6-Dinitrotoluene	1.39E-02	1.50E-02	1.22E-04

ASYss-088M

Initial CMCOPC	Predicted Maximum Leachate Concentration Beneath the Source (mg/L)	MCL/RSL (mg/L)	FWCUG Resident Adult (mg/L)
Naphthalene	6.58E-02	1.40E-04	None
2, Methylnaphthalene	4.8E-02	2.70E-02	None

ASYss-018M

Initial CMCOPC	Predicted Maximum Leachate Concentration Beneath the Source (mg/L)	MCL/RSL (mg/L)	FWCUG Resident Adult (mg/L)
2-Nitrotoluene	7.29E-02	2.70E-04	3.70E-04
2-Amino-4,6-Dinitrotoluene	2.66E-02	3.00E-02	7.30E-04
Silver	1.46E-01	7.10E-02	None

ASYss-093M

Initial CMCOPC	Predicted Maximum Leachate Concentration Beneath the Source (mg/L)	MCL/RSL (mg/L)	FWCUG Resident Adult (mg/L)
3-Nitrotoluene	2.41E-02	1.30E-03	None

Figure 6-5. CMCOPCs Identified in SESOIL and Sediment Screening Analysis for AT123D Evaluation

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7.0 RISK ASSESSMENT

7.1 DATA EVALUATION FOR HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS

The purpose of this data evaluation is to develop a set of chemical data suitable to use in the HHRA and ERA. Atlas Scrap Yard data are evaluated to establish data aggregates and identify a list of SRCs.

7.1.1 Data Aggregates

Section 5.1 provides a summary of available data. Soil data collected at Atlas Scrap Yard were grouped (aggregated) by exposure depth (e.g., surface soil), exposure unit (EU), and sample type (i.e., discrete or ISM). Samples included in the risk assessment datasets are listed in Tables 7-1 and 7-2. No surface water or sediment data were collected at the AOC, as perennial surface water bodies are not present at the AOC. One co-located set of sediment and surface water samples (LL12sd-308 and LL12sw-308) were collected in the ditch east of Atlas Scrap Yard along Paris-Windham Road under the PBA08 RI for Load Line 12. The *Phase III Remedial Investigation Report for Sediment and Surface Water at the RVAAP-12 Load Line 12* (USACE 2010c) contains details of these samples. A description of the data aggregates for the media for which human and ecological receptors are potentially exposed is provided in Section 7.1.1, followed by a summary of SRCs in Section 7.1.2.

EUs were established at Atlas Scrap Yard as part of the data aggregation prior to the risk assessment evaluations. An EU is an area where receptors could come into contact with contaminants in soil on a regular basis. The EUs take into account the potential current and future exposures at Atlas Scrap Yard. In addition, the potential source of contamination was considered when establishing the EUs.

Soil at Atlas Scrap Yard was evaluated in the following two EUs, as shown in Figure 2-1.

- ASA EU: the north-central portion of the AOC was historically used for stockpiling a variety of bulk materials and is currently used for storage of salvaged inert materials, including railroad ties, concrete, and brick.
- IA EU: the area outside the active storage area.

Soil data in each of these EUs were further aggregated by the following depth intervals:

- Surface soil with an exposure depth of 0-1 ft bgs was evaluated for the Resident Receptor (Adult and Child) and potential risk to ecological receptors, as this layer is the most active biological zone (USACE 2003c). Table 7-1 presents the risk assessment data for surface soil (0-1 ft bgs). For this risk assessment, 81 surface soil (0-1 ft bgs) ISM samples were used to characterize surface soil. The evaluation of VOCs and hexavalent chromium speciation were done using results from discrete soil samples. All other discrete surface soil samples collected in 2010 were used to characterize the nature and extent of contamination but were not used for screening purposes since ISM and discrete data should not be combined into a single statistical analysis.

- Subsurface soil with an exposure depth of 1-13 ft bgs was evaluated for the Resident Receptor (Adult and Child). Discrete soil data from samples collected from 1-4, 4-7, and 7-13 ft bgs intervals were used to evaluate this exposure depth. Table 7-2 presents the risk assessment data for subsurface soil (1-13 ft bgs).

Table 7-1. Risk Assessment Dataset for Surface Soil (0-1 ft bgs) ISM Samples

Station	Sample ID	Date	Depth (ft bgs)	Size of ISM Area (acres)
Active Storage Area Grid Samples				
ASYss-088M	ASYss-088M-5756-SO	4/5/2010	0 - 1	3.1
ASYss-089M	ASYss-089M-5763-SO	4/5/2010	0 - 1	3.9
ASYss-093M	ASYss-093M-5767-SO	4/6/2010	0 - 1	3.8
ASYss-094M	ASYss-094M-5768-SO	4/6/2010	0 - 1	3.8
Inactive Area Grid Samples				
ASYss-086M	ASYss-086M-5760-SO	4/2/2010	0 - 1	3.4
ASYss-087M	ASYss-087M-5761-SO	4/2/2010	0 - 1	4.0
ASYss-090M	ASYss-090M-5764-SO	4/5/2010	0 - 1	4.0
ASYss-091M	ASYss-091M-5765-SO	4/5/2010	0 - 1	3.9
ASYss-092M	ASYss-092M-5766-SO	4/5/2010	0 - 1	3.8
ASYss-095M	ASYss-095M-5769-SO	4/6/2010	0 - 1	4.0
ASYss-096M	ASYss-096M-5770-SO	4/5/2010	0 - 1	3.8
ASYss-097M	ASYss-097M-5771-SO	4/6/2010	0 - 1	4.0
ASYss-098M	ASYss-098M-5772-SO	4/6/2010	0 - 1	4.0
ASYss-099M	ASYss-099M-5773-SO	4/6/2010	0 - 1	3.8
ASYss-100M	ASYss-100M-5774-SO	4/6/2010	0 - 1	4.2
ASYss-101M	ASYss-101M-5775-SO	4/6/2010	0 - 1	4.0
ASYss-102M	ASYss-102M-5776-SO	4/6/2010	0 - 1	4.0
ASYss-103M	ASYss-103M-5777-SO	4/5/2010	0 - 1	4.0
Active Storage Area Source Area Samples				
ASYss-002M	ASYss-002M-SO	11/4/2004	0 - 1	0.6
ASYss-005D[a]	ASYss-005D-SO	11/4/2004	0 - 1	NA
ASYss-005M	ASYss-005M-SO	11/4/2004	0 - 1	0.08
ASYss-073M	ASYss-073M-5747-SO	4/6/2010	0 - 1	0.2
ASYss-074M	ASYss-074M-5748-SO	4/6/2010	0 - 1	0.08
ASYss-075M	ASYss-075M-5749-SO	4/6/2010	0 - 1	0.1
ASYss-076M	ASYss-076M-5750-SO	4/6/2010	0 - 1	0.07
ASYss-077m	ASYss-077M-5751-SO	4/7/2010	0 - 1	0.3
ASYss-078M	ASYss-078M-5752-SO	4/7/2010	0 - 1	0.2
ASYss-079M	ASYss-079M-5753-SO	4/7/2010	0 - 1	0.2
ASYss-080M	ASYss-080M-5754-SO	4/7/2010	0 - 1	0.2
ASYss-111M	ASYss-111M-5835-SO	4/20/2011	0 - 1	0.2
ASYss-112M	ASYss-112M-5836-SO	4/20/2011	0 - 1	0.2
ASYss-113M	ASYss-113M-5837-SO	4/20/2011	0 - 1	0.2
ASYss-114M	ASYss-114M-5838-SO	4/20/2011	0 - 1	0.02
ASYss-115M	ASYss-115M-5839-SO	4/20/2011	0 - 1	0.01
ASYss-116M	ASYss-116M-5840-SO	4/21/2011	0 - 1	0.2
ASYss-117M	ASYss-117M-5841-SO	4/21/2011	0 - 1	0.2
ASYss-118M	ASYss-118M-5842-SO	4/21/2011	0 - 1	0.5
ASYss-119M	ASYss-119M-5843-SO	4/21/2011	0 - 1	0.5

1 **Table 7-1. Risk Assessment Dataset for Surface Soil (0-1 ft bgs) ISM Samples (continued)**

Station	Sample ID	Date	Depth (ft bgs)	Size of ISM Area (acres)
ASYss-120M	ASYss-120M-5844-SO	4/21/2011	0 - 1	0.3
ASYss-121M	ASYss-121M-5845-SO	4/21/2011	0 - 1	2.7
ASYss-122M	ASYss-122M-5846-SO	4/21/2011	0 - 1	0.1
ASYss-123M	ASYss-123M-5847-SO	4/21/2011	0 - 1	0.1
ASYss-124M	ASYss-124M-5848-SO	4/21/2011	0 - 1	3.3
ASYss-125M	ASYss-125M-5849-SO	4/21/2011	0 - 1	3.0
ASYss-126M	ASYss-126M-5850-SO	4/21/2011	0 - 1	0.2
Inactive Area Source Area Samples				
ASYss-006M	ASYss-006M-SO	11/4/2004	0 - 1	0.1
ASYss-007M	ASYss-007M-SO	11/4/2004	0 - 1	0.2
ASYss-008M	ASYss-008M-SO	11/4/2004	0 - 1	0.2
ASYss-009M	ASYss-009M-SO	11/4/2004	0 - 1	0.2
ASYss-010M	ASYss-010M-SO	11/3/2004	0 - 1	0.3
ASYss-011M	ASYss-011M-SO	11/3/2004	0 - 1	0.2
ASYss-012D[a]	ASYss-012D-SO	11/4/2004	0 - 1	NA
ASYss-012M	ASYss-012M-SO	11/4/2004	0 - 1	0.08
ASYss-013D[a]	ASYss-013D-SO	11/3/2004	0 - 1	NA
ASYss-013M	ASYss-013M-SO	11/3/2004	0 - 1	0.08
ASYss-014M	ASYss-014M-SO	11/4/2004	0 - 1	0.3
ASYss-015D[a]	ASYss-015D-SO	11/4/2004	0 - 1	NA
ASYss-015M	ASYss-015M-SO	11/4/2004	0 - 1	0.2
ASYss-016M	ASYss-016M-SO	11/3/2004	0 - 1	0.1
ASYss-017M	ASYss-017M-SO	11/3/2004	0 - 1	0.2
ASYss-018M	ASYss-018M-SO	11/3/2004	0 - 1	0.1
ASYss-019M	ASYss-019M-SO	11/10/2004	0 - 1	0.08
ASYss-020M	ASYss-020M-SO	11/3/2004	0 - 1	0.3
ASYss-021M	ASYss-021M-SO	11/3/2004	0 - 1	0.3
ASYss-022M	ASYss-022M-SO	11/12/2004	0 - 1	0.3
ASYss-023M	ASYss-023M-SO	11/11/2004	0 - 1	0.1
ASYss-025M	ASYss-025M-SO	11/11/2004	0 - 1	0.3
ASYss-026M	ASYss-026M-SO	11/3/2004	0 - 1	0.1
ASYss-027D[a]	ASYss-027D-SO	11/3/2004	0 - 1	NA
ASYss-027M	ASYss-027M-SO	11/3/2004	0 - 1	0.2
ASYss-028M	ASYss-028M-SO	11/3/2004	0 - 1	0.3
ASYss-029M	ASYss-029M-SO	11/11/2004	0 - 1	0.3
ASYss-030M	ASYss-030M-SO	11/10/2004	0 - 1	0.5
ASYss-031M	ASYss-031M-SO	11/10/2004	0 - 1	0.5
ASYss-032M	ASYss-032M-SO	11/2/2004	0 - 1	0.2
ASYss-033M	ASYss-033M-SO	11/3/2004	0 - 1	0.3
ASYss-034M	ASYss-034M-SO	11/3/2004	0 - 1	0.4
ASYss-066[b]	ASYss-066-5778-SO	4/7/2010	0 - 1	NA
ASYss-067[b]	ASYss-067-5779-SO	4/7/2010	0 - 1	NA
ASYss-068[b]	ASYss-068-5780-SO	4/7/2010	0 - 1	NA
ASYss-069M	ASYss-069M-5743-SO	4/7/2010	0 - 1	0.2
ASYss-070M	ASYss-070M-5744-SO	4/5/2010	0 - 1	0.1
ASYss-071M	ASYss-071M-5745-SO	4/6/2010	0 - 1	0.3
ASYss-072M	ASYss-072M-5746-SO	4/7/2010	0 - 1	0.2
ASYss-081M	ASYss-081M-5755-SO	4/2/2010	0 - 1	0.3
ASYss-082M	ASYss-082M-5756-SO	4/2/2010	0 - 1	0.1
ASYss-083M	ASYss-083M-5757-SO	4/2/2010	0 - 1	0.1

Table 7-1. Risk Assessment Dataset for Surface Soil (0-1 ft bgs) ISM Samples (continued)

Station	Sample ID	Date	Depth (ft bgs)	Size of ISM Area (acres)
ASYss-084M	ASYss-084M-5758-SO	4/2/2010	0 - 1	0.1
ASYss-085M	ASYss-085M-5759-SO	4/2/2010	0 - 1	0.1

[a] Discrete sample taken in ISM areas for the determination of volatile organic compounds.

[b] Chromium speciation samples used to evaluate the presence of hexavalent chromium. ASYss-066 collected at ISM area ASYss-031M; ASYss-067 collected at ISM area ASYss-019M; ASYss-068 collected at ISM area ASYss-013M.

ft bgs = Feet below ground surface.

ISM = Incremental Sampling Method.

NA = Not applicable.

Table 7-2. Risk Assessment Datasets for Subsurface Soil

Station	Sample ID	Date	Depth (ft bgs)
Active Storage Area Subsurface Soil Samples			
ASYsb-046	ASYsb-046-5665-SO	4/5/2010	1 - 4
ASYsb-046	ASYsb-046-5666-SO	4/5/2010	4 - 7
ASYsb-047	ASYsb-047-5669-SO	4/5/2010	1 - 4
ASYsb-047	ASYsb-047-5670-SO	4/5/2010	4 - 7
ASYsb-048	ASYsb-048-5673-SO	4/5/2010	1 - 4
ASYsb-048	ASYsb-048-5674-SO	4/5/2010	4 - 7
ASYsb-049	ASYsb-049-5677-SO	4/5/2010	1 - 4
ASYsb-049	ASYsb-049-5678-SO	4/5/2010	4 - 7
ASYsb-049	ASYsb-049-5686-SO	4/6/2010	8 - 9.5
ASYsb-049	ASYsb-049-5679-SO	4/5/2010	7 - 13
Inactive Area Subsurface Soil Samples			
ASYsb-045	ASYsb-045-5661-SO	4/5/2010	1 - 4
ASYsb-045	ASYsb-045-5662-SO	4/5/2010	4 - 7
ASYsb-045	ASYsb-045-5663-SO	4/5/2010	7 - 13
ASYsb-050	ASYsb-050-5681-SO	4/7/2010	1 - 4
ASYsb-050	ASYsb-050-5682-SO	4/7/2010	4 - 7
ASYsb-052	ASYsb-052-5689-SO	4/6/2010	1 - 4
ASYsb-052	ASYsb-052-5690-SO	4/6/2010	4 - 7
ASYsb-053	ASYsb-053-5693-SO	4/7/2010	1 - 4
ASYsb-053	ASYsb-053-5694-SO	4/7/2010	4 - 7
ASYsb-054	ASYsb-054-5697-SO	4/6/2010	1 - 4
ASYsb-054	ASYsb-054-5698-SO	4/6/2010	4 - 7
ASYsb-056	ASYsb-056-5703-SO	4/7/2010	1 - 4
ASYsb-056	ASYsb-056-5704-SO	4/7/2010	4 - 7
ASYsb-057	ASYsb-057-5707-SO	4/7/2010	1 - 4
ASYsb-057	ASYsb-057-5708-SO	4/7/2010	4 - 7
ASYsb-058	ASYsb-058-5711-SO	4/7/2010	1 - 4
ASYsb-058	ASYsb-058-5712-SO	4/7/2010	4 - 7
ASYsb-059	ASYsb-059-5715-SO	3/30/2010	1 - 4
ASYsb-059	ASYsb-059-5716-SO	3/30/2010	4 - 7
ASYsb-059	ASYsb-059-5717-SO	3/30/2010	7 - 13
ASYsb-060	ASYsb-060-5719-SO	3/30/2010	1 - 4
ASYsb-060	ASYsb-060-5720-SO	3/30/2010	4 - 7
ASYsb-061	ASYsb-061-5723-SO	3/30/2010	1 - 4
ASYsb-061	ASYsb-061-5724-SO	3/30/2010	4 - 7
ASYsb-062	ASYsb-062-5727-SO	3/30/2010	1 - 4
ASYsb-062	ASYsb-062-5728-SO	3/30/2010	4 - 7
ASYsb-063	ASYsb-063-5731-SO	4/7/2010	1 - 4

Table 7-2. Risk Assessment Datasets for Subsurface Soil (continued)

Station	Sample ID	Date	Depth (ft bgs)
ASYsb-063	ASYsb-063-5732-SO	4/7/2010	4 – 7
ASYsb-064	ASYsb-064-5735-SO	3/30/2010	1 - 4
ASYsb-064	ASYsb-064-5736-SO	3/30/2010	4 – 7
ASYsb-065	ASYsb-065-5739-SO	4/7/2010	1 – 4
ASYsb-065	ASYsb-065-5740-SO	4/7/2010	4 - 7

ft bgs = Feet below ground surface.

7.1.2 Identification of SRCs

Section 5.1 presents the statistical methods and screening criteria used to identify SRCs. The purpose of identifying SRCs is to determine the presence or absence of contamination that is above naturally occurring levels.

The SRC screen followed the three steps outlined in the FWCUG Report, as summarized below:

- Background screening: MDCs of naturally occurring inorganic chemicals were compared to RVAAP facility-wide background concentrations, which are summarized in the FWCUG Report. Inorganic chemicals detected above BSVs or having no BSVs were retained as SRCs. All detected organic chemicals were retained as SRCs.
- Screening of essential human nutrients: Chemicals considered essential nutrients (e.g., calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) are an integral part of the human food supply and are often added to foods as supplements. USEPA recommends these chemicals not be evaluated so long as they are: (1) present at low concentrations (i.e., only slightly elevated above naturally occurring levels) and (2) toxic at very high doses (i.e., much higher than those that could be associated with contact at the AOC) (USEPA 1989). Essential nutrients detected near or below their RDA/RDI-based screening levels were eliminated as SRCs.
- Frequency of detection screening: In accordance with the FWCUG Report and as revised in the Final (Revised) United States Army Corps of Engineers RVAAP Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals (USACE 2012b) (hereafter referred to as the Position Paper for Human Health FWCUGs), analytes detected in less than 5% of the samples are screened out from further consideration, with the exception of explosives and propellants. At Atlas Scrap Yard, 42 discrete subsurface samples (1-13 ft bgs) were available for frequency of detection screening; however, no SRCs were screened out on this basis. Several PAHs were detected in less than 5% of subsurface soil samples. These PAHs were retained as SRCs because they were identified as SRCs in surface (0-1 ft bgs) soil. The MDC for all of the PAHs identified as SRCs for the 1-13 ft bgs soil interval are from the same sample (ASYsb-048-5673-SO), and most are significantly greater than the detection limit (i.e., 10 times greater than the detection limit). The frequency of detection screening was not applied to ISM samples.

Details of the SRC screening for each exposure medium are provided in Tables G-1 and G-2 of Appendix G. The SRCs identified for Atlas Scrap yard are summarized in Table 7-3.

Table 7-3. Summary of SRCs in Soil

SRC	Surface Soil (0-1 ft bgs)	Subsurface Soil (1-13 ft bgs)
Metals		
Aluminum	X	--
Arsenic	X	X
Barium	X	--
Beryllium	X	X
Cadmium	X	X
Chromium	X	--
Cobalt	X	X
Copper	X	--
Lead	X	X
Manganese	X	--
Mercury	X	--
Nickel	X	--
Selenium	X	X
Silver	X	X
Thallium	X	--
Zinc	X	--
Explosives		
4-Amino-2,6-Dinitrotoluene	X	--
2-Amino-4,6-Dinitrotoluene	X	--
2,6-Dinitrotoluene	X	--
HMX	X	X
Nitrocellulose	X	X
2-Nitrotoluene	X	--
3-Nitrotoluene	X	X
Tetryl	X	--
1,3,5-Trinitrobenzene	X	--
Semi-volatile Organic Compounds		
Acenaphthene	X	X
Acenaphthylene[e]	X	X
Anthracene	X	X
Benz(a)anthracene	X	X
Benzenemethanol	X	--
Benzo(a)pyrene	X	X
Benzo(b)fluoranthene	X	X
Benzo(ghi)perylene[e]	X	X
Benzo(k)fluoranthene	X	X
Bis(2-ethylhexyl)phthalate	X	X
Butyl benzyl phthalate	X	--
Carbazole	X	--
Chrysene	X	X
Dibenz(a,h)anthracene	X	X
Dibenzofuran	X	--
Diethyl phthalate	X	--
Di-n-butyl phthalate	X	--
Fluoranthene	X	X
Fluorene	X	X
Indeno(1,2,3-cd)pyrene	X	X

Table 7-3. Summary of SRCs in Soil (continued)

SRC	Surface Soil (0-1 ft bgs)	Subsurface Soil 1-13 ft bgs
2-Methylnaphthalene	X	--
4-Methylphenol	X	--
Naphthalene	X	X
Phenanthrene[e]	X	X
Phenol	X	--
Pyrene	X	X
Pesticides/PCBs		
PCB-1260	X	--
Volatile Organic Compounds		
Acetone	X	--
2-Butanone	--	X
Carbon disulfide	--	X
Toluene	--	X

ft bgs = Feet below ground surface.
HMX = Octahydro-1,3,5,7-tetranitroi-1,3,5,7-tetrazocane.
PCB = Polychlorinated biphenyl.
SRC = Site-related contaminant.
X = Chemical is an SRC in this medium.
-- = Chemical is not an SRC in this medium.

7.2 HUMAN HEALTH RISK ASSESSMENT

This HHRA identifies COCs that may pose potential health risks to humans resulting from exposure to contamination at Atlas Scrap Yard. This HHRA was conducted as part of the PBA08 RI and is based on methods from the following guidance documents:

- FWHHRAM (USACE 2005b),
- FWCUG Report (USACE 2010a), and
- Position Paper for Human Health FWCUGs (USACE 2012b).

To accomplish the goal of streamlined, risk-based decision making, the FWCUG Report was developed to support risk assessments of the remaining AOCs that will undergo final transfer of the land for use and management by OHARNG. The FWCUG Report contains calculated FWCUGs and guidance for applying the FWCUGs to accelerate the risk assessment process. This approach takes advantage of the many risk assessment inputs and decisions that have previously been accepted by stakeholders through the application of the CERCLA process at the former RVAAP.

Most of the agreed upon risk assessment methodology has been documented in the FWHHRAM (USACE 2005b) and follows standard USEPA-approved risk assessment guidance. This includes the process to identify RVAAP COPCs (presented in Figure 5-1), a TR of 1E-06 and HQ of 0.1 to identify COPCs, and a TR of 1E-05 and HQ of 1.0 to identify COCs.

Other approaches, such as calculating the sum-of-ratios (SOR), were developed in the FWCUG Report (USACE 2010a) and Position Paper for Human Health FWCUGs (USACE 2012b).

The approach to risk-based decision making is as follows:

1. ***Develop FWCUGs*** – Use the risk assessment process presented in the FWHHRAM to develop FWCUGs for all COPCs identified from the facility-wide dataset. This process has been completed in the FWCUG Report.
2. ***RI Characterization Sampling*** – Perform sampling and analysis to characterize an AOC and establish baseline chemical concentrations. A summary and the results of the RI characterization sampling for Atlas Scrap Yard are presented in Section 4.0 of this report.
3. ***Mapping and Data Analysis to Identify SRCs and COPCs*** – Follow the requirements specified in the FWHHRAM and the Position Paper for Human Health FWCUGs (USACE 2012b), perform data analysis and mapping to identify SRCs and COPCs, establish EUs, and calculate exposure point concentrations (EPCs) for each COPC. The results of the mapping and data analysis for Atlas Scrap Yard to identify SRCs are presented in Section 5.0 of this report and are summarized in Section 7.1.
4. ***Identification of COCs*** – Compare EPCs to FWCUGs to determine COCs.
5. ***Address Identified COCs*** – Develop FS, PP, and ROD to address any COCs requiring remedy.

Identifying COPCs and COCs follows the four steps established in the FWCUG Report and shown in Figure 1-3 for a streamlined risk assessment: identify media of concern, identify COPCs, present AOC Land Use and appropriate receptors, and compare to appropriate FWCUGs to identify COCs. These steps are discussed in the following subsections.

7.2.1 Identify Media of Concern

Media of concern at Atlas Scrap Yard are surface soil and subsurface soil. Surface water and sediment samples were not collected within the AOC during the PBA08 RI, as perennial surface water bodies are not present at the AOC. However, groundwater is present at this AOC and will be evaluated (including a risk assessment) in a separate document, as explained in Section 1.2.

7.2.2 Identify COPCs

Section 5.1 presents the statistical methods and screening criteria used to identify SRCs. COPCs are a subset of the SRCs in each exposure medium present at concentrations that indicate the potential for impacts to human receptors. The COPC screen follows the approach specified in the FWCUG Report and is summarized in this section.

To identify COPCs, the MDC of all SRCs was screened against the most stringent chemical-specific FWCUG of all RVAAP receptors at a target cancer risk level of 1E-06 and non-carcinogenic target HQ of 0.1 for the Resident Receptor (Adult and Child) and National Guard Trainee. If no FWCUGs existed for an SRC, the USEPA Residential RSL (from RSL table dated November 2012) was used for this screen. No reference dose (RfD) or cancer potency factors are available for acenaphthylene, benzo(g,h,i)perylene, and phenanthrene; therefore, the RSL for pyrene was used for these PAHs (NDEP 2006).

Hexavalent chromium was detected in two of three discrete surface soil samples collected at Atlas Scrap Yard for chromium speciation (Table 5-3). Since hexavalent chromium was detected, as part of the conservative screening approach for identifying COPCs, the FWCUG for hexavalent chromium (the more toxic of the two chromium species evaluated) was used at this stage.

Details of the COPC screenings for each exposure medium are provided in Tables G-1 and G-2 of Appendix G. The COPCs identified for the media of concern at Atlas Scrap Yard are presented in Table 7-4 and are summarized below.

7.2.2.1 COPCs in Surface Soil

A total of 60 chemicals were detected in surface soil ISM samples, 53 of these chemicals (16 inorganic chemicals, nine explosives, 26 SVOCs, one PCB, and one VOC) were identified as SRCs. Risk-based screening identified seven inorganic chemicals (aluminum, arsenic, cadmium, chromium, cobalt, lead, and manganese) and seven SVOCs [benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene] as COPCs in surface soil.

At Atlas Scrap Yard, chromium was identified as an SRC in surface soil ISM samples. The MDC of total chromium in surface soil ISM samples was 64 mg/kg, which is greater than the lowest screening value for hexavalent chromium (1.64 mg/kg) and greater than the total chromium background concentration for surface soil (17.4 mg/kg). Therefore, total chromium was retained as a COPC for surface soil.

7.2.2.2 COPCs in Subsurface Soil

A total of 46 chemicals were detected in discrete subsurface soil samples collected from the 1-13 ft bgs exposure depth. Thirty of these chemicals (seven inorganic chemicals, three explosives, 17 SVOCs, and three VOCs) were identified as SRCs. Risk-based screening identified two inorganic chemicals (arsenic and cobalt) and five SVOCs [benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene] as COPCs for subsurface soil.

7.2.3 Land Use and Representative Receptors

Camp Ravenna is a controlled-access facility. Atlas Scrap Yard is located in the southeastern portion of the facility and is not currently used for training. However, the north-central portion of the AOC is used for storage of railroad ties and salvaged inert materials. The potential representative human receptor at Atlas Scrap Yard is the National Guard Trainee for Military Training. Unrestricted (Residential) Land Use is considered protective for Military Training Land Use at Camp Ravenna.

Therefore, if an AOC meets the requirements for Unrestricted (Residential) Land Use, then the AOC is also considered to have met the requirements of Military Training Land Use.

Table 7-4. Summary of COPCs in Soil

COPC	Surface Soil (0-1 ft bgs)	Subsurface Soil (1-13 ft bgs)
Metals		
Aluminum	X	--
Arsenic	X	X
Cadmium	X	--
Chromium[a]	X[a]	--
Cobalt	X	X
Lead	X	--
Manganese	X	--
Semi-volatile Organic Compounds		
Benz(a)anthracene	X	X
Benzo(a)pyrene	X	X
Benzo(b)fluoranthene	X	X
Benzo(k)fluoranthene	X	--
Chrysene	X	--
Dibenz(a,h)anthracene	X	X
Indeno(1,2,3-cd)pyrene	X	X

[a] The maximum detected concentration exceeded the screening FWCUG for hexavalent chromium but is less than the FWCUG for trivalent chromium.
ft bgs = Feet below ground surface.
COPC = Chemical of Potential Concern
X = Chemical identified as a COPC in this medium.
-- = Chemical not identified as a COPC in this medium.

7.2.4 Compare to Appropriate FWCUGs

Previous sections have outlined the process for identifying SRCs and COPCs. Comparing COPC exposure concentrations to FWCUGs and determining COCs follows guidance presented in the Position Paper for Human Health FWCUGs (USACE 2012b).

The COC determination process is as follows:

- Report all carcinogenic- and non-carcinogenic-based FWCUGs corresponding to a TR of 1E-05 and target HQ of 1.0 using the most stringent Resident Receptor Adult and Resident Receptor Child FWCUGs to evaluate Unrestricted (Residential) Land Use for each COPC. If no FWCUG is available for a COPC, the Residential RSL, adjusted to represent a TR of 1E-05 or target HQ of 1.0, is used.
- Report critical effect and target organ for each non-carcinogenic-based FWCUG.
- Compare the selected FWCUG to the EPC, including an SOR.
    - For non-carcinogens, compare the EPC to the target HQ FWCUG. Sum the ratios of EPC/FWCUG for COPCs that affect similar target organs or do not have an identified target organ.
    - For carcinogens, compare the EPC to the TR FWCUG. Sum the ratios of EPC/FWCUG for all carcinogens.

- Identify the COPC as a COC if:
    - The EPC exceeds the most stringent Resident Receptor Adult and Resident Receptor Child FWCUGs for either the 1E-05 target cancer risk or the 1.0 target HQ; or
    - The SOR for all carcinogens or all non-carcinogens that may affect the same organ is greater than one. Chemicals contributing at least 10% to the SOR are also considered COCs. In accordance with the Position Paper for Human Health FWCUGs (USACE 2012b), chemicals contributing greater than 5% but less than 10% to the SOR must be further evaluated before being eliminated as COCs.

The process for calculating FWCUGs rearranges cancer risk or non-cancer hazard equations in order to obtain a concentration that will produce a specific risk or hazard level (USEPA 1991, USACE 2010a). For example, the FWCUG for arsenic at the cancer risk level of 1E-05 for the Resident Receptor Adult is the concentration of arsenic that produces a risk of 1E-05 when using exposure parameters specific to the Resident Receptor Adult.

For carcinogens, risk is expressed as the probability that an individual will develop cancer over a lifetime as a result of exposure to the carcinogen. Cancer risk from exposure to contamination is expressed as the increased chance of cancer above the normal background rate. In the United States, the background chance of contracting cancer is a little more than 3 in 10, or 3E-01 (American Cancer Society 2003). The calculated incremental lifetime cancer risks (ILCRs) are compared to the range specified in the NCP of 10^{-6} to 10^{-4}, or 1 in a million to 1 in 10,000 exposed persons developing cancer (USEPA 1990). Cancer risks below 10^{-6} are considered acceptable; cancer risks above 10^{-4} are considered unacceptable. The range between 10^{-6} and 10^{-4} is of concern, and any decisions to address risks further in this range, either through additional study or engineered control measures, should account for uncertainty in risk estimates. The Ohio EPA Division of Environmental Response and Revitalization (DERR) program has adopted a human health cumulative ILCR goal within this range of 1E-05 to be used as the level of acceptable excess cancer risk and for developing remediation goals for the site. The DERR notes that the defined risk goal should be applied as a goal, recognizing the need to retain flexibility when evaluating and selecting remedial alternatives.

In addition to developing cancer from exposure to chemicals, an individual may experience other adverse effects. The term “adverse effects” is used here to describe a wide variety of systemic effects ranging from minor irritations, such as eye irritation and headaches, to more substantial effects, such as kidney or liver disease and neurological damage. The risks associated with toxic (i.e., non-carcinogenic) chemicals are evaluated by comparing an estimated exposure (i.e., intake or dose) from AOC media to an acceptable exposure expressed as an RfD. The RfD is the threshold level below which no adverse effects are expected to occur in a population, including sensitive subpopulations. The ratio of intake over the RfD is the HQ (USEPA 1989).

The SOR is used to account for potential additive effects from exposure to multiple chemicals that can cause the same effect (e.g., cancer) or affect the same target organ. Cancer risk is assumed to be additive for all carcinogens. Non-cancer risk is assumed to be additive for chemicals with similar sites of toxicological action (i.e., target organ such as the liver or critical effect such as adversely affecting the ability to reproduce). This approach compares the EPC of each COPC to the FWCUG to determine a ratio. The sum of these individual ratios is then compared to one. The SOR method is based on the principle that a ratio greater than one represents unacceptable cumulative exposure (i.e., above FWCUGs if adjusted for exposure to multiple COPCs), and a ratio less than or equal to one represents acceptable cumulative exposure (i.e., below FWCUGs if adjusted for exposure to multiple COPCs). The FWCUGs for some chemical/receptor combinations are less than the background concentration. In these instances, the chemical concentrations are compared to background concentrations to identify COCs. Since the background concentration is not risk-based, these chemicals are not included in the SOR calculations.

COCs identified by comparing EPCs to FWCUGs are further evaluated in an uncertainty analysis to identify COCs requiring evaluation in the FS. Selecting FWCUGs, calculating EPCs for comparison to the FWCUGs, and the resulting risk-based COCs are detailed in the following sections.

7.2.4.1 Selection of Appropriate FWCUGs

EPCs for each AOC were evaluated using the most stringent Resident Receptor Adult and Resident Receptor Child FWCUGs to determine if NFA is necessary at an AOC to attain Unrestricted (Residential) Land Use.

Unrestricted (Residential) Land Use is evaluated using FWCUGs for the Resident Receptor (Adult and Child). The Resident Receptor (Adult and Child) FWCUGs provided in Table 7-5 are the lower of the Resident Receptor Adult or Resident Receptor Child values for each COPC and endpoint (non-cancer and cancer). The critical effects or target organs associated with the toxicity values used to calculate the non-cancer FWCUGs are also provided.

Chromium Speciation

FWCUGs are available for hexavalent chromium and trivalent chromium. Existing data at other AOCs, such the Building 1200 and Anchor Test Area AOCs (USACE 2012c, USACE 2012d), indicates chromium exists predominantly in the trivalent state, rather than the more toxic hexavalent state. Implementing the chromium speciation process per the PBA08 SAP is discussed below.

- **Collect hexavalent chromium and total chromium samples and results** – To determine whether the FWCUGs for trivalent or hexavalent chromium are most applicable to Atlas Scrap Yard and to support risk management decisions, three discrete surface soil samples were collected and analyzed for hexavalent chromium and total chromium per the PBA08 SAP and as described in Sections 4.1.1 and 5.1.2. Two samples were collected from areas previously identified as having elevated total chromium concentrations, and one was collected from an area identified as having chromium concentrations near background concentrations. Hexavalent chromium was detected in two of the three samples at 0.97 mg/kg and 1 mg/kg (Table 5-3).

- **Evaluate percent hexavalent chromium in chromium speciation samples –** As documented in the PBA08 SAP, “Chromium speciation evaluates the concentration ratio of hexavalent chromium to total chromium. This ratio will be calculated by collecting and analyzing three samples per AOC for both hexavalent chromium and total chromium.” Hexavalent chromium was not detected in one of the three chromium speciation samples collected at Atlas Scrap Yard. The other two samples contained 6.5% and 7.2% hexavalent chromium. The FWCUG for hexavalent chromium is based on a cancer unit risk factor (URF) calculated using a chromium mixture containing 14% hexavalent chromium and 86% trivalent chromium. These sample results are below the 14% hexavalent chromium used as the basis for the cancer URF, which was used to calculate the hexavalent chromium FWCUGs.
- **Compare the concentration of hexavalent chromium detected in the chromium speciation samples to a FWCUG adjusted to represent only hexavalent chromium** – The most protective FWCUG for hexavalent chromium is for the National Guard Trainee (16.4 mg/kg) and was calculated from a cancer URF based on a chromium mixture containing one-seventh (14%) hexavalent chromium (USEPA 2010). Since the study used as the basis for the cancer URF included workers exposed to trivalent and hexavalent chromium, the FWCUG must be adjusted to represent only hexavalent chromium for comparison to hexavalent chromium results in the speciation samples. The toxicological review of hexavalent chromium written in support of summary information on the USEPA’s Integrated Risk Information System (IRIS) states the risk of hexavalent chromium is estimated on the basis of the total chromium obtained from all soluble and insoluble chromium to which workers were exposed. Since there are likely differences between the chromium compounds to which workers were exposed, the potency of hexavalent chromium compounds may be underestimated. However, since the maximum ratio of trivalent chromium to hexavalent chromium reported in the worker studies is six, the underestimation of the risk for hexavalent chromium is unlikely to be greater than sevenfold (USEPA 1998). Therefore, one-seventh of the National Guard Trainee FWCUG (16.4/7=2.3 mg/kg) is appropriate for evaluating hexavalent chromium alone. The detected concentrations of hexavalent chromium in the chromium speciation samples (0.97 and 1 mg/kg) are less than 2.3 mg/kg, indicating hexavalent chromium is not present above the hexavalent chromium FWCUG.
- **Compare the concentration of total chromium to the FWCUG for trivalent chromium** – After implementing the chromium speciation process specified in the PBA08 SAP, hexavalent chromium was determined to be present at a very low concentration (i.e., below the FWCUG for hexavalent chromium), and the percent hexavalent chromium is less than 14%. Therefore, hexavalent chromium is not of concern at Atlas Scrap Yard, and the reported concentrations of total chromium were compared to the FWCUGs for trivalent chromium for identifying COCs at this AOC.

Table 7-5. FWCUGs Corresponding to an HQ of 1.0 and Target Risk of 1E-05 in Soil

COPC	Critical Effect or Target Organ	FWCUG (mg/kg) Resident Receptor[a] HQ=1	Risk=10^{-5}
Aluminum	Neurotoxicity in offspring	73798	--
Arsenic	Skin	20.2	4.25[b]
Cadmium	Significant proteinuria	64.1	12491
Chromium, hexavalent	Stomach, liver/kidney	199	1874[c]
Chromium, trivalent	NOAEL	81473	--
Cobalt	Thyroid	1313	8030
Lead	--	400[d]	
Manganese	Central nervous system	2927	--
Benz(a)anthracene	NA	--	2.21
Benzo(a)pyrene	NA	--	0.221
Benzo(b)fluoranthene	NA	--	2.21
Benzo(k)fluoranthene	NA	--	22.1
Chrysene	NA	--	221
Dibenz(a,h)anthracene	NA	--	0.221
Indeno(1,2,3-cd)pyrene	NA	--	2.21

[a] Resident Receptor FWCUGs are the lower of the Resident Receptor Adult or Resident Receptor Child values for each COPC and endpoint (non-cancer and cancer).

[b] FWCUG value is less than the background screening values for arsenic in surface soil (arsenic 15.4 mg/kg) and subsurface soil (arsenic 19.8 mg/kg).

[c] FWCUG for hexavalent chromium was calculated using a cancer unit risk factor developed for a chromate mixture consisting of 1/7 hexavalent chromium and 6/7 trivalent chromium.

[d] No FWCUG is available for lead; the Regional Screening Level (RSL) is used. No endpoint is specified for this screening level.

COPC = Chemical of Potential Concern.
FWCUG = Facility-Wide Cleanup Goal.
HQ = Hazard Quotient.
mg/kg = Milligram per kilogram.
NA = Not applicable.
NOAEL = No Observable Adverse Effect Level.
-- = No value available.

7.2.4.2 Exposure Point Concentrations for Comparison to FWCUGs

Surface Soil

Surface soil (0-1 ft bgs) at Atlas Scrap Yard was characterized using ISM and discrete sampling. The ISM analytical result can provide a more reliable estimate of the average concentration for a decision unit but cannot be combined with analytical results from discrete samples (USACE 2009). As noted in the *Technical and Regulatory Guidance for Incremental Sampling Methodology* (ITRC 2012), different objectives require different spatial scales for ISM sample areas.

Some objectives call for characterizing contaminant concentrations over a relatively large area (e.g., multiple acres) if the primary objective is assessing risk in order to represent an exposure concentration within a human health exposure area. Other objectives focus on distinguishing concentration differences on a much smaller scale (e.g., within a few feet) to delineate potential remediation areas. In accordance with the PBA08 SAP, two types of ISM sampling were used to characterize surface soil at Atlas Scrap Yard.

1. Potential source area ISM samples were collected from areas biased toward locations anticipated to have the highest level of potential contamination (i.e., around railroad tie storage piles and along roads) to delineate potential sources. These ISM samples generally ranged from 0.01-0.6 acres and averaged 0.3 acres but also included three larger, 3-acre samples.
2. Larger ISM samples were collected to characterize the potential exposure area within the AOC, but these samples do not provide the spatial resolution needed to identify potential source areas. Characterization of the AOC was achieved using ISM samples with a nominal 3-4 acre grid size.

An EPC was calculated for each EU (ASA and IA) using the ISM grid samples within each EU, presented in Table 7-1. EPCs are intended to provide representative chemical concentrations that a receptor might be exposed to for a long duration (i.e., an exposure duration of 6-30 years). The EPC is either the 95% upper confidence limit (UCL) of the mean or the MDC, whichever value is lowest. If the 95% UCL could not be determined, the EPC is the MDC. The 95% UCL was calculated for an area weighted mean and standard error using the Chebyshev approach (ITRC 2012) shown below:

Chebyshev 95% UCL = weighted mean + sqrt(1/0.05-1) x weighted standard error

The Interstate Technology and Regulatory Council (2012) recommends using an area weighted mean and standard error when combining ISM samples collected over different size areas to calculate an EPC. In the absence of sample-specific estimates of variance, the standard error of the mean is calculated using the variance estimated from the unweighted concentrations. If any COCs are identified for an EU, chemical concentrations in individual ISM sample locations (including all potential source area ISM samples) are compared directly to the soil FWCUGs to identify which ISM sample locations (i.e., smaller decision units) contain COCs.

Subsurface Soil

EPCs were calculated for the 1-13 ft bgs subsurface soil exposure depth using analytical results from the discrete samples presented in Table 7-2. The EPC is either the 95% UCL of the mean or the MDC, whichever value is lowest. If the 95% UCL could not be determined, the EPC is the MDC. Because the subsurface soil samples were collected from a variety of depth intervals within the 1-13 ft interval (i.e., 1-4 ft bgs, 4-7 ft bgs, 7-13 ft bgs, and 8-9.5 ft bgs) the 95% UCL was calculated for a depth weighted mean and standard error using the Chebyshev approach (ITRC 2012) shown above. The weight for each sample was the sample interval thickness in feet. The samples taken from 1-4 and 4-7 ft bgs were given a weight of 3 and the 7-13 ft bgs samples were given a weight of 6 and the 8-9.5 ft samples were given a weight of 1.5.

7.2.4.3 Identification of COCs for Unrestricted (Residential) Land Use

Atlas Scrap Yard COCs for Unrestricted (Residential) Land Use, as represented by the Resident Receptor (Adult and Child), are presented below.

COCs in Surface Soil (0-1 ft bgs)

COC determination for surface soil for the Resident Receptor (Adult and Child) is detailed in Tables G-3 through G-10 of Appendix G. Several PAHs were identified as COCs for the Resident Receptor (Adult and Child), as explained below.

COPCs with EPCs Lower than the Resident Receptor (Adult and Child) FWCUG – The aluminum, cadmium, chromium, cobalt, lead, manganese, benzo(k)fluoranthene, and chrysene EPCs at the ASA and IA are lower than the Resident Receptor (Adult and Child) FWCUG. The EPCs for benzo(a)anthracene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene at the IA are lower than the Resident Receptor (Adult and Child) FWCUG.

COPCs with EPCs Exceeding the Resident Receptor (Adult and Child) FWCUG – The EPCs for arsenic at the ASA (10.1 mg/kg) and IA (9.65 mg/kg) exceed the FWCUG of 4.25 mg/kg but are less than the surface soil BSV of 15.4 mg/kg. Therefore, arsenic was not identified as a COC in surface soil.

The EPCs for benzo(a)anthracene (17 mg/kg), benzo(a)pyrene (18 mg/kg), benzo(b)fluoranthene (21mg/kg), dibenz(a,h)anthracene (2.8 mg/kg), and indeno(1,2,3-cd)pyrene (10 mg/kg) at the ASA exceed FWCUGs. Therefore, these PAHs are identified as COCs for Unrestricted (Residential) Land Use at the ASA. The EPC for benzo(a)pyrene (0.79 mg/kg) at the IA exceeds the FWCUG. Therefore, benzo(a)pyrene is identified as a COC for Unrestricted (Residential) Land Use at the IA.

SOR Analysis – Four additional COCs were identified for the Resident Receptor (Adult and Child) exposed to surface soil at the IA based on the SOR analysis. The SOR analysis is summarized below:

- No FWCUG is available for lead and the Residential RSL is based on an acceptable blood-lead level, not a specific target organ. Therefore, lead was not included in the SOR analysis.
- Six COPCs (aluminum, arsenic, cadmium, chromium, cobalt, and manganese) identified in surface soil have FWCUGs for non-cancer endpoints. The EPCs for three of these COPCs (aluminum, arsenic, and cobalt) are below the BSVs at the ASA and IA; therefore, these metals were not included in the SOR. The EPCs for cadmium and chromium exceed BSVs at the ASA and IA. The EPC for manganese exceeds the BSV at the ASA. The critical effect used to calculate the RfD for cadmium is significant proteinuria. The target organ for manganese is the central nervous system. The RfD for chromium is based on a no observable adverse effect level (NOAEL) and does not have an identified target organ for toxicity; therefore, an SOR was calculated for cadmium and chromium for potential effects to the kidney at the ASA and IA. An SOR was calculated for manganese and chromium for potential effects to the central nervous system at the ASA. The SORs are less than one (Tables G-5 and G-6); therefore no additional COCs were identified using this analysis.

- Ten COPCs [arsenic; cadmium; cobalt; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene] identified in surface soil have FWCUGs for the cancer endpoint. The EPCs for arsenic and cobalt are less than the BSV. These inorganic chemicals were not included in the SOR calculations. The SORs for carcinogenic COPCs are greater than one at the ASA and IA (Tables G-7 and G-8), largely due to the contribution from benzo(a)pyrene. COPCs contributing at least 10% to these SORs and identified as COCs are the PAHs benzo(a)pyrene and dibenz(a,h)anthracene. Benz(a)anthracene and benzo(b)fluoranthene contribute greater than 5% to the SOR. Because other PAHs were identified as COCs, and it is common to find mixtures of PAHs, benz(a)anthracene and benzo(b)fluoranthene were also identified as COCs using this analysis.

Sample Location Analysis – Because COCs were identified at Atlas Scrap Yard, further analysis was used to identify the ISM sample locations (i.e., smaller decision units) within each EU where the COCs exceed FWCUGs. The evaluation of COCs at individual ISM sample locations for Unrestricted (Residential) Land Use is detailed in Tables G-9 and G-10 of Appendix G. At the ASA, 26 of 28 ISM sample locations analyzed for PAHs were identified as having COCs detected above FWCUGs for the Resident Receptor (Adult and Child). Benzo(a)pyrene concentrations in this area ranged from 0.078 mg/kg to 50 mg/kg with a median concentration of 3.5 mg/kg. At the IA, 17 of 26 ISM sample locations analyzed for PAHs were identified as having COCs detected above FWCUGs for the Resident Receptor (Adult and Child). Benzo(a)pyrene concentrations in this area ranged from 0.015-4.4 mg/kg with a median concentration of 0.35 mg/kg.

COCs in Subsurface Soil (1-13 ft bgs)

The COC determination for the subsurface soil exposure depth (1-13 ft bgs) for the Resident Receptor (Adult and Child) is detailed in Tables G-11 through G-14 of Appendix G.

COPCs with EPCs Lower than the Resident Receptor (Adult and Child) FWCUG – The EPCs for cobalt; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene are all lower than the FWCUGs for the Resident Receptor (Adult and Child) at the ASA and IA.

COPCs Exceeding the Resident Receptor (Adult and Child) FWCUG – The EPCs for arsenic at the ASA (18.4 mg/kg) and IA (17.6 mg/kg) exceed the FWCUG of 4.25 mg/kg but are less than the subsurface soil BSV of 19.8 mg/kg. Therefore, arsenic was not identified as a COC in subsurface soil.

SOR Analysis – No COCs were identified for the Resident Receptor (Adult and Child) exposed to subsurface soil based on the SOR analysis. The SOR analysis is summarized below:

- Arsenic and cobalt are the only non-cancer COPCs identified in subsurface soil and the EPCs of both these metals are below BSVs; therefore, a non-cancer SOR calculation was not needed.

- Six COPCs [arsenic, benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene] identified in subsurface soil have FWCUGs for the cancer endpoint so SORs were calculated (Tables G-13 and G-14). The SORs are less than one at both EUs; therefore, no COCs were identified based on this analysis.

The COCs identified for Unrestricted (Residential) Land Use are summarized in Table 7-6.

7.2.5 Uncertainty Assessment

The sources of uncertainty, as well as the potential bias they impart to the risk assessment (i.e., whether conservatism is increased or decreased) and approaches for minimizing their impact on the conclusions of the RI, are briefly discussed below.

Table 7-6. Surface Soil and Subsurface Soil COCs for Unrestricted (Residential) Land Use

COC	FWCUG (mg/kg)	BSV (mg/kg)	Exposure Point Concentration (mg/kg)			
			Surface Soil (0-1 ft bgs)		Subsurface Soil (1-13 ft bgs)	
			ASA	IA	ASA	IA
Benz(a)anthracene	2.21	--	17	0.89	0.036	0.065
Benzo(a)pyrene	0.221	--	18	0.79	0.035	0.078
Benzo(b)fluoranthene	2.21	--	21	1.1	0.05	0.11
Dibenz(a,h)anthracene	0.221	--	2.8	0.14	ND	0.021
Indeno(1,2,3-cd)pyrene	2.21	--	10	0.49	0.027	0.051

ASA = Active Storage Area Exposure Unit.
ft bgs = Feet below ground surface.
BSV = RVAAP Background Screening Value.
COC = Chemical of Concern.
FWCUG = Risk-based Facility-Wide Cleanup Goal corresponding to a target risk of 1E-05.
IA = Inactive Area Exposure Unit.
mg/kg = Milligram per kilogram.
ND = Not detected.
-- = No value available.

7.2.5.1 Uncertainty in Estimating Potential Exposure

Sources of uncertainty in estimating potential human exposure include sampling and analysis limitations, comparison to background concentrations to identify SRCs, and estimation of EPCs.

Sampling Limitations – Uncertainties arise from limits on the media sampled, the total number of samples, specific locations that can be sampled, and the parameters chosen for analysis to characterize the AOC. In accordance with the PBA08 SAP, potential source area ISM samples (0.07-0.6 acres) were collected from areas biased toward areas anticipated to have the highest level of potential contamination (i.e., around former buildings and stockpiles) to delineate potential sources. An additional 16 ISM surface soil samples were collected in 2011 to delineate PAH contamination around the existing contributing sources such as the stockpiled railroad ties to further assess the non-CERCLA releases. These samples ranged from 0.01-3.3 acres with most less than 0.5 acres. In addition, 18 ISM grid samples were used to characterize surface soil (0-1 ft bgs) across the AOC. Characterization of the AOC was achieved using ISM samples with a nominal 4-acre grid size. These large sampling areas fully characterize the potential exposure area at the AOC but do not provide the spatial resolution needed to identify potential source areas.

The results of surface soil sampling were used to select locations for discrete subsurface soil sampling that focused on areas with the highest potential for contamination.

Analytical Limitations – Uncertainty is associated with the contaminant concentrations detected and reported by the analytical laboratory. The quality of the analytical data used in the risk assessment was maximized and uncertainty was minimized by implementing QA/QC procedures that specify how samples are selected and handled; however, sampling errors, laboratory analysis errors, and data analysis errors can occur. Beyond the potential for errors, there is normal variability in analytical results.

Some current analytical methods are limited in their ability to achieve detection limits at or below risk-based screening levels. Under these circumstances, it is uncertain whether the true concentration is above or below the screening levels, which are protective of human health.

When analytes have a mixture of detected and non-detected concentrations, EPC calculations may be affected by these detection limits. Risks may be overestimated as the result of non-detected sample concentrations being reported at the MDL, when the actual concentration may be much lower. Risks may be underestimated if analytes that were not detected in any sample are removed from the COPC list. If these analyte concentrations are below the MDL but above the screening level, the risk would not be included in the risk assessment results.

There is some evidence that using stainless steel grinding blades when processing ISM samples could contribute chromium and nickel to the ISM soil samples. However, neither of these metals were identified as COCs at Atlas Scrap Yard; therefore, the impact of the potential contribution from grinding is minimal.

Identification of SRCs – Part of determining SRCs is to identify chemicals detected above the established RVAAP BSVs. This screen does not account for potential sources of chemicals, and BSVs are only available for inorganic chemicals.

Uncertainty associated with screening against background concentrations results from statistical limitations and natural variation in background concentrations. Because of these variations, inorganic chemical concentrations below the BSV likely represent background conditions. Inorganic chemical concentrations above the BSV may be above background concentrations or may reflect natural variation. This is especially true for measured concentrations close to the BSV.

At Atlas Scrap Yard, 10 inorganic SRCs (aluminum, arsenic, barium, cobalt, chromium, iron, manganese, nickel, potassium, and selenium) had MDCs in soil that were above but close to (i.e., less than three times) the BSVs. The consequences of carrying most of these inorganic chemicals forward as SRCs, even if they actually represent background concentrations, is negligible because they are not toxic at near background concentrations. By contrast, naturally occurring arsenic and manganese in soil exceed risk-based FWCUGs. Therefore, the consequence of identifying arsenic or manganese as SRCs if they are, in fact, representative of background can have a significant impact on the conclusions of the risk assessment.

Arsenic concentrations in surface soil (0-1 ft bgs) ISM samples at Atlas Scrap Yard range from 3.7-41 mg/kg, with concentrations in all but two samples below the RVAAP BSV for arsenic in surface soil (15.4 mg/kg) and subsurface soil (19.8 mg/kg). Because building demolition and other earthmoving activities such as removing surface soil and exposing subsurface soil at the surface have disturbed the soil, it is appropriate to compare surface soil sample results to the surface and subsurface BSVs. The arsenic EPCs at the ASA (10.1 mg/kg) and IA (9.65 mg/kg) are less than these BSVs. Other studies indicate arsenic may be naturally occurring in Ohio soils at greater than 20 mg/kg. For example, an environmental study of three locations in Cuyahoga County performed for Ohio EPA (Weston 2012) showed arsenic ranged from 4.6-25.2 mg/kg (22.9 mg/kg excluding statistical outliers) in surface soil (0-2 ft bgs) and 5.3-34.8 mg/kg (22.6 mg/kg excluding statistical outliers) in subsurface soil (2-4 ft bgs). Also, Vosnakis and Perry (2009) published the results of arsenic concentration studies that included 313 samples of Ohio soil. Naturally occurring arsenic in these samples ranged from 1.6-71.3 mg/kg with 95th percentiles of 21.7 mg/kg in surface soil, 25.5 mg/kg in subsurface soil, and upper tolerance limits of 22.8 mg/kg for surface soil and 29.6 mg/kg for subsurface soil. In other studies, native soil concentrations of arsenic in Ohio have been reported as ranging from 0.5-56 mg/kg (Ohio EPA 1996), and the U.S. Geological Survey's Certificate of Analysis of the Devonian Ohio Shale estimates arsenic concentrations of 68.5 mg/kg are naturally present in bedrock shale (USGS 2004). Based on this information, arsenic appears to be present at Atlas Scrap Yard at naturally occurring concentrations.

Manganese concentrations in surface soil (0-1 ft bgs) ISM samples at Atlas Scrap Yard range from 95-3600 mg/kg, with concentrations in all but two samples below the RVAAP BSV for manganese in subsurface soil (3030 mg/kg). An additional 18 samples have reported concentrations above the BSV for surface soil (1450 mg/kg). Because building demolition and other earthmoving activities such as removing surface soil and exposing subsurface soil at the surface have disturbed the soil, it is appropriate to compare surface soil sample results to the surface and subsurface BSVs. The manganese EPCs at the ASA (1610 mg/kg) and IA (795 mg/kg) are within this range of BSVs. Other studies identify naturally occurring manganese in Ohio soils at concentrations ranging from 59-1750 mg/kg (Weston 2012, Ohio EPA 1996) with concentrations as high as 7000 mg/kg in the eastern United States (Shacklette and Boerngen 1984). Based on this information, manganese appears to be present at Atlas Scrap Yard at naturally occurring concentrations.

Organic chemicals are not screened against background concentrations, even though some organic compounds are present in the environment as a result of natural or human activities not related to CERCLA releases at the AOC. For example, PAHs are present in the environment as a result of burning fossil fuels and as a component of road dust, vehicle exhaust, tire wear particles, pavement, and slag used as railroad ballast and fill. Samples collected near roadways or parking areas may represent normal "urban" sources of PAHs. These issues represent significant sources of uncertainty at sites where low levels of PAHs are found over large areas of the AOC. At Atlas Scrap Yard, PAHs were detected across the entire AOC, and one or more PAHs were detected in all 54 surface soil samples analyzed for SVOCs. At the ASA, benzo(a)pyrene concentrations ranged from 0.078-50 mg/kg with a median concentration of 3.5 mg/kg. As discussed in Section 5, the April 2011 sampling indicated that high PAH concentrations are associated with the ditch along the access road (ASY-123M and ASY-126M) and the parking areas constructed of slag and asphalt gravel (ASY-116M, ASY-117M, ASY-118M, and ASY-119M). In addition, the samples collected around the railroad ties (ASY-111M, ASY-112M, and ASY-113M) had benzo(a)pyrene concentrations from 0.72-1.4 mg/kg. At the IA, benzo(a)pyrene concentrations ranged from 0.015-4.4 mg/kg with a median concentration of 0.35 mg/kg. The highest PAH concentrations in the IA are reported in samples collected near roads and in gravel parking areas.

Although no BSVs for PAHs were established for RVAAP, the *Phase II Remedial Investigation Report for Winklepeck Burning Grounds* (USACE 2001b), which established the BSVs for inorganics, included a characterization of naturally occurring background metal concentrations in surface and subsurface soil at Camp Ravenna using samples from outside the process areas. Surface soil samples were collected at 15 locations on the eastern half of Camp Ravenna. These background locations were chosen using aerial photographs and by conducting site visits with the concurrence of Ohio EPA and USACE to (1) reflect areas not impacted by former RVAAP activities and (2) establish background values that are unaffected by any human activity. The background locations were situated upgradient and generally upwind of known or suspected contaminant sources.

Background sampling was conducted in April and May 1998. All background samples were analyzed for TAL metals, cyanide, and SVOCs. Two of the background samples were also analyzed for VOCs and pesticides/PCBs. The background soil sampling effort established BSVs for naturally occurring metals in soil at former RVAAP/Camp Ravenna.

In establishing BSVs for naturally occurring metals, data were screened to identify outliers in the inorganic chemical results. Ohio EPA guidance (Comment Resolution Meeting, December 2, 1998) called for using upper and lower cutoff limits based on quartiles to identify outliers. The upper cutoff limit is the third quartile (the 75th percentile) plus one and a half times the interquartile range. All results that exceeded the upper cutoff limit were examined to determine if the results should be used in establishing BSVs for naturally occurring metals. Outliers were removed so that background values would most nearly represent natural conditions and exclude human disturbance whether from former RVAAP or pre-RVAAP activities.

Statistical outliers were identified in five surface soil and 15 subsurface soil samples. All analytical results for four of these samples [BKGss-011(b)-0794-SO, BKGss-012(b)-0795-SO, BKGss-015(b)-0798-SO, and BKGss-005(b)-0788-SO] were removed from the surface soil background dataset. These four samples were eliminated from the surface soil background dataset since PAHs were elevated and these sampling locations were near pre-existing homes or farms and could have been influenced by activities associated with those structures (e.g., burning wood and fossil fuels, vehicle exhaust, or building materials such as slag used as fill or tar paper and shingles). The other 11 outlier samples were not excluded from the BSV calculations primarily because no SVOCs were detected in those samples and thus the outliers did not appear to be associated with human activities.

Concentrations of PAHs in surface soil at Camp Ravenna associated with pre-RVAAP anthropogenic sources calculated from the 15 RVAAP background surface soil samples are shown in Table 7-7. Since the purpose here is to identify PAH levels associated with anthropogenic activities unrelated to CERCLA releases from operations at former RVAAP, it is appropriate to include all 15 background samples in these calculations. The following criteria were used per the method used in establishing BSVs for naturally occurring metals (USACE 2001b):

- For analytes with a frequency of detection > 50%, a distribution (determined using the Shapiro-Wilk test) that is neither normal nor log-normal, and a sample size of 59 or less, the maximum result represents the nonparametric 95% UTL and was identified as the BSV for naturally occurring metals. These conditions apply to four of the PAHs detected in background samples [benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene].
- For analytes with a frequency of detection between 0 and 50% with a sample size of 15, the maximum result represents the 99th percentile value and was identified as the BSV for naturally occurring metals. These conditions apply to the remainder of the PAHs detected in background samples.

These results demonstrate the large variability in environmental concentrations of PAHs. For example, benzo(a)pyrene was detected in 8 of 15 background surface soil samples at concentrations ranging from 0.058-3.7 mg/kg.

Table 7-7. Environmental Concentrations of PAHs Measured in Background Surface Soil Samples at RVAAP

		Reported Concentration[a] (mg/kg)		
Analyte	**% Detects**	**Minimum**		**Maximum**
Acenaphthene	1/ 15	7%	0.88	0.88
Acenaphthylene	1/15	7%	0.07	0.07
Anthracene	2/15	13%	0.12	1
Benz(a)anthracene	10/15	67%	0.044	4.1
Benzo(a)pyrene	8/15	53%	0.058	3.7
Benzo(b)fluoranthene	10/15	67%	0.062	4.8
Benzo(g,h,i)perylene	6/15	40%	0.046	1.3
Benzo(k)fluoranthene	6/15	40%	0.053	2.6
Chrysene	10/15	67%	0.057	4
Dibenz(a,h)anthracene	2/15	13%	0.11	0.37
Indeno(1,2,3-cd)pyrene	5/15	33%	0.054	1.5

[a] Phase II Remedial Investigation Report for Whinklepeck Burning Grounds (USACE 2001b).
mg/kg = Milligram per kilogram.

Other studies of environmental concentrations of PAHs in Ohio soils show similar variability. For example, in the environmental study of three locations in Cuyahoga County performed for Ohio EPA (Weston 2012), PAHs were detected in only 1 of 36 surface soil samples with a reported concentration of benzo(a)pyrene of 1.33 mg/kg. Aerial photographs indicate this sample was collected near an old road or trail, but no other sources of PAHs are apparent.

In addition to these RVAAP and Cuyahoga County studies, numerous other environmental studies have been conducted that examine environmental levels of PAHs in rural and urban surface soil (e.g., ATSDR 1995, Bradley et al. 1994, IEPA 2005, MADEP 2002, Teaf et al. 2008). Reported minimum, maximum, and 95th percentile concentrations of benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene from numerous studies are shown in Table 7-8.

These studies further demonstrate the high variability in environmental levels of PAHs within a single study area and among multiple studies.

The lack of established RVAAP-specific BSVs for identifying SRCs for PAHs is a source of uncertainty. Evaluating potential former RVAAP process-related sources and other common anthropogenic (non-CERCLA) sources using available PAH environmental data minimizes the impact of this uncertainty on the conclusions of the RI (see Section 7.2.6).

Exposure Point Concentrations – Surface soil (0-1 ft bgs) was characterized using ISM. ISM is used to determine an average concentration representative of the soil contained within an ISM sample location (i.e., the “decision unit”). For ISM samples, 30-50 aliquots of surface soil are generally collected from random locations within a decision unit and combined into a single sample. Using ISM reduces the uncertainty associated with estimating a statistical average concentration within a decision unit.

Soil data at Atlas Scrap Yard were aggregated into surface and subsurface soil as described in Section 7.1.1. Based on AOC characteristics and the operational constraints during its use, the sample coverage to define nature and extent of operationally impacted areas of the AOC is adequate.

Potential source area ISM samples (generally 0.01-0.6 acres but also included three 3-acre samples) were collected from areas biased toward locations anticipated to have the highest level of potential contamination (i.e., around former buildings and storage areas) to delineate potential sources. Characterization of the AOC was achieved using ISM grid samples with a nominal 3-4-acre grid size. These large sample areas characterize the entire AOC, but do not provide the spatial resolution needed to identify potential source areas. Therefore, both types of samples were used in the analysis.

First, an EPC was calculated for the AOC using the ISM grid samples listed in Table 7-1. The EPC is intended to represent the mean concentration a receptor may be exposed to over a long duration (i.e., the exposure duration of 6-30 years). The 95% UCL or MDC, whichever is lower, was used as a conservative estimate of the mean to compensate for uncertainty in the exposure estimates.

Table 7-8. Concentrations of Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, and Dibenz(a,h)anthracene in Soil from Various Environmental Studies

Study	Number of Samples	Geometric Mean or Median	Minimum	95th Percentile[a]	Maximum
Benz(a)anthracene					
CA/T Project[b]	872	0.33	0.045	19	250
LSPA Project[b]	490	0.563	ND	--	796
Watertown[b]	17	0.411	0.021	6.04	6.05
Worcester[b]	68	--	ND	3.8	15
New England[c]	62	0.672	ND	1.86	15
Illinois[d] Urban	--	--	--	1.8	--
Illinois[d] Rural	--	--	--	0.72	--
ATSDR[e] Urban	--	--	0.169	--	59
ATSDR[e] Rural	--	--	0.005	--	0.02
ATSDR[e] Agricultural	--	--	0.056	--	0.11
NYSDEC Rural Near Roads[f]	28	--	ND	1.2	2.9
NYSDEC Rural Distant Roads[f]	118	--	ND	0.16	2.6
Benzo(a)pyrene					
CA/T Project[b]	873	0.3	0.031	17	230
LSPA Project[b]	489	0.44	ND	--	222
Watertown[b]	17	0.95	0.6	4.77	6.08
Worcester[b]	67	--	ND	3.3	9.7
New England[c]	62	0.686	ND	1.82	13
Illinois[d] Urban	--	--	--	2.1	--
Illinois[d] Rural	--	--	--	0.98	--
ATSDR[e] Urban	--	--	0.165	--	0.22
ATSDR[e] Rural	--	--	0.002	--	1.3
ATSDR[e] Agricultural	--	--	0.0046	--	0.9
NYSDEC Rural Near Roads[f]	28	--	ND	1.1	2.4
NYSDEC Rural Distant Roads[f]	118	--	ND	0.12	3.4
Benzo(b)fluoranthene					
CA/T Project[b]	873	0.68	0.045	18	270
LSPA Project[b]	486	--	ND	--	250
Watertown[b]	17	1.4	0.6	6.79	7.08
Worcester[b]	--	--	--	--	--
New England[c]	62	0.722	ND	1.97	12
Illinois[d] Urban	--	--	--	2	--
Illinois[d] Rural	--	--	--	0.7	--
ATSDR[e] Urban	--	--	15	--	62
ATSDR[e] Rural	--	--	0.02	--	0.03
ATSDR[e] Agricultural	--	--	0.058	--	0.22
NYSDEC Rural Near Roads[f]	28	--	ND	1.2	3.3
NYSDEC Rural Distant Roads[f]	118	--	ND	0.36	4.6
Dibenz(a,h)anthracene					
CA/T Project[b]	866	0.17	0.045	2.1	39
LSPA Project[b]	--	--	--	--	--
Watertown[b]	17	0.195	0.155	0.604	0.64
Worcester[b]	68	--	ND	--	1.6
New England[c]	62	0.245	ND	--	2.9
Illinois[d] Urban	--	--	--	0.42	--

Table 7-8. Concentrations of Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, and Dibenz(a,h)anthracene in Soil from Environmental Studies (continued)

Study	Number of Samples	Geometric Mean or Median	Minimum	95th Percentile[a]	Maximum
Illinois[d] Rural	--	--	--	0.15	--
ATSDR[e]	--	--	--	--	--
NYSDEC Rural Near Roads[f]	28	--	--	--	--
NYSDEC Rural Distant Roads[f]	118	--	ND	--	0.23

[a] Lognormal 95th percentile value for all studies except: (1) New England value is 95% upper confidence limit and (2) NYSDEC values are distribution-free 95th percentile.

[b] Data reported by Massachusetts Department of Environmental Protection (MADEP 2002) are from the following datasets:
CA/T = Data collected by Mass Highway Department as part of the Central Artery/Tunnel (CA/T) project.
LSPA = Preliminary data compiled by the Massachusetts Licensed Site professional Association (LSPA) from data submitted by its members in 2001.
Water Town and Worcester Site-specific samples.

[c] Data from three New England locations from Bradley et al. 1994.

[d] Concentrations of PAHs in Illinois metropolitan statistical areas (urban) and non-metropolitan statistical areas (rural) as reported by Illinois EPA (IEPA 2005).

[e] Data published by the Agency for Toxic Substances and Disease Registry (ATSDR) in Polycyclic Aromatic Hydrocarbons (PAHs) August 1995.

[f] Distribution-free 95th percentile values for near roads (less than 10 ft from roads and pavement) and not near roads (more than 15 ft from roads and pavement) from New York State Brownfield Cleanup program Development of Soil Cleanup Objectives Technical Support Document (September 2006), Appendix D.

ND = Not detected.
NYSDEC = New York State Department of Environmental Conservation.
-- = No value reported for this source.

After the EPC was evaluated, chemical concentrations for COCs identified at the AOC in individual ISM sample locations (including all source area ISM samples) were compared directly to the soil FWCUGs to identify which ISM sample locations (i.e., smaller decision units) contain COCs. This evaluation is provided in Tables G-9 and G-10.

EPCs were calculated for the 1-13 ft bgs subsurface soil sample interval using analytical results from the discrete samples listed in Table 7-2. Soil borings for discrete samples were located in areas of highest potential contamination based on previous sampling results, resulting in calculated EPCs that provide conservative estimates of exposure concentrations across the AOC.

7.2.5.2 Uncertainty in Use of FWCUGs

Sources of uncertainty in the FWCUGs used to identify COCs include selecting appropriate receptors and exposure parameters, exposure models, and toxicity values used in calculating FWCUGs.

Selection of Representative Receptors – An evaluation using Resident Receptor (Adult and Child) FWCUGs is included to provide an Unrestricted (Residential) Land Use evaluation as required by CERCLA and the U.S. Army.

Exposure Parameters and Exposure Models – For each primary exposure pathway included in the FWCUGs, assumptions are made concerning the exposure parameters (e.g., amount of contaminated media a receptor can be exposed to and intake rates for different routes of exposure) and the routes of exposure. Most exposure parameters have been selected so that errors occur on the side of human health protection. When several of these upper-bound values are combined in estimating exposure for a pathway, the resulting risks can be in excess of the 99th percentile and are therefore outside of the range that may be reasonably expected. Consistently selecting upper-bound parameters generally leads to overestimation of potential risks.

Toxicity Values – The toxicity of chemicals is under constant study and values change from time to time. The toxicity values used in calculating FWCUGs were the most recent values available at the time (September 2008). These values are designed to be conservative and provide an upper-bound estimate of risk.

The toxicity and mobility of many inorganic chemicals in the environment depends on the chemical species present. Two important examples are arsenic and chromium. The toxicity values used in developing FWCUGs are for inorganic arsenic, and do not distinguish between arsenite and arsenate. Chromium is generally present in the environment as either the trivalent (Cr+3) or hexavalent (Cr+6) species, with the trivalent form generally being more stable and, therefore, more common. FWCUGs are available for hexavalent chromium and trivalent chromium.

Trivalent chromium has not been shown to be carcinogenic. It is an essential micronutrient but can also be toxic at high doses (i.e., above the RfD used to calculate the FWCUG). FWCUGs for trivalent chromium are based on non-cancerous effects. Hexavalent chromium is much more toxic than trivalent chromium. It is classified as a "known human carcinogen" and may also cause non-cancerous effects. The cancer URF for hexavalent chromium published in USEPA's IRIS is based on epidemiological data on lung cancer in workers associated with chromate production. Workers in the chromate industry are exposed to trivalent and hexavalent compounds of chromium. The cancer mortality in the study used to establish the URF was assumed to be due to hexavalent chromium. It was further assumed that hexavalent chromium constituted no less than one-seventh of the total chromium in air that the workers were exposed to. As noted in IRIS, the assumption that the ratio of hexavalent to trivalent chromium was 1:6 in this study may lead to a sevenfold underestimation of risk when using this URF to evaluate exposure to hexavalent chromium alone.

To avoid the underestimation of risk, selecting the FWCUG for chromium includes a step that compares the maximum concentration of hexavalent chromium detected in chromium speciation samples to a FWCUG adjusted to represent only hexavalent chromium. The lowest and most conservative FWCUG for hexavalent chromium is for the National Guard Trainee (16.4 mg/kg) and is based on a cancer URF calculated using a chromate mixture containing 14% hexavalent chromium (USEPA 2010). Since the study used as the basis for the cancer URF included workers exposed to trivalent and hexavalent chromium, the FWCUG must be adjusted to represent only hexavalent chromium. A total of 1/7, or 14%, of the National Guard Trainee FWCUG [(16.4 mg/kg)/7 = 2.3 mg/kg] is appropriate for evaluating hexavalent chromium alone. Concentrations of hexavalent chromium in chromium speciation samples that are less than or equal to 2.3 mg/kg indicate that hexavalent chromium is not present above the hexavalent chromium FWCUGs and supports using the trivalent chromium FWCUGs.

Using speciation samples to identify the appropriate FWCUG minimizes the associated uncertainty.

FWCUGs Below Background Concentrations – One purpose of the HHRA process is to identify COCs and cleanup goals for evaluating remedial alternatives for remediating residual contamination that has resulted from process operations at the AOC. The FWCUGs are risk-based values. In some cases, natural or anthropogenic background concentrations unrelated to process operations exceed the risk-based FWCUGs. For naturally occurring inorganic chemicals, this problem is addressed by using the BSV as the cleanup goal. This introduces uncertainty in the chosen cleanup goal because there is uncertainty in assigning a specific value to background, which can be highly variable.

No BSVs are available for organic chemicals, although PAHs are often present in the environment from natural and anthropogenic sources and regulatory standards are often much lower than environmental levels of PAHs in urban and rural surface soil, especially near areas of vehicle traffic (e.g., roads and parking areas). Given their frequent presence in environmental media, especially in areas influenced by vehicle exhaust and tire particles, it is important to compare risk-based cleanup levels with typical environmental concentrations before utilizing unrealistically low cleanup targets. Numerous studies have been conducted that examine ambient levels of PAHs in rural and urban surface soil (ATSDR 1995, Bradley et al. 1994, MADEP 2002, Teaf et al. 2008). These studies indicate that given the multitude of non-point mobile sources for PAHs, it is not uncommon for ambient concentrations to exceed health-based regulatory recommendations. Some states have begun to include consideration of ambient anthropogenic levels by establishing minimum screening levels based on environmental studies. For example, the New York State Department of Environmental Conservation has established a minimum soil cleanup objective of 1.0 mg/kg for benz(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene and 0.1 mg/kg for dibenz(a,h)anthracene, based on the 95th percentile concentrations of these PAHs in rural areas near roads (NYSDEC 2006).

7.2.5.3 Uncertainty in the Identification of COCs

All sources of uncertainty described in previous sections potentially impact the identification of COCs. The exposure and toxicity values used to calculate FWCUGs, as well as the approach for identifying SRCs, COPCs, and ultimately COCs based on FWCUGs, were designed to ensure the overestimation rather than underestimation of potential risks. The uncertainty assessment attempts to put the identified COCs in perspective to facilitate informed risk management decisions for the AOC.

The SOR is used to account for potential additive effects from exposure to multiple chemicals that can cause the same effect or affect the same target organ. Cancer risk is assumed to be additive for all carcinogens. Non-cancer risk is assumed to be additive for chemicals with similar sites of toxicological action. In the event that any combination of COPCs results in synergistic effects, risk might be underestimated. Conversely, the assumption of additivity would overestimate risk if a combination of COPCs acted antagonistically. It is unclear whether the potential for chemical interaction has been inadvertently understated or overstated. It seems unlikely that the potential for chemical interaction contributes significant uncertainty to the conclusions of the risk assessment.

7.2.6 Identification of COCs for Potential Remediation

Soil COCs were identified in Section 7.2.4 as any COPC having an EPC greater than a FWCUG. For inorganic chemicals with FWCUGs below BSVs, the BSV was used as the point of comparison. The TR for the FWCUGs used to identify COCs is 1E-05 per the Ohio EPA DERR program, which has adopted a human health cumulative ILCR goal of 1E-05 to be used as the level of acceptable excess cancer risk and for developing site remediation goals.

The results of the COC screening (Section 7.2.4) are combined with the results of the uncertainty assessment (Section 7.2.5) to identify COCs to be carried forward for potential remediation. Five PAHs [benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene] were identified as COCs for Unrestricted (Residential) Land Use. The EPCs of all five of these PAHs in surface soil (0-1 ft bgs) exceed the Resident Receptor (Adult and Child) FWCUG at the ASA with benzo(a)pyrene concentrations ranging from 0.078-50 mg/kg with a median concentration of 3.5 mg/kg. At the IA, only the EPC of benzo(a)pyrene exceeded the FWCUG; however, an additional four PAHs were identified as COCs based on the SOR analysis. Benzo(a)pyrene concentrations in the IA ranged from 0.015-4.4 mg/kg with a median concentration of 0.35 mg/kg.

Organic chemicals do not have established RVAAP BSVs. However, some organic compounds are present in the environment as a result of natural or human activities not related to CERCLA releases at the AOC. For example, PAHs are present in the environment as a result of burning fossil fuels and as a component of road dust, vehicle exhaust, tire wear particles, pavement, and slag used as railroad ballast and fill. At the ASA, PAHs are present at high concentrations due to ongoing sources such as outgoing and incoming traffic on roads, parking areas made up of slag and asphalt gravel, and stored railroad ties. The gravel parking area is the primary source of PAHs. Per Ohio EPA (2002), clean hard fill includes asphalt and may be used as construction material or to change grade on a site. Whoever uses the fill is not liable for any adverse environmental impacts so long as the material is not mismanaged. Mismanaging clean hard fill may include using fill material with regulated material adhered to it. The PAHs in asphalt are not adhered contaminants but are an integral part of the asphalt. These ongoing sources do not represent a CERCLA-related release. At the IA, PAHs are present at much lower concentrations and are associated with gravel (including ballast) roads and parking areas. PAH concentrations at the IA are similar to those reported from normal urban sources and do not represent a CERCLA-related release.

Based on the evaluation of potential sources of PAHs at Atlas Scrap Yard, including ongoing sources associated with active parking areas and other debris, PAHs are not associated with a CERCLA release at Atlas Scrap Yard and were not identified as COCs requiring remediation.

No COCs were identified in subsurface soil.

7.2.7 Summary of HHRA

This HHRA documents COCs that may pose potential health risks to human receptors resulting from exposure to contamination at Atlas Scrap Yard. This HHRA was conducted as part of the RI and was based on the streamlined approach described in the FWCUG Report and Position Paper for Human Health FWCUGs (USACE 2012b). The components of the risk assessment (receptors, exposure media, EPCs, and results) are summarized below.

Receptors – Camp Ravenna is a controlled access facility. Atlas Scrap Yard is located in the central portion of the facility and is currently used for storing railroad ties and salvaged inert materials. The potential representative human receptor at Atlas Scrap Yard is the National Guard Trainee for military training. An evaluation using Resident Receptor (Adult and Child) FWCUGs was used to provide an Unrestricted (Residential) Land Use evaluation as required by CERCLA and the U.S. Army. Unrestricted (Residential) Land Use is considered protective for all categories of Land Use at the former RVAAP/Camp Ravenna.

Exposure Media – Media of concern at Atlas Scrap Yard are surface soil and subsurface soil. Surface soil exposure depth is defined as 0-1 ft bgs for the Resident Receptor (Adult and Child). Subsurface soil exposure depth is defined as 1-13 ft bgs for the Resident Receptor (Adult and Child) (USACE 2010a). Surface water and sediment samples were not collected within the AOC during the PBA08 RI, as perennial surface water bodies are not present at the AOC.

Estimation of EPCs – EPCs for surface soil (0-1 ft bgs) were calculated using analytical results from the ISM grid samples for surface soil in each EU listed in Table 7-1. These grid samples provide full coverage of the AOC. The COCs identified at the AOC were further evaluated by reviewing analytical results for individual source area ISM samples. EPCs for subsurface soil were calculated for each EU using analytical results from discrete soil boring samples listed in Table 7-2. The EPC was either the 95% UCL of the mean or the MDC, whichever value is lowest. If the 95% UCL could not be determined, the EPC is the MDC.

Results of Human Health Risk Assessment – The only COCs presently identified above FWCUGs are five PAHs. At the ASA, PAHs are present at high concentrations due to ongoing sources such as outgoing and incoming traffic on roads and parking areas made up of slag and asphalt gravel. The gravel parking area is the primary source of PAHs. These ongoing sources do not represent a CERCLA-related release. At the IA, PAHs are present at much lower concentrations and are associated with gravel (including ballast) roads and parking areas. PAH concentrations at the IA are similar to those reported from normal urban sources and do not represent a CERCLA-related release. Consequently, these PAHs do not require remediation under CERCLA.

7.3 ECOLOGICAL RISK ASSESSMENT

The ERA presented in this RI Report follows a unified approach of methods, integrating U.S. Army, Ohio EPA, and USEPA guidance. This ERA approach is consistent with the general approach by these agencies and primarily follows the Level I Scoping ERA, Level II Screening ERA, and Level III Baseline ERA outlined in the *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008), with specific application of components from the FWERWP, *Risk Assessment Handbook Volume II: Environmental Evaluation* (USACE 2010b), and *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA 1997). The process implemented in this RI Report combines these guidance documents to meet requirements of the Ohio EPA and U.S. Army, while following previously accepted methods established for RVAAP. This unified approach resulted from coordination between USACE and Ohio EPA during the summer of 2011.

7.3.1 Scope and Objective

Atlas Scrap Yard contains terrestrial and aquatic habitat that supports ecological receptors. The terrestrial habitats have known chemical contamination (MKM 2007). Habitat types and an assessment of the ecological resources found at Atlas Scrap Yard are presented in subsequent subsections. Additionally, the results of a historical ERA (an ERS performed as part of the Characterization of 14 AOCs) and the PBA08 RI are provided to determine whether a qualitative ERA (Level I) is sufficient, based on the quality of the habitat and the presence of contamination, or whether a more rigorous ERA (Level II or Level III) should be conducted.

Under the scope of this RI Report, the term sediment equates to frequently or permanently inundated wet sediment as defined by RVAAP guidelines. Dry sediment refers to unconsolidated inorganic and organic material within natural conveyances, drainage ditches, or low-lying areas that occasionally may be covered with water, usually following a precipitation event or due to snowmelt. Dry sediment is not covered with water for extended periods and typically is dry within seven days of a precipitation event. Dry sediment does not function as a permanent habitat for aquatic organisms, although it may serve as a natural medium for the growth of terrestrial organisms. These definitions and terminology usage are consistent with the FWCUG Report.

Using the definitions in the FWCUG Report, sediment and perennial surface water are not media of concern evaluated within this RI Report, as surface water is only present at the AOC during and immediately after times of heavy rainfall. The entire ground surface at the AOC is evaluated as soil in the nature and extent characterization, fate and transport evaluation, HHRA, and ERA. Consequently, the media evaluated in the nine identified wetlands at Atlas Scrap Yard (including eight seasonally inundated and one more frequently inundated wetland) are considered soil for risk assessment purposes. It should be noted that wetland classification methods (e.g., the Ohio Rapid Assessment Method) might define some or all of the wetlands at Atlas Scrap Yard as sediment. However, classifying the media at Atlas Scrap Yard as soil is most appropriate because the sediment screening values are typically developed for use in permanently inundated water bodies (e.g., ponds and streams) that do not exist at Atlas Scrap Yard. Thus, surface soil screening levels are more appropriate for use at Atlas Scrap Yard.

7.3.2 Level I: Scoping Level Ecological Risk Assessment

The ERA method for Level I follows guidance documents listed in Section 7.3.1. Level I is intended to evaluate if the AOC had past releases, the potential for current contamination, and if there are important ecological resources in or near the AOC.

The following two questions should be answered at when the Level I ERA is complete:

1. **Are current or past releases suspected at the AOC?** Current or past releases are determined by evidence that chemical contaminants or COPECs are present.
2. **Are important ecological resources present at or in the locality of the AOC?** Important ecological resources are defined in the *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008) and *Technical Document for Ecological Risk Assessment: Process for Developing Management Goals* (BTAG 2005).

If an AOC has contaminants but lacks important ecological resources, the ERA process can stop at Level I. Contamination and important ecological resources must both be present to proceed to a Level II Screening Level ERA.

7.3.2.1 AOC Description and Land Use

Atlas Scrap Yard is approximately 73 acres. Atlas Scrap Yard was evaluated as two EUs: the ASA EU (14 acres) in the north-central portion of the AOC, including all active storage and process areas, and the IA EU (59 acres) outside the active storage area. Both areas were evaluated collectively in this ERA.

Important aquatic resources exist on the AOC, including nine wetlands. The habitat is mostly herbaceous vegetation, with smaller amounts of shrubland, forests, and wetlands. The size of the habitat is large enough to completely support cover and food for small birds and mammals that typically require approximately 1 acre (USEPA 1993). The habitat area at Atlas Scrap Yard represents 0.3% of the 21,683 acres at Camp Ravenna.

7.3.2.2 Evidence of Historical Chemical Contamination

The goal of the historical ERA (MKM 2007) was to identify COPECs in soil for Atlas Scrap Yard. The historical ERA also identified COPECs for sewer sediment and water. The Facility-Wide Sewers (storm and sanitary sewer systems) is identified as a separate AOC, designated as RVAAP-67. The risk in the sewer sediment and surface water at Atlas Scrap Yard is evaluated in a separate report specific to the Facility-Wide Sewers. Sewer samples and COPECs identified in the historical ERA are not discussed in this report.

The historical ERA followed instructions presented in the *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2003) and consisted of the first two of the six steps listed in Figure III of the

FWERWP. These two steps identify the evaluation procedures, which were used to determine AOC-related COPECs. First, the MDC of each chemical was compared to its respective facility-wide background concentration. Chemicals were not considered COPECs if the MDC was below the background concentration. For all chemicals detected above background concentrations, the MDC was compared to an ESV. The hierarchy of screening values was based on the guidance included in the FWERWP and *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2003). In addition to the ESV comparison, it was determined if the chemical was a persistent, bioaccumulative, and toxic (PBT) compound. Chemicals were retained as COPECs if they exceeded background concentrations and the ESV, if the chemical exceeded background concentrations and had no toxicity information, or if the chemical was a PBT compound.

Groundwater was not included in the historical ERA. As explained in Section 3.2.2 of the FWERWP, groundwater is not considered an exposure medium to ecological receptors because these receptors are unlikely to contact groundwater greater than 5 ft bgs. The water table at Atlas Scrap Yard occurs in the unconsolidated zone at 5.2-17.0 ft bgs.

The historical ERA table for soil is included in Appendix Table H-1 and contains the following:

- Frequency of detection;
- Average concentration;
- MDC;
- Background concentration for soil;
- Comparison of MDC to background concentrations;
- ESVs used for COPEC determinations;
- Comparison of MDC to screening values;
- PBT compound identification;
- COPEC determination; and
- COPEC rationale.

Historical COPECs for Soil – The historical ERA conducted as part of the Characterization of 14 AOCs reported 51 chemicals in surface soil (0-1 ft) (MKM 2007). Of the 51 chemicals detected, four chemicals (calcium, magnesium, potassium, and sodium) were essential nutrients and were excluded from the COPEC screen. Forty-six chemicals were determined to be SRCs because they either exceeded background concentrations or did not have an associated background concentration for comparison. Fourteen inorganic chemicals (aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc), one pesticide (aroclor 1260), and four organic chemicals [benzo(a)pyrene, bis(2-ethylhexyl) phthalate, butylbenzyl phthalate, and naphthalene] were identified as COPECs because detected concentrations were above ESVs. Six other chemicals (4-methylphenol; dibenzofuran; 2-amino-4,6-DNT; 2-nitrotoluene; 3-nitrotoluene; and nitrocellulose) were also identified as COPECs due to a lack of ESV. Twenty-five chemicals were identified as COPECs in soil (Table 7-9). Appendix Table H-1 presents the ecological screening for soil.

Historical COPECs for Sediment – No historical sediment samples were collected at the AOC, except those from the sewers.

Historical COPECs for Surface Water – No historical surface water samples were collected at the AOC, except those from the sewers.

Summary of Historical ERA – As explained previously, a historical ERA was performed to determine COPECs in surface soil at Atlas Scrap Yard. The COPECs are summarized in Table 7-9. Based on the identification of COPECs, ecological risk in surface soil was predicted in the historical investigation, and an additional investigation was recommended for Atlas Scrap Yard (MKM 2007).

Table 7-9. Summary of Historical COPECs per the Characterization of 14 AOCs

Group	COPEC	Shallow Soil
Inorganic Chemicals	Aluminum	X
	Arsenic	X
	Barium	X
	Cadmium	X
	Chromium	X
	Copper	X
	Iron	X
	Lead	X
	Manganese	X
	Mercury	X
	Nickel	X
	Selenium	X
	Silver	X
	Zinc	X
Pesticides	Aroclor 1260	X
SVOCs	4-Methylphenol	Q
	Benzo(a)pyrene	X
	Bis(2-ethylhexyl) phthalate	X
	Butylbenzyl phthalate	X
	Dibenzofuran	Q
	Naphthalene	X
Explosives	2-Amino-4,6-dinitrotoluene	Q
	2-Nitrotoluene	Q
	3-Nitrotoluene	Q
Propellants	Nitrocellulose	Q

Adapted from Table ASY-14 from the Characterization of 14 AOCs (MKM 2007)
COPEC = Chemical of Potential Ecological Concern
SVOC = Semi-volatile Organic Compound
Q = Qualitative COPEC, PBT chemical or no ESV
X = Quantitative COPEC, exceeds ESV

7.3.2.3 Ecological Significance

Sources of data and information about the ecological resources at Atlas Scrap Yard include the INRMP (OHARNG 2008), *Facility-Wide Biological and Water Quality Study* (USACE 2005a), previous characterization work (e.g., Characterization of 14 AOCs), and visits to the AOC conducted for the PBA08 RI. Revisions to the INRMP (OHARNG 2008) and the Rare Species List are underway; however, documents associated with PBA08 will reference and utilize information from the 2008 INRMP.

One of the two key questions to answer in the Level I Scoping ERA is whether there are ecologically important and especially ecologically significant resources at Atlas Scrap Yard. Ecological importance is defined as a place or resource that exhibits unique, special, or other attributes that makes it of great value. Ecological significance is defined as an important resource found at an AOC or in its vicinity that is subject to contaminant exposure. The underlying basis for this distinction can be found in *Ecological Significance and Selection of Candidate Assessment Endpoints* (USEPA 1996a), stated as follows:

> *"A critical element in the ERA process requires distinguishing important environmental responses to chemical releases from those that are inconsequential to the ecosystem in which the site resides: in other words, determining the ecological significance of past, current, or projected site-related effects."*

Important places and resources identified by the U.S. Army and Ohio EPA (Appendix Table H-2) include wetlands, terrestrial areas used for breeding by large or dense aggregations of animals, habitat known to be used by threatened or endangered species, state land designated for wildlife or game management, locally important ecological places, and state parks. The U.S. Army and Ohio EPA recognize 17 important places and resources. The U.S. Army recognizes an additional 16 important places (BTAG 2005), and the Ohio EPA recognizes another six important places (Ohio EPA 2008). In total, there are 39 important places. Presence or absence of an ecologically important place can be determined by comparing environmental facts and characteristics of Atlas Scrap Yard with each of the important places and resources listed in Appendix Table H-2.

Ecological significance is defined as an important resource found at an AOC or in its vicinity that is subject to contaminant exposure. Thus, any important places and resources listed in Appendix Table H-2 are elevated to ecologically significant when present in the AOC and there is exposure to contaminants. For all 39 important places and resources, it is relatively clear whether the ecological place or resource is present or absent on the AOC; therefore, the decision process is objective. If no important or significant ecological resource is present at an AOC, the evaluation will not proceed to Level II regardless of the presence of contamination. Instead, the Level I Scoping ERA would acknowledge there are important ecological places, but that those resources are not ecologically significant and no further evaluation is required.

Management Goals for the AOC – Regardless of whether the evaluation is concluded at Level I or continues to Level II, there is another level of environmental protection for Atlas Scrap Yard through the natural resource management goals expressed in the INRMP (OHARNG 2008). The U.S. Army is required to monitor ecological conditions to maintain or enhance the current integrity of the natural resources and ecosystem. While the monitoring focuses on the potential adverse effects from training activities, degradation from contamination would be noticed as well.

Some natural resources management goals of OHARNG (listed in Appendix Table H-3) benefit Atlas Scrap Yard, including Goal 1 which requires management of natural resources to be compatible with the military mission, and Goal 5 which requires the U.S. Army to sustain usable training lands and native natural resources by implementing a natural resource management plan that incorporates invasive species management and utilizes native species mixes for revegetation after ground disturbance activities. These management goals help detect degradation (whether from training activities or historical contamination). While the applicability of the remaining nine management goals to Atlas Scrap Yard varies, all of the management goals are intended to monitor, maintain, or enhance the facility's natural resources and ecosystem. Additionally, these goals are for managing all types of resources at and near Atlas Scrap Yard; however they do not affect decisions concerning the presence or absence of important or significant ecological places or resources.

Important Places and Resources – Ecological importance means a place or resource that exhibits a unique, special, or other attribute that makes it of great value. Examples of important places and resources include wetlands, terrestrial areas used for breeding by large or dense aggregations of animals, and habitat of state-listed or federally listed species. An important resource becomes significant when found on an AOC and there is contaminant exposure. The wetlands at Atlas Scrap Yard are important/significant ecological resources.

Terrestrial Resources – Atlas Scrap Yard is dominated by terrestrial resources, as described below.

Habitat Descriptions and Species. The INRMP and AOC visits by SAIC scientists indicated Atlas Scrap Yard consisted of five vegetation types (Figure 7-1). Atlas Scrap Yard is dominated by dry, early-successional, herbaceous field (HU1) in the central part of the habitat area. Four other vegetation types are present at the AOC: dry, late-successional, cold-deciduous shrubland (SU2) along the western side and southwestern corner of the habitat area; red maple (*Acer rubrum*) successional forest (FU4) in the northwest corner and southern boundary of the habitat area; pin oak (*Quercus palustris*)/swamp white oak (*Quercus bicolor*) seasonally flooded forest alliance (FL4) in the northeastern corner and center of the habitat area; and cattail (*Typha angustifolia*, *T. latifolia*)/bulrush (*Scirpus* spp.) semi-permanently flooded herbaceous alliance (HL4) vegetation in the northeastern corner. This characterization was originally established by a vegetation study using aerial photography and field verification (USACE 1999) and was later used in the INRMP (OHARNG 2008).

On May 18, 2010, SAIC biologists conducted field surveys at Atlas Scrap Yard and determined there have been small changes in vegetation at the AOC since 1999 (USACE 1999), including the conversion of portions of the dry, early-successional, herbaceous field habitat to dry, late-successional, cold-deciduous shrubland. The small cattail-bulrush wetland and large blocks of forested habitat have remained relatively unchanged.

The habitats at Atlas Scrap Yard were assessed to be healthy and functioning, based on May 2010 (Photographs 7-1 and 7-2) observations. Functional habitat was determined by noting the absence of large bare spots and dead vegetation or other obvious visual signs of an unhealthy ecosystem. Additional habitat photographs are provided in Appendix H.

Threatened, Endangered, and Other State-listed or Federally Listed Species. There are no federally listed species or critical habitat on Camp Ravenna. Atlas Scrap Yard has not been previously surveyed for state-listed or federally listed species; however, there have been no documented sightings of state-listed, federally listed, threatened, or endangered species at the AOC (OHARNG 2008).

***Other Terrestrial Resources*.** While there are no known important terrestrial places and resources (Appendix Table H-2), there are other resources at or near Atlas Scrap Yard (e.g., vegetation, animals) that interact in their ecosystems and support nutrient cycling and energy flow. For example, wildlife such as wild turkey (*Meleagris gallopavo*) and white-tailed deer (*Odocoileus virginianus*) could use the area. The INRMP provides information about species and habitat surveys at Camp Ravenna (e.g., timber and ecological succession) (OHARNG 2008). There are no other reported surveys of habitats and wildlife at Atlas Scrap Yard beyond those summarized in the INRMP (OHARNG 2008).

Aquatic Resources – Atlas Scrap Yard has aquatic resources. There are no ponds or streams at the AOC; however, nine wetlands (described below) are present at Atlas Scrap Yard.

Habitat Descriptions and Species. As noted, the only aquatic resources at Atlas Scrap Yard are wetlands. Surface water flows intermittently in small drainage ditches bordering the roads (Figure 3-1). These ditches are dry during most of the year; however, stagnant water was observed during April and May 2010 in the drainage ditch parallel to Paris-Windham Road because storm water runoff could not drain from this conveyance due to downstream beaver dams obstructing surface water flow.

Precipitation data from Camp Ravenna are provided in Section 3.5. The storm frequency is 35 days per year, and precipitation occurs 154 days per year. This is a sufficient amount of precipitation to create and maintain wetlands at Atlas Scrap Yard.

Wetlands. Wetlands are important resources with water-saturated soil or sediment and plant life that can survive saturation. Wetlands are home to many different species and are also chemical sinks that can serve as detoxifiers and natural water purifiers. Nine wetlands are present within the AOC (Figure 7-1). Eight of the nine wetlands at the AOC are ephemeral; they contain standing water only for relatively short periods of time following rain events and are not expected to support aquatic biota or aquatic plants that cannot survive persistent dry conditions. Per the definitions in the FWCUG Report, the media in these wetlands are considered soil. One of the wetlands (Wetland 1) holds water more frequently but not permanently.

There are nine planning level survey [i.e., based on desktop surveys conducted for the OHARNG of wetland data and resources (e.g., National Wetlands Inventory maps, aerials)] wetlands and wetland complexes at Atlas Scrap Yard (Figure 7-1). No jurisdictional wetlands determination has been conducted at this AOC. For any wetland at the AOC potentially affected by remedial activities, a jurisdictional determination by USACE would be required to determine the regulatory status.

An SAIC Professional Wetland Scientist used the Ohio Rapid Assessment Method (ORAM) (Ohio EPA 2001) in May 2010 to assess the condition of the wetlands discussed at the Atlas Scrap Yard (Appendix Figures H-1 through H-9). The ORAM evaluation included the total area of a wetland or wetland complex, not just the portion of a wetland within the AOC boundary.

Using the ORAM, wetlands are classified into three categories:

- Category 1 wetlands are described as “limited quality waters.” They are considered to be a resource that has been degraded, has limited potential for restoration, or is of such low functionality that lower standards for avoidance, minimization, and mitigation can be applied. Scores range from 1 to 29.
- Category 2 includes wetlands of moderate quality and wetlands that are degraded but exhibit reasonable potential for restoration. Scores range from 30 to 59.
- Category 3 includes wetlands of very high quality and wetlands of concern regionally and/or statewide, such as wetlands that provide habitat for species listed as threatened or endangered. Scores range from 60 to 100.

The field sheets detailing the ORAM at Atlas Scrap Yard are presented in Appendix Figures H-1 through H-9. Table 7-10 summarizes ORAM scores and other characteristics for each wetland at Atlas Scrap Yard. Figure 7-1 shows the locations of the wetlands.

Wetland 1: Wetland 1 is a small wetland complex that covers 0.5 acres in the northeastern corner of the AOC. The wetland is located entirely within Atlas Scrap Yard. This area is more frequently inundated than other Atlas Scrap Yard wetlands and is surrounded by seasonally flooded forested habitat. Relief at this portion of the AOC slopes downward to a topographic low in the central-eastern boundary of the AOC leading to the ditch along Paris-Windham Road. Based on the ORAM, Wetland 1 is classified as Category 2 (with a final score of 49), which indicates moderate wetland quality with some minor impairment of wetland functions and conditions (Appendix Figure H-1).

Wetland 2: Wetland 2 is a very small, seasonally flooded/saturated 0.05-acre emergent/scrub-shrub wetland located near the eastern boundary, within 200 ft of Paris-Windham Road. The wetland is located entirely within Atlas Scrap Yard. The scrub-shrub habitat in Wetland 2 has developed in recent years as disturbance from mowing has diminished. The wetland has also increased in size over time, largely as a result of beaver dams built downstream within and north of Load Line 12. The downstream beaver dams obstruct surface water flow, resulting in periodic ponding of water at Atlas Scrap Yard. Topographic relief at this portion of the AOC slopes downward to the ditch along Paris-Windham Road. When the beaver dams do not obstruct surface water flow, surface water in the ditch flows through Load Line 12, Upper and Lower Cobbs Ponds, and ultimately to Sand Creek a few thousand feet north of Atlas Scrap Yard. Based on the ORAM, Wetland 2 is classified as Category 1 (with a final score of 29), which indicates low wetland quality with some impairment of wetland functions and conditions (Appendix Figure H-2).

Wetland 3: Wetland 3 is a very small (0.05 acres), seasonally flooded/saturated forested wetland near the southeastern corner of Atlas Scrap Yard. The wetland is located entirely within Atlas Scrap Yard. Topographic relief at this portion of the AOC slopes downward to a ditch along Paris-Windham Road. Surface water in the ditch flows through Load Line 12, Upper and Lower Cobbs Ponds, and ultimately to Sand Creek a few thousand feet north of Atlas Scrap Yard. Based on the ORAM, Wetland 3 is classified as Category 2 (with a final score of 33), which indicates moderately good wetland quality with some moderate impairment of wetland functions and conditions (Appendix Figure H-3).

Wetland 4: Wetland 4 is a very small (0.03 acres), seasonally flooded/saturated emergent wetland near the center of Atlas Scrap Yard. The wetland is located entirely within Atlas Scrap Yard. It appears to be an isolated wetland and is the topographic low of the immediate area. There are no ditches or natural conveyances that drain water offsite from this portion of the AOC. Based on the ORAM, Wetland 4 is classified as Category 1 (with a final score of 19), which indicates low wetland quality with some impairment of wetland functions and conditions. It was noted in the May 2010 site visit that Wetland 4 had been disturbed by recent activities at the AOC (Appendix Figure H-4).

Wetland 5: Wetland 5 is a small (0.45 acres), seasonally flooded/saturated scrub-shrub wetland in the north-central part of Atlas Scrap Yard. The wetland is located entirely within Atlas Scrap Yard. It appears to be an isolated wetland and is the topographic low of the immediate area. There are no ditches or natural conveyances that drain water offsite from this portion of the AOC. Based on the ORAM, Wetland 5 is classified as Category 1 (with a final score of 25), which indicates low wetland quality with some impairment of wetland functions and conditions. It was noted in the May 2010 site visit that Wetland 5 was disturbed by recent demolition activities at the AOC (Appendix Figure H-5).

Wetland 6: Wetland 6 is a seasonally flooded/saturated forested wetland in the northwestern corner of the AOC, adjacent to Newton Falls Road. The wetland is 3.35 acres, but only 0.1 acres are inside Atlas Scrap Yard. The remainder of the wetland complex extends west of the AOC. Wetland 6 slopes downward to a topographic low north of the AOC to the ditch along Newton Falls Road. Water in this ditch ultimately drains north through a series of off-site drainage ditches, ultimately to Sand Creek, located a few thousand feet north of the AOC. Based on the ORAM, Wetland 6 is classified as Category 2 (with a final score of 37), which indicates moderate wetland quality with some moderate impairment of wetland functions and conditions (Appendix Figure H-6).

Wetland 7: Wetland 7 is a small (0.39 acres), seasonally flooded/saturated, emergent wetland in the northeast corner of the AOC at the intersection of Newton Falls Road and Paris-Windham Road. The wetland is located entirely within Atlas Scrap Yard. Wetland 7 slopes downward to a topographic low east of the AOC to the ditch along Paris-Windham Road. Surface water in the ditch flows through

Load Line 12, Upper and Lower Cobbs Ponds, and ultimately to Sand Creek a few thousand feet north of Atlas Scrap Yard. Based on the ORAM, Wetland 7 is classified as Category 1 (with a final score of 29), which indicates low wetland quality with some impairment of wetland functions and conditions (Appendix Figure H-7).

Wetland 8: Wetland 8 is a moderately large, seasonally flooded/saturated, forested wetland complex along the southern border of the AOC. The wetland is 2.1 acres, but only 1.42 acres are inside Atlas Scrap Yard. The remainder of the wetland complex extends south of the AOC. Wetland 8 slopes to a topographic low, east of the AOC, to the ditch along Paris-Windham Road. Surface water in the ditch flows through Load Line 12, Upper and Lower Cobbs Ponds, and ultimately to Sand Creek a few thousand feet north of Atlas Scrap Yard. Based on the ORAM, Wetland 8 is classified as Category 2 (with a final score of 43), which indicates moderate wetland quality with some moderate impairment of wetland functions and conditions (Appendix Figure H-8).

Wetland 9: Wetland 9 is a small, seasonally flooded/saturated, forested wetland complex along the southern border of the AOC. The wetland is 0.9 acres, but only 0.03 acres are inside Atlas Scrap Yard. The remainder of the wetland complex extends south and west of the AOC. Wetland 9 slopes to a topographic low, east of the AOC, to the ditch along Paris-Windham Road. Surface water in the ditch flows through Load Line 12, Upper and Lower Cobbs Ponds, and ultimately to Sand Creek a few thousand feet north of Atlas Scrap Yard. Based on the ORAM, Wetland 9 is classified as Category 2 (with a final score of 42), which indicates moderate wetland quality with some moderate impairment of wetland functions and conditions (Appendix Figure H-9).

Threatened and Endangered and Other State-listed or Federally Listed Species. There are no federally listed species or critical habitat on Camp Ravenna. Atlas Scrap Yard has not been previously surveyed for state-listed or federally listed threatened or endangered species; however, there have been no documented sightings of state-listed or federally listed threatened or endangered species at the AOC (OHARNG 2008).

Other Aquatic Resources. There are no other known aquatic resources (Appendix Table H-2) at or near the AOC (e.g., vegetation, animals). There are no other reported surveys of aquatic habitats and wildlife at Atlas Scrap Yard beyond those summarized in the INRMP (OHARNG 2008).

Ecosystem and Landscape Roles and Relationships – Four spatial areas were evaluated to assess the ecosystem and landscape roles and relationships: the AOC, the vicinity of the AOC, the entire Camp Ravenna, and the northeastern or ecoregion of Ohio. Information about the first spatial area (the AOC) is provided in the terrestrial and aquatic resources subsections above.

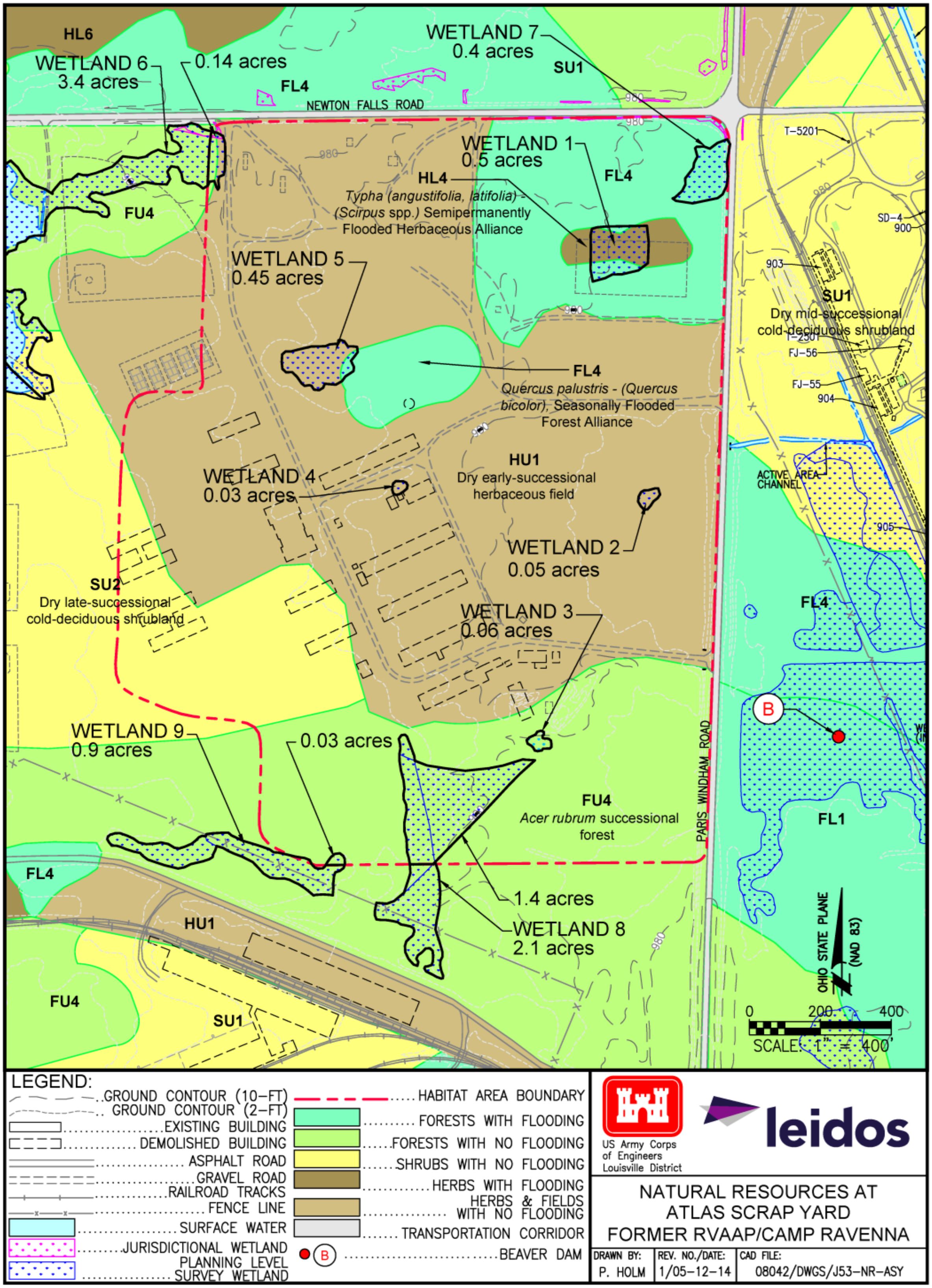

Figure 7-1. Natural Resources (OHARNG 2008) at Atlas Scrap Yard

Photograph 7-1. Habitat of Herbaceous and Shrubland Fields in Foreground and Forest in Background at Atlas Scrap Yard (looking southeast from access road, May 17, 2010)

Photograph 7-2. Oak Forest Vegetation (looking south from Newton Falls Road, May 17, 2010)

Table 7-10. Wetlands (OHARNG 2008) at Atlas Scrap Yard

Wetland ID	Wetland Type[a]	Total Wetland Size	ORAM Score	ORAM Category
Wetland 1	PEM1E/PFO1E	0.5 acre	49	2
Wetland 2	PEM1E/PSS1E	0.05 acre	29	1
Wetland 3	PFO1E	0.05 acre	33	2
Wetland 4	PEM1E	0.03 acre	19	1
Wetland 5	PSS1E	0.45 acre	25	1
Wetland 6	PFO1E	3.35 acres	37	2
Wetland 7	PEM1E	0.39 acre	29	1
Wetland 8	PFO1E	2.1 acres	43	2
Wetland 9	PFO1E	0.9 acre	42	2

[a] Cowardin Classification: PEM1E = palustrine, persistent emergent, seasonally flooded/saturated; PSS1E = palustrine, broad-leaved deciduous, scrub-shrub, seasonally flooded/saturated; PFO1E = palustrine, broad-leaved deciduous, forested, seasonally flooded/saturated.

ID = Identification.

ORAM = Ohio Rapid Assessment Method.

Vicinity of the AOC. Six vegetation communities border Atlas Scrap Yard (Figure 7-1), including herbaceous field, shrubland, and forest communities similar to the vegetation observed at the AOC. There are no apparent differences in habitat quality of these plant communities inside or outside of the AOC. For example, the dry, herbaceous fields extend several hundred feet beyond the western AOC boundary. The red maple successional forest extends a few hundred feet beyond the southern boundary. Pockets of the pin oak/swamp white oak, seasonally flooded forest alliance occur to the north and across Paris-Windham Road to the east. These types and qualities of habitat are not unique and can be found at many other areas within Camp Ravenna.

Figure 7-1 shows there are nine wetlands inside the AOC. Other wetlands of varying sizes are located near the eastern, western, and northern boundaries of the habitat area.

The closest recorded state-listed or federally listed species [four-toed salamander (*Hemidactylium scutatum*)] is located approximately 400 ft north of the AOC (Table 7-11) (OHARNG 2008); it is a state species of concern. The next closest state-listed species [least flycatcher (*Empidonax minimus*)], is located approximately 850 ft west of the AOC, and is threatened.

No beaver dams are located in the AOC. There are three beaver dams near the AOC (400 ft east, 700 ft east, and 700 ft north) but their existence may be ephemeral. Although there is no 100-year floodplain within the AOC, there is 100-year floodplain along the unnamed tributary from Load Line 3 to Upper Cobbs Pond, approximately 1,500 ft northeast of Atlas Scrap Yard. There are biological and water quality stations in Upper and Lower Cobbs Ponds, 3,100 and 4,000 ft downstream of the AOC.

The Entire Camp Ravenna. The habitat area at Atlas Scrap Yard is approximately 73 acres, which represents 0.33% of the total area of Camp Ravenna (21,683 acres). There are five types of vegetation at Atlas Scrap Yard that are also found throughout Camp Ravenna. There are approximately 3,510 acres of FU4 vegetation type (red maple successional forest) (OHARNG 2008), representing 16.2% of the habitat at Camp Ravenna. There are approximately 2,050 acres of HU1 vegetation type – dry, early successional herbaceous field vegetation [e.g., goldenrod (*Solidago* spp.) and clasping-leaf dogbane (*Apocynum cannabinum*)] (OHARNG 2008), representing 9.5% of the habitat at Camp Ravenna. There are approximately 980 acres of FL4 vegetation type (pin oak/swamp white oak forest alliance) (OHARNG 2008), representing 4.5% of the habitat at Camp Ravenna. There are approximately 662 acres of SU2 vegetation type (red maple successional forest) (OHARNG 2008), representing 3.1% of the habitat at Camp Ravenna. There are approximately 169 acres of HL4 vegetation type (semi-permanently flooded cattail/bulrush alliance) (OHARNG 2008), representing 0.8% of the habitat at Camp Ravenna. In addition to the five types of vegetation, there are approximately 1,970 acres of jurisdictional and "planning level survey" wetlands (as defined in the INRMP) (OHARNG 2008), representing 9.1% of the habitat at Camp Ravenna. These types of resources are abundant at Camp Ravenna and are not unique to Atlas Scrap Yard.

Table 7-11. Survey of Various Ecological Resources in Proximity to the AOC

Natural Resource	Inside Habitat Area	Near the AOC	Distances to Nearest Resources and Comments[a]
Wetlands (planning level survey and jurisdictional)	Five medium-quality (Category 2) wetlands and four low-quality (Category 1) wetlands	Many other wetlands are in vicinity of AOC (Figure 7-1)	Many other wetlands are in vicinity of AOC (Figure 7-1)
State-listed or federally listed species	No known sightings	None	Nearest occurrence 400 ft north of AOC. Additional state-listed species occurred 850 ft to the west of AOC. See text for species names
Beaver dams	None	Three beaver dams are in the vicinity; two dams are east of the AOC within Load Line 12, one dam is north of the AOC	Closest beaver dam is 400 ft east. Other dams are 700 ft east and 700 ft north
100-year floodplain	None	None	Floodplain along tributary to Upper Cobbs Pond approximately 1,500 ft northeast
Stream sampling[b]	None	None	Nearest stream station is at Load Line 4, approximately 2,045 ft southwest on tributary to Mahoning River. Surface water from the AOC does not drain to the Mahoning River watershed where the station is located
Pond sampling[b]	None	None	Nearest pond station is at Load Line 4 Pond 2,000 ft southwest of the AOC. The AOC does not contribute to this pond where the station is located. The nearest downgradient pond station is at Upper Cobbs Pond 3,100 ft northeast of the AOC

[a] Measurements of distance and direction are taken from the nearest boundary of the AOC to the resource being measured.

[b] Stream and pond sampling refers to *Facility-Wide Biological and Water Quality Study 2003* (USACE 2005a).

AOC = Area of Concern.

Ecoregion. In the area surrounding Camp Ravenna, forests occupy a high percentage of the terrain. Ohio's forests cover approximately 8,000,000 acres or 30% of the state (USDA 2009). The Erie/Ontario Drift and Lake Plain ecoregion are located in the northeastern part of Ohio and exhibit rolling to level terrain formed by lacustrine and low lime drift deposits. Lakes, wetlands, and swampy streams occur where stream networks converge or where the land is flat and clayey (USEPA 2011). The United States Forest Service has a Forest Inventory Data Online tool that was queried for the forest types in the surrounding counties in or near Camp Ravenna (USFS 2011). In 2009, approximately 11,340 acres of forest type FL4 and 265,290 acres of forest type FU4 were found throughout northwestern Ohio in Cuyahoga, Geauga, Mahoning, Portage, Stark, Summit, and Trumbull counties that surround Camp Ravenna (USFS 2011). The herbaceous field and shrubland were not individually found in this query because it is not classified as a main group of trees in the forest inventory data tool. However, herbaceous communities (HL4 and HU1) are common across the ecoregion (USDA 2011). Late-successional, cold-deciduous shrubland (SU2) across the ecoregion comprise 171,380 acres (USFS 2011). Wetlands across the ecoregion comprise 207,800 acres (USEPA 1999). Thus, the vegetation communities and wetlands at Atlas Scrap Yard are also found in the surrounding counties in the ecoregion of northeastern Ohio.

In summary, the current vegetation types of: (1) pin oak/swamp white oak; seasonally flooded forest alliance; (2) red maple, successional forest; (3) dry, early-successional, herbaceous field; (4) dry, late-successional, cold-deciduous shrubland; and (5) cattail/bulrush, semi-permanently flooded, herbaceous alliance are found in the vicinity of Atlas Scrap Yard. In addition to the five types of vegetation, wetlands are also found in the vicinity of Atlas Scrap Yard. The two forest alliance types, two herbaceous vegetation types, shrublands, and wetlands are in abundance at Camp Ravenna and the larger surrounding local ecoregion. There is no known unique resource at Atlas Scrap Yard that cannot be found in the immediate vicinity of the AOC, Camp Ravenna, and in a large part of the ecoregion of northeastern Ohio.

7.3.2.4 Evaluation of Historical Chemical Contamination and Ecological Significance

There were 25 COPECs for surface soil identified in the historical ERA as part of the Characterization of 14 AOCs: 14 inorganic chemicals (aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc), one pesticide (aroclor-1260), six organic chemicals [4-methylphenol, benzo(a)pyrene, bis(2-ethylhexyl) phthalate, butylbenzyl phthalate, dibenzofuran, and naphthalene], three explosives (2-amino-4,6-DNT; 2-nitrotoluene; and 3-nitrotoluene), and one propellant (nitrocellulose) (Section 7.3.2.2).

The U.S. Army and Ohio EPA provide a checklist of important ecological places and resources to determine if such ecological resources are present in an AOC and nearby. There are wetlands at the AOC. OHARNG environmental management goals and objectives are applicable to Atlas Scrap Yard, including Goal 1 requiring management of natural resources to be compatible with the military mission, and Goal 5 requiring the U.S. Army to sustain usable training lands and native natural resources by implementing a natural resource management plan, which incorporates invasive species management, and by utilizing native species mixes for revegetation after ground disturbance activities.

Atlas Scrap Yard is made up of approximately 73 acres of herbaceous field, shrubland, forest, and bulrush/cattail wetlands. Current forest communities consist of pin oak/swamp white oak and red maple successional forest alliances. Additional wetlands, drainage ditches, natural conveyances, and low lying areas are found at the AOC. The vegetation types and wetlands at Atlas Scrap Yard are also found nearby, at Camp Ravenna, and in the ecoregion.

Because there is contamination and important or ecologically significant resources at Atlas Scrap Yard (i.e., wetlands), this ERA will continue to a Level II Screening Level ERA.

7.3.3 Level II: Screening Level Ecological Risk Assessment

The Level II method follows the guidance documents listed in Section 7.3.1 and identifies evaluation procedures used for problem formulation and ecological effects evaluation to determine AOC-related COPECs. This work includes defining habitats/environmental setting, suspected contaminants, possible pathways, and mechanisms for ecotoxicity and contaminant transport. Level II also includes establishing screening values.

In addition, technical and refinement factors can be used to assess outcomes of the above procedures. The factors include using mean exposure concentrations and discussing approved ESVs, wetland quality at the AOC, and other topics that evaluate and refine COPECs from the Level II Screening ERA. This type of assessment is called Step 3A in the ERA process (USEPA 1997).

7.3.3.1 Generic Ecological Conceptual Exposure Model

The Conceptual Site Exposure Model (CSEM) identifies the interconnections of contaminant sources and transport mechanisms for contaminant migration through the environment to the receptors. The CSEM provides an understanding of the relationships of all sources, release and transport pathways, potential exposure media, and receptors. The CSEM includes:

- **Source Media –** Based on historical AOC information, operations associated with various former buildings at Atlas Scrap Yard are the contaminant source. The operations contributed chemicals to the surrounding soil and perhaps to the nearby wetlands that contain sediment and surface water.
- **Transport Mechanisms –** Contaminants in soil can migrate via erosion and leaching. Migration to temporary sediment and temporary surface water via erosion is controlled by the amount of precipitation, type of ground cover, and topography of the AOC. Little erosion is expected to occur at the AOC because the land is relatively flat and has extensive vegetative cover. This extensive vegetative cover includes herbaceous fields, shrublands, forests, and wetlands. Much of the precipitation landing in this area is expected to leach to the soil, and some precipitation would be absorbed into the wetlands.

- **Exposure Media –** Exposure media are media where contaminants are available for exposure to ecological receptors. Potential exposure media at Atlas Scrap Yard are soil, vegetation, and animals.
- **Exposure Pathways –** A main exposure pathway is ingestion of contaminated food. Other pathways may include ingestion of soil and dermal contact by receptors with soil.
- **Ecological Receptors –** A variety of ecological receptors, such as terrestrial birds and mammals, are present in the area. Receptors associated with various published toxicological endpoints (e.g., reproduction, physiology) are assumed to represent these various plants and animals.

7.3.3.2 Habitats and Species (Including Generic Receptors)

Habitats and species were defined in the Level I ERA (Section 7.3.2). For example, five types of habitats were described. Habitats, species, and other resources were analyzed, and it was determined that important or significant ecological resources are present at Atlas Scrap Yard and in its vicinity. Wetlands are present at the AOC. Contamination is present; therefore, a Level II analysis is needed. Level II assumes ecological receptors are sensitive to various chemicals based on a variety of toxicological data from field-observed effects and laboratory tests.

7.3.3.3 Procedure to Identify COPECs

The screening level approach to evaluate sample results from the PBA08 RI followed a similar approach used in the historical ERA. Section 5.1 details chemical concentration data. The PBA08 RI evaluation uses ISM soil data collected during the PBA08 RI and ISM soil data used in the historical ERA. The PBA08 RI included collecting ISM surface soil (0-1 ft bgs) samples at locations different from the historical soil sample locations, and some samples were co-located with previous samples (Figure 4-1). While 19 discrete surface soil samples were collected during the PBA08 RI, these samples were only used in the nature and extent evaluations. No sediment or surface water samples were collected within Atlas Scrap Yard during the PBA08 RI. This ERA uses updated ESVs that follow the revised *Ecological Risk Assessment Guidance* (Ohio EPA 2008), as provided in Appendix Table H-4.

The MDC of each chemical is compared to its respective facility-wide background concentration. Chemicals are not considered site-related if the MDC is below the background concentration. For all chemicals detected above background concentrations, the MDC is compared to the chemical-specific ESV. In addition to the ESV comparison, it was determined if the chemical is a PBT compound. Chemicals are retained as COPECs if they exceed background concentrations and the ESV, if the chemical exceeds background concentrations and had no toxicity information (i.e., ESV), or if the chemical is considered a PBT compound. Ratios of MDC to ESV are used to determine the integrated COPECs that result from the combined current and historical datasets. A ratio greater than one suggests a possible environmental consequence; any chemicals with ratios greater than one are identified as integrated COPECs.

Maximum Detected Concentrations – The MDCs were compared to background concentrations and ESVs for each detected chemical. These comparisons are provided in Appendix Table H-5 for surface soil.

Ecological Screening Values – Although the historical ERA used ESVs from the 2003 version of the *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2003), this ERA uses updated ESVs from the 2008 version of this guidance document. The hierarchy for soil is Ecological Soil Screening Levels (EcoSSLs), PRGs, and environmental screening levels. Appendix Table H-4 provides for values and sources for ESVs.

7.3.3.4 Integrated COPECs for Soil (0-1 ft bgs)

During the PBA08 RI, 60 chemicals were detected in surface soil. Five chemicals (calcium, iron, magnesium, potassium, and sodium) were essential nutrients and were excluded as SRCs, as described in Section 5.1. Sixteen detected inorganic chemicals and 37 organic chemicals were determined to be SRCs because they either exceeded background concentrations or did not have an associated background concentration for comparison. Of the 53 SRCs, 12 inorganic chemicals (aluminum, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, selenium, silver, and zinc) and six organic chemicals [2,6-DNT, benz(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, chrysene, and naphthalene] exceeded their ESVs and are identified as integrated COPECs (Table 7-12). Butylbenzylphthalate has a ratio of 1.00 and will not be included as an integrated COPEC. In addition, nine organic chemicals (2-amino-4,6-DNT; 2-nitrotoluene; 3-nitrotoluene; 4-amino-2,6-DNT; HMX; nitrocellulose; tetryl; carbazole; and dibenzofuran) were selected as COPECs because they do not have an ESV. Besides exceeding the ESV, mercury is also a PBT compound. While PCB-1260 did not exceed the ESV, it is identified as an integrated COPEC because it is a PBT compound. The calculated ratio of MDC to ESV is shown in Table 7-12 for each integrated COPEC. Appendix Table H-5 presents the details of the ESV comparisons for surface soil.

Most of the 28 surface soil COPECs reported in the historical ERA (Table 7-9) are also identified in the current ERA. The Characterization of 14 AOCs identified four COPECs (barium, iron, nickel, and 4-methylphenol) that are not integrated COPECs. Barium, nickel, and 4-methylphenol were below the new ESVs (Ohio EPA 2008, Appendix Table H-4) and iron was considered an essential nutrient in the integrated COPEC screen. Eight new COPECs [cobalt; 2,6-DNT; 4-amino-2,6-DNT; HMX; tetryl; benz(a)anthracene; carbazole; and chrysene] are identified in the PBA08 RI data. The addition of cobalt is due to updated, more conservative ESVs. The addition of 2,6-DNT; 4-amino-2,6-DNT; HMX; tetryl; and carbazole is due to lack of screening values. Based on the presence of integrated COPECs, this ERA predicts a potential for ecological risk in surface soil.

7.3.3.5 Integrated COPECs for Sediment

No historical or PBA08 RI sediment samples were collected at the AOC because this medium was not present.

Table 7-12. Summary of Integrated COPECs for Surface Soil

COPEC	Maximum Concentration (mg/kg)	ESV (mg/kg)	Ratio of Maximum to ESV	Comments
Aluminum	32100	50	642	None
Arsenic	41	18	2.28	None
Cadmium	9.5	0.36	26.39	None
Chromium	64	26	2.46	None
Cobalt	19	13	1.46	None
Copper	200	28	7.14	None
Lead	1200	11	109.09	None
Manganese	3600	220	16.36	None
Mercury	0.64	0.00051	1254.90	PBT Compound
Selenium	2.9	0.52	5.58	None
Silver	5.2	4.2	1.24	None
Zinc	1800	46	39.13	None
2,6-Dinitrotoluene	0.13	0.0328	3.96	None
2-Amino-4,6-dinitrotoluene	0.1	No ESV	--	COPEC because no ESV
2-Nitrotoluene	0.43	No ESV	--	COPEC because no ESV
3-Nitrotoluene	0.12	No ESV	--	COPEC because no ESV
4-Amino-2,6-dinitrotoluene	0.21	No ESV	--	COPEC because no ESV
HMX	0.016	No ESV	--	COPEC because no ESV
Nitrocellulose	4.2	No ESV	--	COPEC because no ESV
Tetryl	0.14	No ESV	--	COPEC because no ESV
Benz(a)anthracene	17	5.21	3.26	None
Benzo(a)pyrene	20	1.52	13.16	None
Bis(2-ethylhexyl)phthalate	1.5	0.925	1.62	None
Carbazole	0.44	No ESV	--	COPEC because no ESV
Chrysene	30	4.73	6.34	None
Dibenzofuran	0.51	No ESV	--	COPEC because no ESV
Naphthalene	1.4	0.0994	14.08	None
PCB-1260	0.17	0.371	0.46	PBT Compound

Table excludes nutrients.
COPEC = Chemical of Potential Ecological Concern.
ESV = Ecological Screening Value.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
mg/kg = Milligrams per kilogram.
PBT = Persistent, Bioaccumulative, and Toxic.
PCB = Polychlorinated Biphenyl
x = Multiplier.

7.3.3.6 Integrated COPECs for Surface Water

No historical or PBA08 RI surface water samples were collected at the AOC because this medium was not present.

7.3.3.7 Step 3A: Refinement of Integrated COPECs

Step 3A refines the list of integrated COPECs to determine if: (1) there are final COPECs requiring further evaluation in Level III or remediation to protect ecological receptors; or (2) integrated COPECs can be eliminated from further consideration. This section applies and evaluates refinement factors to the integrated COPECs for the AOC. This evaluation is an important part of Level II and is adapted from USEPA Step 3A, outlined in the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA 1997) and *Risk Assessment Handbook Volume II: Environmental Evaluation* (USACE 2010b). The purpose of Step 3A is stated as follows by the U.S. Army (BTAG 2005):

> *"The results of Step 3A will be used to determine if threats to ecological receptors are negligible and an appropriate risk management decision may be made to end the ERA process, or potential threats are still indicated and a baseline ERA should be initiated."*

The evaluation and refinement factors used in Step 3A include:

- Comparing the average (i.e., mean) concentration to ESV;
- Comparing the mean concentration to background concentration;
- Comparing the background concentration to ESV;
- Evaluating the frequency of chemical occurrence relative to ESV;
- Evaluating the magnitude of ESV exceedance (ratio of ESV to chemical concentrations);
- Discussing Ohio EPA approved and preferred ESVs;
- Categorizing wetland quality inside the AOC;
- Evaluating geographical relationship of on-site wetlands to AOC exceedance area;
- Providing information about on-site migration of chemicals to on-site wetlands; and
- Evaluating off-site migration of chemicals at biological/water quality stations.

There are 28 integrated COPECs identified in soil at Atlas Scrap Yard. Aluminum; arsenic; cadmium; chromium; cobalt; copper; lead; manganese; mercury; selenium; silver; zinc; 2,6-DNT; benz(a)anthracene; benzo(a)pyrene; bis(2-ethylhexyl)phthalate; chrysene; and naphthalene are the 18 integrated COPECs that exceeded their background concentrations and ESVs. Nine chemicals (2-amino-4,6-DNT; 2-nitrotoluene; 3-nitrotoluene; 4-amino-2,6-DNT; HMX; nitrocellulose; tetryl; carbazole; and dibenzofuran) are integrated COPECs because they do not have an ESV. Mercury and PCB-1260 are also PBT compounds.

Chemicals with no ESVs are discussed later in Step 3A and in the uncertainty section (Section 7.3.3.9). PBT compounds are discussed later in Step 3A. All integrated COPECs that have an MDC to ESV ratio greater than one are evaluated based on a series of evaluation or refinement factors. The first four evaluation and refinement factors are organized to compare key quantitative information and are listed below.

- Compare average or mean concentration to ESV;
- Compare mean concentration to background concentration;
- Compare background concentration to ESV; and
- Evaluate frequency of chemical occurrence relative to ESV.

Multiple evaluation factors can be used to define whether an integrated COPEC should be retained or eliminated from further consideration. There are two types of comparisons and associated decisions in the first steps of the refinement process (Table 7-13).

Table 7-13. Application and Decisions of Selected Evaluation Factors to Integrated COPECs for Surface Soil from Level II

Action	Condition for Decision to Dismiss or Retain COPEC	Outcome
Compare mean concentration to ESV	(A) Mean concentration smaller than or equal to the ESV	COPEC is not a candidate to be a final COPEC. Evaluation ceased.
	(B) Mean concentration larger than the ESV	Continue evaluation of chemical.
Compare mean concentration above ESV to background concentration	(A) Mean concentration smaller than the background concentration	COPEC is not a candidate to be a final COPEC. Evaluation ceased.
	(B) Mean concentration larger than background concentration	Continue evaluation of chemical.

COPEC = Chemical of Potential Ecological Concern.
ESV = Ecological Screening Value.

Comparing background concentrations to ESVs is also an important consideration in this part of the evaluation. Additionally, frequency of detection is provided. The evaluations are presented by type of decision on a COPEC-by-COPEC basis (Table 7-14). These evaluations are followed by applying additional evaluation and refinement factors, when necessary.

Comparison of Mean Concentration to ESV – Seven integrated COPECs [arsenic, chromium, cobalt, copper, silver, benz(a)anthracene, and chrysene] in soil are eliminated in this step because the mean concentration is smaller than the ESV (Appendix Table H-6). Each eliminated integrated COPEC is discussed relative to the mean concentration being smaller than the ESV and the related evaluation and refinement factors. Table 7-14 shows the relevant data and various comparisons.

Arsenic**.** Arsenic was detected in all 65 ISM samples analyzed for inorganic chemicals at Atlas Scrap Yard. Only two samples had detections above the background concentration and the ESV (Table 7-14). Although the MDC for arsenic in surface soil exceeds the background concentration and ESV, the mean concentration is less than both the ESV and background concentrations. Therefore, arsenic is eliminated from further consideration and will not be a final COPEC.

Chromium. Chromium was detected in all 65 ISM samples analyzed for inorganic chemicals at Atlas Scrap Yard. Forty-six samples had detections above the background concentration, and only 11 samples had chromium concentrations exceeding the ESV (Table 7-14). Although the MDC for chromium in surface soil exceeds the background concentration and ESV, the mean concentration is less than the ESV. Therefore, chromium is eliminated from further consideration and will not be a final COPEC.

Cobalt. Cobalt was detected in all 65 ISM samples analyzed for inorganic chemicals at Atlas Scrap Yard. Four samples had detections above the background concentration, but only two of these samples had cobalt concentrations exceeding the ESV (Table 7-14). Although the MDC for cobalt in surface soil exceeds the background concentration and ESV, the mean concentration is less than the ESV and close to background concentration. Therefore, cobalt is eliminated from further consideration and will not be a final COPEC.

Copper. Copper was detected in all 65 ISM samples analyzed for inorganic chemicals at Atlas Scrap Yard. Only fourteen samples had detections above the background concentration, and only six samples had copper concentrations exceeding the ESV (Table 7-14). Although the MDC for copper in surface soil exceeds the background concentration and ESV, the mean concentration is less than the ESV. Therefore, copper is eliminated from further consideration and will not be a final COPEC.

Silver. Silver was detected in 39 of 65 ISM samples analyzed for inorganic chemicals at Atlas Scrap Yard. All 39 samples had detections above the background concentration, but only two samples had silver concentrations exceeding the ESV (Table 7-14). Although the MDC for silver in surface soil exceeds the background concentration and ESV, the mean concentration is less than the ESV. Therefore, silver is eliminated from further consideration and will not be a final COPEC.

Benz(a)anthracene. Benz(a)anthracene was detected in all 38 ISM samples. There is no background concentration for comparison, but only six samples had benz(a)anthracene concentrations exceeding the ESV (Table 7-14). Although the MDC for benz(a)anthracene in surface soil exceeds the ESV, the mean concentration is less than the ESV. Therefore, benz(a)anthracene is eliminated from further consideration and will not be a final COPEC.

Chrysene. Chrysene was detected in all 38 ISM samples. There was no background concentration for comparison, but only eight samples had chrysene concentrations exceeding the ESV (Table 7-14). Although the MDC for chrysene in surface soil exceeds the ESV, the mean concentration is less than the ESV. Therefore, chrysene is eliminated from further consideration and will not be a final COPEC.

Of the 18 integrated soil COPECs with MDCs exceeding the ESV, arsenic, chromium, cobalt, copper, silver, benz(a)anthracene, and chrysene were eliminated from further consideration because the mean concentration is smaller than the ESV. Eleven remaining integrated COPECs with MDCs greater than the ESV [aluminum; cadmium; lead; manganese; mercury; selenium; zinc; 2,6-DNT; benzo(a)pyrene; bis(2-ethylhexyl)phthalate; and naphthalene] in surface soil have mean concentrations larger than the ESV.

Comparison of Mean Concentration Above ESV to Background Concentration – Three integrated COPECs in surface soil (aluminum, manganese, and selenium) are eliminated in this step because the mean concentrations are larger than the ESVs but smaller than the background concentrations. Aluminum, manganese, and selenium are discussed relative to the various evaluation and refinement factors.

Aluminum. Aluminum in surface soil has a mean concentration less than the background concentration (Table 7-14). The background concentration is more than 350 times greater than the

ESV, so the ESV can be considered conservative. Although aluminum was detected in all 65 ISM samples at concentrations above the ESV, only seven samples had detections exceeding the background concentration. Having only seven samples exceed the background concentration suggests the concentration of aluminum in surface soil is not likely a concern. Additionally, aluminum is not likely a concern because the soil pH is too high to dissociate the chemical. A typical soil pH is 6.0-7.0 at one of the nearby load lines (USACE 2004). Regarding aluminum chemistry and ecological risk in soil, the USEPA states, “aluminum is identified as a COPC only for soil with a pH less than 5.5” (USEPA 2003a). Therefore, because the mean concentration is less than the background concentration, the ESV is rather conservative, and the soil pH at Camp Ravenna is higher than the USEPA dissociation limit, aluminum is eliminated from further consideration and will not be a final COPEC.

Manganese. Manganese in surface soil has a mean concentration less than the background concentration (Table 7-14). The background concentration is more than 6.5 times greater than the ESV, so the ESV can be considered conservative. Although manganese was detected in 61 of 65 ISM samples at concentrations above the ESV, only 11 samples had detections exceeding the background concentration. Having only 11 samples exceed the background concentration suggests the concentration of aluminum in surface soil is not likely a concern. Therefore, because the mean concentration is less than the background concentration and the ESV is rather conservative, manganese is eliminated from further consideration and will not be a final COPEC.

Selenium. Selenium in surface soil has a mean concentration less than the background concentration (Table 7-14). The background concentration is more than two times greater than the ESV, so the ESV can be considered conservative. Although selenium was detected in 56 of 65 ISM samples at concentrations above the ESV, only nine samples had detections exceeding the background concentration. Having only nine samples exceed the background concentration suggests the concentration of selenium in surface soil is not likely a concern. Therefore, because the mean concentration is less than the background concentration and the ESV is rather conservative, selenium is eliminated from further consideration and will not be a final COPEC.

Continued Evaluations – The remaining eight integrated COPECs [cadmium, lead, mercury, zinc, 2,6-DNT, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, and naphthalene] in soil have mean concentrations greater than the ESV and the background concentration. Each remaining integrated COPEC is presented below and is discussed relative to the first four evaluation and refinement factors and related evaluation and refinement factors.

Cadmium. Cadmium was detected in 58 of 65 ISM samples. All 58 detections were above the background concentration, but only 14 samples had cadmium concentrations exceeding the ESV (Table 7-14). The MDC and mean concentration for cadmium in surface soil exceeds the ESV. Therefore, cadmium requires further evaluation as a COPEC.

Lead. Lead was detected in all 65 ISM samples. It has a mean concentration greater than the background concentration and ESV. It was detected above the background concentration in only 24

ISM samples, but it was detected at concentrations above the ESV in all 65 samples (Table 7-14). This is because the ESV is lower than the background concentration, which indicates the ESV for lead may be conservative. Although the ESV may be conservative, the mean concentration for lead in surface soil exceeds both the background concentration and ESV. Lead requires further evaluation as a COPEC.

Mercury. Mercury was detected in 59 of 65 ISM samples. It has a mean concentration greater than the background concentration and ESV. Mercury was detected above the background concentration in 48 ISM samples, but it was detected at concentrations above the ESV in all 59 samples (Table 7-14). This is because the background concentration is 70 times greater than the ESV, suggesting the ESV may be very conservative. Although mercury has a very conservative ESV, it is a PBT compound, and the mean concentration exceeds the background concentration and ESV. Mercury requires further evaluation as a COPEC.

Zinc. Zinc was detected in all 65 ISM samples. It has a mean concentration greater than the background concentration and ESV. Zinc was detected above the background concentration in only 37 of 65 ISM samples, but it was detected at concentrations above the ESV in 55 samples (Table 7-14). This is because the ESV is lower than the background concentration, which indicates the ESV for zinc may be conservative. Because the mean concentration in surface soil exceeds the background concentration and the ESV, zinc requires further evaluation as a COPEC.

2,6-Dinitrotoluene. 2,6-DNT was detected in only 1 of 65 ISM samples. There was no background concentration for comparison, but the only detected concentration was greater than the ESV (Table 7-14). Because 2,6-DNT was detected at only one location throughout the entire AOC, it is not pervasive. Therefore, 2,6-DNT is eliminated as a COPEC because of the very low frequency of detection.

Benzo(a)pyrene. Benzo(a)pyrene was detected in all 38 ISM samples. There was no background concentration for comparison, but 13 samples had concentrations exceeding the ESV (Table 7-14). The mean concentration for benzo(a)pyrene in surface soil exceeds the ESV. Therefore, benzo(a)pyrene requires further evaluation as a COPEC.

Bis(2-ethylhexyl)phthalate. Bis(2-ethylhexyl)phthalate was detected in 3 of 7 ISM samples. There was no background concentration for comparison, but only one sample had a concentration that exceeded the ESV (Table 7-14). The mean concentration of bis(2-ethylhexyl)phthalate in surface soil slightly exceeds the ESV. Therefore, bis(2-ethylhexyl)phthalate requires further evaluation as a COPEC.

Naphthalene. Naphthalene was detected in 37 of 38 ISM samples. There was no background concentration for comparison, but only 17 samples had naphthalene concentrations exceeding the ESV (Table 7-14). The MDC and mean concentration for naphthalene in surface soil exceeds the ESV. Therefore, naphthalene requires further evaluation as a COPEC.

Additional Aspects of Continued Evaluations – The second refinement factor comparing the mean concentration to background concentration evaluates how much higher the mean soil concentration is compared to the background concentration. Three COPECs (lead, mercury, and zinc) that require further evaluation have mean concentrations higher than their background concentrations. If the degree of difference between the mean concentration and the background concentration is small, the integrated COPEC may not be considered a final COPEC. Table 7-15 shows that while the mean concentration exceeds the background concentration, the exceedance is small in three cases (lead, mercury, and zinc) where background concentrations are available. For example, the mean concentration for lead is 57 mg/kg, while the background concentration is 26.1 mg/kg (i.e., ratio of 2.18).

Additional Technical and Refinement Factors – Additional evaluation and refinement factors include:

- Magnitude of ESV exceedance (ratio of ESV to chemical concentrations); and
- Discussion of Ohio EPA approved and preferred ESVs.

Magnitude of ESV Exceedance. As discussed previously, a ratio greater than one suggests a possible environmental consequence. However, there is not always a linear relationship between increasing media concentrations and increasing toxicity. Thus, COPECs with greater mean concentration to ESV ratios are not necessarily more toxic than those COPECs with lower mean concentration to ESV ratios. However, there is typically greater confidence that minor exceedances are of less concern because the screening values are typically conservative. As a result, the magnitude of exceedance was used as another refinement factor. Accordingly, while the mean concentration to ESV ratios for cadmium (1.42), lead (5.18), mercury (150.20), zinc (2.52), benzo(a)pyrene (2.04), bis(2-ethylhexyl)phthalate (1.04), and naphthalene (1.84) indicate a possibility of risk, five of the ratios are relatively small (Appendix Table H-6).

The small ratios for cadmium, zinc, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, and naphthalene indicate the potential for toxicity is relatively low, and this likely supports elimination of the integrated COPECs. The *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008) states:

> *"If only minor exceedances are detected and other evidence can substantiate, a claim may be made that some or all of the site-associated soils have not been impacted and no additional ecological investigation of the soils is warranted."*

Comparison of Ohio EPA Approved and Preferred ESVs – The *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008) gives specific guidance on selecting media screening values (ESVs) for Level II evaluation. For soil, three possible sources of ESV values are listed in order of preference: (1) USEPA EcoSSLs; (2) *Preliminary Remediation Goals for Ecological*

Endpoints (DOE 1997); and (3) *Region 5 Ecological Screening Levels* (USEPA 2003b). However, it is important to note the preferred source (EcoSSLs) can have up to four values per chemical—one for each receptor type (plants, soil invertebrates, birds, and mammals). Because Ohio EPA does not provide guidance on which value to select of these four, the most conservative (lowest) value was chosen for this ERA. It is possible that the chosen ESV is too conservative. Alternative ESVs are presented below for four of the remaining seven integrated COPECs.

The cadmium ESV used in this ERA is 0.36 mg/kg. This concentration is considered the Ohio EPA approved and preferred ESV for cadmium in accordance with the *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008); the ESV originated from the *Ecological Soil Screening Levels for Cadmium* (USEPA 2005a). The USEPA EcoSSL guidance document is Ohio EPA's preferred source of ESVs (Appendix Table H-4). The cadmium ESV used in this ERA is the most conservative ESV of the USEPA EcoSSLs. Other possible EcoSSLs for cadmium include 0.77 mg/kg, 32 mg/kg, and 140 mg/kg (USEPA 2005a). The ESV of 0.36 mg/kg is more than 10 times lower than the ESV (4.0 mg/kg) from *Preliminary Remediation Goals for Ecological Endpoints* (DOE 1997), considered the next source of ESVs preferred by Ohio EPA (Appendix Table H-4), which is almost 10 times the mean concentration (0.511 mg/kg) for cadmium. This information indicates that the Ohio EPA approved and preferred ESV for cadmium is conservative; thus, the selection of cadmium as a COPEC is conservative.

The Ohio EPA approved and preferred lead ESV used in this ERA is 11 mg/kg. This ESV is from the USEPA EcoSSLs (Appendix Table H-4). The lead ESV used in this ERA is the most conservative ESV of the USEPA EcoSSLs. Other EcoSSLs for lead include 56 mg/kg, 120 mg/kg, and 1,700 mg/kg (USEPA 2005b). The ESV of 11 mg/kg is about four times lower than the ESV (40.5 mg/kg) from the next source of ESVs preferred by Ohio EPA (Appendix Table H-4) (DOE 1997). The preferred ESV used for lead is also lower than the background concentration of 26.1 mg/kg (Appendix Table H-6), while all of the other EcoSSLs and the alternate ESV are above the background concentration. This information indicates the Ohio EPA approved and preferred ESV for lead, and thus the selection of lead as a COPEC, is very conservative.

The Ohio EPA approved and preferred mercury ESV used in this ERA is 0.00051 mg/kg (Appendix Table H-4). The ESV is lower than other ESVs for mercury (0.1 mg/kg), the ESV for methylmercury (0.0016 mg/kg) (USEPA 2000, USEPA 2001, USEPA 2003b) (Appendix Table H-4), and the background concentration (0.036 mg/kg). The *Preliminary Remediation Goals for Ecological Endpoints* labels this form of mercury as an "inorganic chemical" and notes that the ESV for mercury is "so low that it may often be within background soil concentrations" (DOE 1997). Although mercury can bioaccumulate in food chains as a PBT compound, the Ohio EPA approved and preferred ESV is very low; therefore, the selection of mercury as a COPEC is very conservative.

Table 7-14. Summary of Data for Step 3A Refinement of Integrated COPECs in Surface Soil at Atlas Scrap Yard

COPEC	Mean Concentration (mg/kg)	ESV (mg/kg)	Mean Concentration > ESV? (Yes/No)	Background Concentration (mg/kg)	Mean Concentration > Background Concentration? (Yes/No)	ESV > Background Concentration? (Yes/No)	Frequency of Detections[a] > ESV	Frequency of Detections[a] > Background Concentration	Further Evaluation in Level II Required? (Yes/No)
COPEC with Mean Concentration < ESV									
Arsenic	9.31	18	No	15.4	No	Yes	2/65	2/65	No
Chromium	22.3	26	No	17.4	Yes	Yes	11/65	46/65	No
Cobalt	6.18	13	No	10.4	No	Yes	2/65	4/65	No
Copper	18.4	28	No	17.7	Yes	No	6/65	14/65	No
Silver	0.482	4.2	No	0	Yes	Yes	2/39	39/39	No
Benz(a)anthracene	2.94	5.21	No	0	Yes	Yes	6/38	38/38	No
Chrysene	4.13	4.73	No	0	Yes	Yes	8/38	38/38	No
COPEC with Mean Concentration > ESV and Mean Concentration < Background Concentration									
Aluminum	13,900	50	Yes	17,700	No	No	65/65	7/65	No
Manganese	964	220	Yes	1450	No	No	61/65	11/65	No
Selenium	1.06	0.52	Yes	1.4	No	No	56/57	9/57	No
COPEC with Mean Concentration > ESV and Mean Concentration > Background Concentration									
Cadmium	0.511	0.36	Yes	0	Yes	Yes	14/58	58/58	Yes
Lead	57	11	Yes	26.1	Yes	No	65/65	24/65	Yes
Mercury	0.0766	0.00051	Yes	0.036	Yes	No	59/59	48/59	Yes
Zinc	116	46	Yes	61.8	Yes	No	55/65	37/65	Yes
2,6-Dinitrotoluene	0.124	0.0328	Yes	0	Yes	Yes	1/1	1/1	Yes
Benzo(a)pyrene	3.1	1.52	Yes	0	Yes	Yes	13/38	38/38	Yes
Bis(2-ethylhexyl)phthalate	0.96	0.925	Yes	0	Yes	Yes	1/3	3/3	Yes
Naphthalene	0.183	0.0994	Yes	0	Yes	Yes	17/37	37/37	Yes

[a] Frequency of detection refers to the subset of detections relative to ESV or background concentration as opposed to the standard frequency of detections of total samples taken.
COPEC = Chemical of Potential Ecological Concern.
ESV = Ecological Screening Value.
mg/kg = Milligrams per kilogram.

Table 7-15. Summary of Mean Concentrations and Background Concentrations of Remaining Integrated Soil COPECs in the Refinement Factors

COPEC	Mean Concentration (mg/kg)	Background Concentration (mg/kg)	Ratio of Mean Concentration to Background Concentration	Qualitative Assessment of Mean to Background Concentration
Surface Soil				
Cadmium	0.511	0	NA	Concentrations are dissimilar
Lead	57	26.1	2.18	Concentrations are somewhat similar
Mercury	0.0766	0.036	2.13	Concentrations are somewhat similar
Zinc	116	61.8	1.88	Concentrations are somewhat similar
Benzo(a)pyrene	3.1	0	NA	Benzo(a)pyrene does not have an established background concentration for RVAAP
Bis(2-ethylhexyl)phthalate	0.96	0	NA	Bis(2-ethylhexyl)phthalate does not have an established background concentration for RVAAP
Naphthalene	0.183	0	NA	Naphthalene does not have an established background concentration for RVAAP

COPEC = Chemical of Potential Ecological Concern.
RVAAP = Ravenna Army Ammunition Plant.
mg/kg = Milligrams per kilogram.
NA = Not available, ratio could not be calculated.

The Ohio EPA approved and preferred zinc ESV used in this ERA is 46 mg/kg. This value is from the USEPA EcoSSLs (Appendix Table H-4). The zinc ESV used in this ERA is the most conservative ESV of the USEPA EcoSSLs. Other EcoSSLs for zinc include 79 mg/kg, 120 mg/kg, and 160 mg/kg (USEPA 2007b). The ESV of 46 mg/kg is about five times greater than the ESV (8.5 mg/kg) from the next source of ESVs preferred by Ohio EPA (Appendix Table H-4) (DOE 1997). The preferred ESV used for zinc is also lower than the background concentration of 61.8 mg/kg (Appendix Table H-6), while all of the other EcoSSLs are above the background concentration. These factors indicate the Ohio EPA approved and preferred ESV for zinc is somewhat conservative; thus, the selection of zinc as a COPEC is somewhat conservative.

The above information about alternative ESVs shows there are less conservative ESVs that could be chosen for the Level II work. Table 7-16 shows the ratio of ESV to mean concentration for the preferred ESV and an alternative ESV. This alternative ESV is the ESV with the closest concentration to the preferred ESV that is above the background concentration. For the six remaining integrated COPECs, using the alternative ESV would decrease the ratios for cadmium and mercury to less than one. Thus, if the alternative ESVs were used, cadmium and mercury would be eliminated from further consideration and would not be final COPECs. Using the alternative ESV also would also decrease the ratios for lead and zinc to ratios between one and two.

Table 7-16. Comparison of Alternative ESV to Mean Concentration for Remaining Integrated COPECs

COPEC	Background Concentration (mg/kg)	Preferred ESV (mg/kg)	Alternative ESV[a] (mg/kg)	Ratio of Preferred ESV to Mean Concentration	Ratio of Alternative ESV to Mean Concentration
Cadmium	0	0.36	4.0	1.42	0.18
Lead	26.1	11	40.5	5.18	1.41
Mercury	0.036	0.00051	0.1	150.20	0.77
Zinc	61.8	46	79	2.52	1.47
Benzo(a)pyrene	0	1.52	NA	2.04	NA
Bis(2-ethylhexyl)phthalate	0	0.925	NA	1.04	NA
Naphthalene	0	0.0994	NA	1.84	NA

[a] The Alternative ESV is the ESV with the closest concentration to the preferred ESV that is above the background concentration.
COPEC = Chemical of Potential Ecological Concern.
ESV = Ecological Screening Value.
mg/kg = Milligrams per kilogram.
NA = Not available, ratio could not be calculated.

Based on the three previous refinement factors, the seven integrated COPECs remaining in Table 7-16 all are dismissed as final COPECs. More specifically, mean concentrations are only slightly higher than background concentrations in lead, mercury, and zinc. Mean concentration-to-ESV ratios of exceedance are near one in cadmium, zinc, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, and naphthalene. Using alternate ESVs results in ratios below one for cadmium and mercury and slightly just above one for lead and zinc.

Wetland Quality, Geographical Information, and On-site Migration of Chemicals – The following evaluation and refinement factors are concerned with risk to wetlands:

- Category of wetland quality inside the AOC;
- Geographical relationship of on-site wetlands to AOC exceedance area; and
- Information about on-site migration of chemicals to on-site wetlands.

If the wetland quality is low, it is typically distant from the AOC exceedance area (i.e., high concentration area) or on-site migration is unlikely, increasing the likelihood that the remaining integrated COPECs will not be of ecological concern and do not need to be evaluated as final COPECs. At this point in the evaluation, all integrated COPECs have been eliminated as final COPECs. Nonetheless, discussing these three evaluation and refinement factors remains pertinent, as there is some uncertainty associated with eliminating all integrated COPECs as final COPECs. Wetland quality, geographical relationship to the eliminated integrated COPECs, and potential for migration to wetlands may reduce the uncertainty associated with eliminating the integrated COPECs.

There are nine wetlands partially or completely inside Atlas Scrap Yard. They range from 0.03-3.35 acres, with 0.03-1.42 acres inside the AOC boundary. Five of the nine wetlands are Category 2, while four of the wetlands are Category 1 (Table 7-10). Category 2 indicates moderate wetland quality, with some degradation of wetland functions. Category 1 indicates low wetland quality, with degradation of wetland functions. Camp Ravenna contains about 1,990 acres of wetlands, and the 3.89 acres of wetlands inside the habitat boundary at Atlas Scrap Yard represent 0.2% of the total wetlands of Camp Ravenna (OHARNG 2008). The moderate to low quality and availability of many more wetland acres at Camp Ravenna lowers the importance of the wetlands at Atlas Scrap Yard.

The wetlands are scattered throughout the AOC (Figure 7-1). Given the widespread exceedances of ESVs by contaminants (particularly inorganic chemicals) detected in the ISM surface soil sampling and the proximity of the wetlands to areas with integrated COPECs, it is possible contaminants have migrated to the wetlands from surface water runoff during storm events. However, there is limited on-site storm water migration given the relatively flat terrain and vegetative cover inside the AOC. There is also limited off-site migration (i.e., south to the watershed, east to the ditch along and culvert under Paris-Windham Road, and east into the ditch system through Load Line 12 to Upper and Lower Cobbs Ponds).

In summary, the wetlands at Atlas Scrap Yard are of low or moderate quality. These wetlands are surrounded by areas with integrated COPECs, so COPECs may migrate to on-site wetlands. Limited amounts of off-site migration may occur during storm events through drainage ditches and conveyances. Although the geographical relationship of the on-site wetlands to exceedances and potential for migration does not significantly reduce the uncertainty associated with eliminating integrated COPECs as part of the Step 3A refinement, the limited capability of the wetlands to serve as a breeding habitat for the closest recorded state-listed or federally listed species [four-toed salamander (*Hemidactylium scutatum*)] reduces the uncertainty. More specifically, water needs to persist for at least 32-68 days for a wetland or vernal pool to serve as a breeding habitat for salamanders. The salamander embryos are entirely aquatic, and 32-68 days is the duration of the embryo development (Petranka 1998). Although salamanders may be present and use the surrounding habitat and forest during non-breeding periods, with the exception of Wetland 1, the wetlands at Atlas Scrap Yard would not be sufficient for salamander breeding. Wetland 1 may be flooded frequently enough to serve as breeding habitat for salamanders, but the inorganic chemicals concentrations in the ISM grid where this wetland is located are much lower than the rest of the AOC.

Evaluation of Biological and Water Quality Sampling Stations – The final evaluation and refinement factor is:

- Evaluate off-site migration of chemicals at biological/water quality stations.

Various biological measurements of macroinvertebrates and fish, as well as chemical and physical measurements of surface water and sediment, were taken and assessed for evidence of upgradient and downgradient contamination. These studies were published in the *Facility-Wide Biological and Water Quality Study* (USACE 2005a). Monitoring stations are positioned in streams and ponds downgradient of several AOCs. For Atlas Scrap Yard, the nearest stream sampling station is 2,100 ft southwest, and the nearest pond sampling station is 2,000 ft southwest. These monitoring stations are upgradient of the AOC. The nearest downgradient stream sampling station is 5,000 ft northeast and the nearest downgradient pond sampling station is 3,100 ft northeast of the AOC (Table 7-11). While runoff from Atlas Scrap Yard enters Load Line 12, the monitoring results from the downgradient stream and pond sampling stations are discussed in more detail in the *Phase III Remedial Investigation Report for Wet Sediment and Surface Water at RVAAP-12 Load Line 12* (USACE 2012b) and *Phase III Remedial Investigation Report and Feasibility Study for Soil, Sediment, and Surface Water at RVAAP-29 Upper and Lower Cobbs Ponds* (USACE 2012a), because these two AOCs are closer to the monitoring stations. Therefore, this particular factor was not applied.

Evaluation of PBT Compounds and COPECs Without ESVs – As discussed in Level II, there are two chemicals that are PBT compounds and nine chemicals that are integrated COPECs because they did not have ESVs in surface soil. These chemicals are briefly evaluated below.

PBT Compounds. The *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008) includes a PBT compound screen in the Level II ERA. This screen is necessary because not all ESVs account for bioaccumulation; instead, they are derived based primarily on toxicity to endpoint receptors exposed by direct contact (e.g., plants, soil-dwelling invertebrates) or ingestion of soil or water (e.g., mammals, birds). Ohio EPA allows PBTs to be screened out in Level II if the “method used to derive the screening value considered exposure to higher trophic level organisms in the development of the screening value” (Ohio EPA 2008).

Bioaccumulation in higher trophic levels is considered when developing the ESV for the first two sources of soil ESVs preferred by Ohio EPA (EcoSSLs and PRGs). Derivation of EcoSSL values includes uptake equations that account for direct ingestion and food chain bioaccumulation (USEPA 2007a). The same is true of PRGs: “the 90th percentile of the soil-to-biota uptake factor was used as a conservative estimate of the chemical concentrations in wildlife food types (earthworms, plants, or small mammals),” and “the model accounts for the ingestion of soil as well as food” (DOE 1997). It is also important to note that both sources often derive values for multiple receptors, and the most conservative (lowest) value is chosen. Thus, for soil ESVs from these two sources, PBT compounds that have ratios less than one can be dismissed as final COPECs. For this ERA, this includes PCB-1260.

The ESV for mercury accounts for bioaccumulation (DOE 1997). Mercury was detected in soil above the ESV.. This exceedance can be expected, considering the background concentration is 70 times greater than the ESV. However, the similarity between the mean concentration of mercury (0.077 mg/kg) and the background concentration (0.036 mg/kg) (Table 7-15) suggests exposures to mercury at Atlas Scrap Yard are not very different from background conditions. Thus, mercury is eliminated from further consideration as a PBT chemical and will not be a final COPEC.

COPECs without ESVs. The *Guidance for Conducting Ecological Risk Assessments* specifies that chemicals without screening benchmark values should be retained as COPECs (Ohio EPA 2008). While Ohio EPA allows the use of additional screening benchmark values, such values need to be approved prior to submitting the report. For Atlas Scrap Yard, a search for (and subsequent approval of) additional values was deemed unnecessary. Rather, to mitigate concern for the uncertainties associated with COPECs that lack ESVs, a limited additional evaluation was conducted for each medium, focusing on frequency of detection, relationship to background concentration, and other chemical-specific refinement factors.

For soil at Atlas Scrap Yard Area, the integrated COPECs without ESVs are 2-amino-4,6-DNT; 2-nitrotoluene; 3-nitrotoluene; 4-amino-2,6-DNT; HMX; nitrocellulose; tetryl; carbazole; and dibenzofuran. 2-Amino-4,6-DNT (2 of 65); 2-nitrotoluene (2 of 65); 3-nitrotoluene (4 of 65); 4-amino-2,6-DNT (6 of 65); HMX (1 of 65); and tetryl (4 of 65) were detected infrequently. Thus, exposure to these chemicals would be limited. While nitrocellulose was detected in 5 of 6 samples, it is essentially non-toxic (USEPA 1987), and this chemical is also not expected to be an ecological concern. Because there is no ESV for carbazole (4 of 7) and dibenzofuran (6 of 7), they are assumed to be of limited concern to ecological receptors with respect to toxicity.

Summary of Findings in Step 3A – Of the 28 integrated COPECs in surface soil at Atlas Scrap Yard, nine were eliminated as COPECs because they did not have ESVs and had low frequency of detection or little to no toxicity. One PBT compound (PCB-1260) was eliminated because it had a ratio less than one when using an ESV that accounted for bioaccumulation. Another PBT compound (mercury) was eliminated because its mean concentration was only slightly above its background concentration. Additional integrated COPECs were eliminated from further consideration because the mean concentration is smaller than the ESV [arsenic, chromium, cobalt, copper, silver, benz(a)anthracene, and chrysene] or the mean concentration is smaller than the background concentration (aluminum, manganese, and selenium). 2,6-DNT was eliminated as a final COPEC due to low frequency of detection. The remaining seven integrated COPECs in soil [cadmium, lead, mercury, zinc, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, and naphthalene] have a combination of factors that together eliminated them from further consideration. These factors are presented below:

1. Mean concentration is only slightly higher than background concentrations (i.e., lead, mercury, and zinc).
2. Mean concentration-to-ESV ratio of exceedance is near one (i.e., cadmium, zinc, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, and naphthalene).
3. Alternative ESV that is less conservative than the ESV used in this ERA results in ratio below one (for cadmium and mercury) or just slightly greater than one (for lead and zinc).
4. Wetland quality is medium or low. Migration of COPECs from AOC media to on-site wetlands is possible, but is limited by the vegetation and topography at the AOC.

No final COPECs were identified for Atlas Scrap Yard surface soil.

7.3.3.8 <u>Consideration of Human Health Driven Remediation</u>

The HHRA does not identify any COCs and recommends NFA for soils at Atlas Scrap Yard. Thus, there would be no remediation implemented to further protect human health that would also protect ecological resources at Atlas Scrap Yard.

7.3.3.9 Uncertainties and Mitigations

Uncertainties or unknowns are present in the exposure and effects data. To mitigate uncertainty in exposure data, the MDCs of all available and appropriate data were used in Level I. In Level II, the MDC and mean COPEC concentrations were used to mitigate uncertainty concerning exposure data for receptors in the AOC. To mitigate uncertainty in effects information, a site visit for habitat condition was conducted, and the latest INRMP was used, which provides natural resource information for Camp Ravenna, including state-listed or federally listed species sightings and jurisdictional wetlands (OHARNG 2008). In addition, the ORAM was applied to the wetlands. Conservative ESVs, which are typically based on concentrations observed to have no effect on test species in laboratory studies, were used in Level II to mitigate uncertainty concerning effects on receptors in the AOC. Some chemicals are COPECs because they do not have ESVs. These COPECs are assumed to have limited toxicity given the lack of cause-effect laboratory tests and field-observed effects in the scientific literature.

In Level II, to mitigate uncertainty concerning effects on receptors in the AOC, the ESVs for COPECs are compared to background concentrations. Using ESVs that are lower than background concentrations provides an indication of the conservative nature of the evaluation. Conservative ESVs are appropriate for use as screening thresholds in Level I and II (i.e., soil constituents with an MDC below the ESV need no further consideration in Level II).

7.3.3.10 Summary and Conclusions of Screening Level Ecological Risk Assessment

Integrated COPECs were identified in surface soil at Atlas Scrap Yard. Most of the soil COPECs identified in the historical ERA were also identified during screening of PBA08 RI data. Four historical COPECs (barium, iron, nickel, and 4-methylphenol) were not identified during the PBA08 RI, and eight new COPECs [cobalt; 2,6-DNT; 4-amino-2,6-DNT; HMX; tetryl; benz(a)anthracene; carbazole; and chrysene] were identified due to additional sampling data. Those chemicals retained after screening historical and PBA08 RI data were termed integrated COPECs.

A total of 28 integrated soil COPECs were further evaluated with technical and refinement factors in Step 3A. All integrated soil COPECs were determined to be of no ecological concern. None require remediation or further evaluation. Consequently, the ERA for Atlas Scrap Yard can conclude with Level II and NFA from the ecological perspective.

7.3.4 Conclusions

There is chemical contamination present in surface soil at Atlas Scrap Yard. This contamination was identified using historical and PBA08 RI data. Forest alliances consisting of seasonally flooded, pin oak/swamp white oak alliance; dry, red maple, successional forest alliance; dry, late-successional, cold-deciduous shrubland; dry, early-successional, herbaceous field; and semi-permanently flooded cattail/bulrush alliances were observed on the 73 acres of the AOC. Wetlands are important and significant ecological resources near contamination in the AOC. These findings invoked a Level II assessment.

The Level II assessment evaluated soil using historical and PBA08 RI data, identified integrated COPECs, and evaluated the integrated COPECs using technical and refinement factors in Step 3A. The factors in Step 3A showed there is no further evaluation necessary for integrated COPECs, and there is no ecological concern requiring remediation. Consequently, the ERA for Atlas Scrap Yard can conclude with Level II and NFA from the ecological perspective.

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8.0 REMEDIAL INVESTIGATION CONCLUSIONS

8.1 INTRODUCTION

This RI Report for Atlas Scrap Yard presents a detailed analysis of historical and newly acquired environmental data. The following sections summarize the major findings of the nature and extent of contamination, modeling of contaminant fate and transport, HHRA, and ERA. An updated CSM incorporating all available information is also presented to integrate results of prior investigations and the PBA08 RI. The CSM denotes, based on available data where source areas occur, the mechanisms for contaminant migration from source areas to receptor media (e.g., surface water and groundwater), exit pathways from the AOC, and if COCs occur that may require further evaluation in an FS. This section presents the need for any further characterization of the media evaluated under the RI phase of work and whether to proceed to the FS phase of the CERCLA RI/FS process.

8.2 SUMMARY OF DATA USED IN THE REMEDIAL INVESTIGATION

Available, quality-assured data for Atlas Scrap Yard represent conditions of the AOC over a span of approximately seven years and were collected using ISM and discrete sampling methods. Data were collected in 2004 during the Characterization of 14 AOCs (MKM 2007) and in 2010 and 2011 as part of the PBA08 RI. Physical conditions at the AOC changed during the time between the 2004 Characterization of 14 AOCs and the PBA08 RI because various materials were stored and moved within the ASA. PBA08 RI samples were collected using ISM (surface soil) and discrete (subsurface soil) methods to be consistent with the population of historical samples and allow evaluation of equivalent data.

A systematic process was used to evaluate data usability for the RI Report based on project DQOs, data age and representativeness with respect to current AOC conditions, and sampling methods. The data usability evaluation included a particular focus on whether Characterization of 14 AOCs data represent current conditions and if sample results were appropriately used in the various data evaluations conducted in this report. Section 5.1.4 presents the results of the data usability evaluation for all available Atlas Scrap Yard samples; a summary is presented below.

All data collected during the 2004 Characterization of 14 AOCs and 2010 PBA08 RI investigations were deemed usable for this report. Surface soil samples at ASYss-001M, ASYss-003M, ASYss-004M and ASYss-004D were not included in the SRC screening dataset, as these ISM locations were re-sampled in 2010 under the PBA08 RI, and the more recent data were used for SRC screening. The sample results from these locations were used in the nature and extent evaluation only. For surface soil, all other available ISM samples (with the exception of field duplicate samples) were included in the data screening and risk assessments to identify SRCs, contaminant nature and extent, contaminant fate and transport. Discrete surface soil samples associated with ISM samples, which were used for VOC analysis, were also included in all RI evaluations.

Certain surface soil samples were limited to only nature and extent evaluation and analysis of temporal trends. These surface soil sample types, which are not included in quantitative data screening (i.e., identification of SRCs) or risk assessment calculations, included ISM and discrete field duplicate samples from all investigations, discrete samples from PBA08 RI soil borings (0-1 ft bgs interval), and discrete samples collected for chromium speciation analyses.

In April 2011, an additional sampling event was conducted to refine contaminated areas in the ASA, specifically grid ISM locations ASYss-088M, ASYss-089M, ASYss-093M and ASYss-094M. Sixteen samples were collected to close any potential data gaps resulting from the samples collected as part of the PBA08 RI in 2010 and the Characterization of 14 AOCs. These sample locations were derived from the features (e.g., railroad ties, concrete footer pile) present within the ASA.

For subsurface soil, only PBA08 RI discrete sample data were available and are included (with exception of field duplicate samples) for all evaluations performed in this RI Report. Surface water and sediment samples were not collected within the AOC during the PBA08 RI. Surface water is only present at the AOC during periods of heavy precipitation. Storm water runoff at Atlas Scrap Yard ultimately discharges to Load Line 12. One co-located set of sediment and surface water samples (L12sd-308 and L12sw-308) were collected in the ditch east of Atlas Scrap Yard along Paris-Windham Road under the PBA08 RI for Load Line 12. The sediment and surface water samples were incorporated into the Atlas Scrap Yard evaluation to represent the potential exit point for runoff or surface drainage from the AOC. This sample location is included in the HHRA contained in the *Phase III Remedial Investigation Report for Sediment and Surface Water at the RVAAP-12 Load Line 12* (USACE 2010c).

8.3 SUMMARY OF NATURE AND EXTENT

The Characterization of 14 AOCs and PBA08 RI data provide effective characterization of the nature and extent of the contamination at the AOC, and no further sampling is required.

The predominant SRCs in surface and subsurface soil at Atlas Scrap Yard were PAHs, which were observed in all surface soil samples analyzed across the entire AOC. Inorganic chemicals were also observed in soil at concentrations above their respective background concentrations throughout the AOC. A limited number of SRCs were observed in sediment and surface water, relative to soil at Atlas Scrap Yard. Detections of explosives, propellants, VOCs, pesticides, and PCBs were limited in frequency. A summary of observations for each medium is presented below.

8.3.1 Surface Soil

Fifty-three SRCs were identified in surface soil, with SVOCs (26 total, 16 of which were PAHs) being the predominant SRCs observed. Although SVOCs are widely distributed in surface soil, the highest concentrations of SRCs were observed in the north-central portion of the AOC, in the ASA. As indicated by the April 2011 sampling event, the highest concentrations of PAHs are from the parking areas made up of slag and asphalt gravel (locations ASY-116M, ASY-117M, ASY-118M, and ASY-119M) and in the ditch adjacent to an access road (locations ASY-123M and ASY-126M). The lower PAH concentrations from the April 2011 sampling event were from the sample areas encircling the existing railroad tie pile.

Sixteen inorganic chemicals were identified as SRCs in surface soil, with the highest number of inorganic SRCs detected at their maximum concentration at historical sample location ASYss-019M located in the vicinity of the former incinerator. Eight explosives, one propellant (nitrocellulose), one VOC (acetone), and one PCB (PCB-1260) were also identified as SRCs. No pesticides were detected or identified as SRCs in surface soil.

8.3.2 Subsurface Soil

Thirty SRCs were identified in subsurface soil. Seventeen SVOCs were identified as SRCs, 16 of which were PAHs. The sample with the greatest number and highest concentrations of PAH SRCs was the 1-4 ft bgs interval at ASYsb-063, located within a drainage ditch east of Atlas Scrap Yard and along the west side of Paris-Windham Road. All 16 PAH SRCs were detected at ASYsb-063, with 15 observed at their maximum concentrations in the 1-4 ft bgs sample, and likely sourced from road runoff. Seven inorganic chemicals were identified as SRCs in subsurface soil. Detections of inorganic chemicals above background concentrations were generally sporadic across the AOC and occurred within a narrow range of concentration. Two explosives (3-nitrotoluene and HMX), one propellant (nitrocellulose), and three VOCs (2-butanone, carbon disulfide, and toluene) were also identified as SRCs in subsurface soil. No pesticides or PCBs were identified as SRCs for subsurface soil. As there were no exceedances of the preliminary screening criteria defined in the PBA08 SAP in the samples collected from 4-7 ft bgs, the vertical nature and extent of contamination is considered defined by the 4-7 ft bgs interval.

8.3.3 Sediment

ISM and discrete sediment samples were screened separately for SRCs due to the use of different sampling methodologies. Twenty-two SRCs were identified for the discrete sample dataset; 11 SRCs were identified for the ISM screening dataset. Seventeen SVOCs, all PAHs, were identified as SRCs in the discrete sediment dataset. SVOCs were not analyzed for in the historical ISM sediment sample. Five inorganic chemicals were identified as SRCs in discrete sediment; 10 inorganic SRCs were identified for the ISM sediment dataset. Explosives were not detected or identified as SRCs for the discrete sediment sample, and the explosive 2-amino-4,6-DNT was identified as an SRC for the ISM sediment dataset only. No PCBs were detected or identified as SRCs for the discrete dataset for Atlas Scrap Yard; these analyses were not performed on the historical ISM sample.

8.3.4 Surface Water

Twenty-five SRCs were identified in surface water: 17 inorganic chemicals (16 metals and nitrate), seven SVOCs (six PAHs), and one pesticide (delta-BHC). Six of the inorganic chemicals observed in surface water sample L12sw-308 (aluminum, arsenic, barium, copper, manganese, and zinc) had concentrations that were on average an order of magnitude higher than their respective background concentrations. Sample L12sw-308 was collected east of Paris-Windham Road, adjacent to Load Line 12 and was used for the nature and extent evaluation of Atlas Scrap Yard. With the exception of bis(2-ethylhexyl)phthalate, all SVOC SRCs detected at surface water station L12sw-308 were also detected in the co-located PBA08 RI sediment sample at this location (L12sd-308). No propellants, explosives, PCBs, or VOCs were detected in surface water.

8.4 SUMMARY OF CONTAMINANT FATE AND TRANSPORT

Contaminant fate and transport evaluation (Section 6.0) included analysis of two contaminant migration pathways: (1) leaching and migration from soil to groundwater; and (2) partitioning contaminants from sediment to surface water within the main drainage ditch exiting the AOC, with transferal to groundwater through surface water/groundwater interaction.

Maximum concentrations of SRCs identified in surface and subsurface soil were evaluated using a series of generic screening steps to identify initial CMCOPCs. These CMCOPCs for soil were further evaluated using the SESOIL model to predict leaching concentrations and identify final CMCOPCs based on RVAAP facility-wide background criteria and the lowest risk-based screening criteria among USEPA MCLs, USEPA tap water RSLs, or RVAAP groundwater FWCUGs for the Resident Receptor Adult. Final CMCOPCs were evaluated using the AT123D model to predict groundwater mixing concentrations beneath source areas and concentrations at the nearest downgradient groundwater receptor locations to the AOC (e.g., streams). Maximum SRC concentrations in sediment were evaluated using an analytical solution to identify final CMCOPCs for evaluation using AT123D. The AT123D modeling results were evaluated with respect to AOC groundwater monitoring data and model limitations and assumptions to identify chemicals to be retained as CMCOCs that may warrant further evaluation in an FS.

Conclusions of the soil and sediment screening, leachate modeling, and groundwater modeling are as follows:

- The AT123D model predicted maximum future groundwater concentrations for the final soil CMCOPCs 2-nitrotoluene; 3-nitrotoluene; 2,6-DNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; 2-methylnaphthalene; and naphthalene exceed groundwater screening criteria beneath soil source areas but do not exceed groundwater screening criteria at the downgradient receptor locations [i.e., unnamed tributary to Sand Creek (flowing northwest) and unnamed tributary to the Mahoning River (flowing southwest)]. Predicted groundwater concentrations of the final sediment CMCOPCs barium, chromium, copper, lead, mercury, selenium, 2-amino-4,6-DNT; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene also do not exceed groundwater screening criteria at the downgradient receptor location [unnamed tributary to Cobbs Ponds (flowing northeast)].
- Evaluation of modeling results with respect to current AOC groundwater data and model limitations indicate that identified CMCOPCs are not impacting groundwater beneath the

> source areas and that modeling assumptions are conservative. Evaluation of predicted breakthrough curves show peak concentrations for sediment CMCOPCs and for four soil CMCOPCs (nitrotoluene; 3-nitrotoluene; 2-amino-4,6-DNT; and 4-amino-2,6-DNT) would have occurred in the past. Potential future impacts predicted by the model for remaining CMCOPCs would likely be mitigated by factors such as chemical and biological degradation, lateral dispersivity, and AOC-specific variations soil geochemistry.

All SRCs identified in the surface soil, subsurface soil, and sediment at Atlas Scrap Yard were evaluated through the stepwise fate and transport evaluation. All SRCs were eliminated as posing future impacts to groundwater, and NFA is necessary for surface soil, subsurface soil, and sediment to protect groundwater.

8.5 SUMMARY AND CONCLUSIONS OF THE HUMAN HEALTH RISK ASSESSMENT

The HHRA identified COCs and conducted risk management analysis to identify CERCLA-related COCs requiring potential remediation based on potential risks to human receptors. Camp Ravenna is a controlled access facility. Atlas Scrap Yard is located in the central portion of the facility and is currently used for railroad tie and salvaged inert materials storage. An evaluation using Resident Receptor (Adult and Child) FWCUGs was used to evaluate Unrestricted (Residential) Land Use. Unrestricted (Residential) Land Use is considered protective for all categories of Land Use on the former RVAAP/Camp Ravenna.

The media of concern evaluated in the HHRA are surface soil (0-1 ft bgs) and subsurface soil (1-13 ft bgs). Surface water and sediment samples were not collected within the AOC during the PBA08 RI, as perennial surface water bodies are not present at the AOC. The only soil COCs identified were PAHs [benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene]. Concentrations of these chemicals detected in soil either exceeded FWCUGs or contributed to an SOR greater than one. At the ASA, PAHs are present at high concentrations at locations consisting of parking areas made up of slag and asphalt gravel (locations ASY-116M, ASY-117M, ASY-118M, and ASY-119M) and the ditchline paralleling the site access road (ASY-123M and ASY-126M). In addition, there is ongoing storage of railroad ties and salvaged inert materials at the AOC. These do not represent a CERCLA-related release. At the IA, PAHs are present at much lower concentrations. Evaluation of PAH concentrations associated with common anthropogenic (non-CERCLA) sources using available data from RVAAP background soil samples and other regional environmental studies of environmental concentrations of PAHs indicate the PAH concentrations at the IA are indicative of releases from road dust, vehicle exhaust, tire wear particles, ballast and pavement from roads and parking areas, and slag used as fill. Thus, there are no CERCLA-release related sources of PAHs at this AOC. No CERCLA-release related COCs pose an unacceptable risk to human health; therefore no COCs require remediation or evaluation in an FS.

8.6 SUMMARY AND CONCLUSIONS OF THE ECOLOGICAL RISK ASSESSMENT

There is chemical contamination present in soil at Atlas Scrap Yard. This contamination was identified using historical and PBA08 RI data. Wetlands are important and significant ecological resources near contamination in the AOC. These findings invoked a Level II assessment.

The Level II assessment evaluated soil data and identified COPECs. There are 28 integrated COPECs for soil at Atlas Scrap Yard. Aluminum; arsenic; cadmium; chromium; cobalt; copper; lead; manganese; mercury; selenium; silver; zinc; 2,6-DNT; benz(a)anthracene; benzo(a)pyrene; bis(2-ethylhexyl)phthalate; chrysene; and naphthalene are the 18 integrated COPECs that exceeded their background concentrations and ESVs. Nine chemicals (2-amino-4,6-DNT; 2-nitrotoluene; 3-nitrotoluene; 4-amino-2,6-DNT; HMX; nitrocellulose; tetryl; carbazole; and dibenzofuran) are integrated COPECs because they did not have an ESV. Mercury and PCB-1260 are PBT compounds.

The integrated soil COPECs were further evaluated with technical and refinement factors in Step 3A. The factors in Step 3A showed there are no integrated COPECs that are of ecological concern requiring remediation or further evaluation. Consequently, the ERA for Atlas Scrap Yard can conclude with Level II and NFA from the ecological perspective.

8.7 UPDATED CONCEPTUAL SITE MODEL

The preliminary CSM for Atlas Scrap Yard is summarized in Section 3.7. The CSM is updated in this section to incorporate results of the PBA08 RI. Elements of the CSM include:

- Primary and secondary contaminant sources and release mechanisms;
- Contaminant migration pathways and discharge or exit points;
- Potential receptors with unacceptable risk; and
- Data gaps and uncertainties.

The following sections describe each of the above elements of the CSM for Atlas Scrap Yard. Figures contained in earlier sections of the report that illustrate AOC features, topography, groundwater and surface water flow directions, and nature and extent of SRCs are cited to assist in visualizing key summary points of the revised CSM.

8.7.1 Primary and Secondary Contaminant Sources and Release Mechanisms

The parking areas made up of slag and asphalt gravel are the primary contributing contaminant source still present at the AOC. The highest levels of PAHs were identified during the PBA08 RI within the areas of the slag parking area used for vehicle traffic and equipment and material staging (Figure 4-4). The ditch sample (ASYss-126M), collected from the east side of the access road in the ASA, contains the highest concentrations of PAHs. Overland flow during precipitation events carries contamination particulates from the access road and debris piles and accumulates in the ditch, as evidenced by the concentrations observed from the ditch sample. Samples collected immediately adjacent to debris piles did not contain the highest concentrations of PAH contamination; therefore, the debris piles are not considered to be as significant of a contributor to contamination as the slag parking area.

Remnant contamination in soil and sediment within the AOC is considered a secondary source of contamination. The occurrence and distribution of inorganic SRCs and SVOCs in surface soil is generally widespread, and notable spatial patterns are not evident for most SRCs. Concentrations of inorganic SRCs in subsurface soil were observed above background concentrations throughout Atlas Scrap Yard. Generally, the greatest number of inorganic SRCs above background concentrations occurred in the 1-4 ft bgs interval, and concentrations decreased with depth.

The primary mechanisms for release of contaminants from secondary sources at the AOC are:

- Erosion of soil matrices with sorbed contaminants and mobilization in overland surface water storm runoff during heavy rainfall conditions; and
- Contaminant leaching to groundwater.

8.7.2 Contaminant Migration Pathways and Exit Points

8.7.2.1 Surface Water Pathways

Surface water at Atlas Scrap Yard occurs intermittently as storm water runoff within natural and constructed drainage ditches or conveyances. Migration of contaminants from soil sources via surface water occurs primarily by: (1) movement of the particle-bound contaminants in surface water runoff; and (2) transport of dissolved constituents in surface water. In the case of particle-bound contaminant migration, contaminants will be mobilized during periods of high flow (e.g., rain events), and upon reaching portions of surface water conveyances where flow velocities decrease, they will settle out as sediment accumulation. Sediment-bound contaminants may become re-suspended and migrate during storm events or may partition to dissolved phase in surface water.

In the case of particle-bound contaminant migration, contaminants will be mobilized during periods of high flow (e.g., rain events). Upon reaching lowest elevation of the AOC where temporary ponding of water may occur, the particulates will settle out as sediment accumulation. Re-suspension and migration of sediment-bound contaminants from the low points in the AOC would not occur.

Dissolved phase contaminant migration in surface water is relevant with respect to leaching processes to groundwater. Temporary ponding of surface water runoff in the lowest points of the AOC is likely during heavy rainfall events or periods of snowmelt; however, visual observations during various investigations have not indicated evidence of long-term standing water. Infiltration rates and evapotranspiration processes appear sufficiently high to prevent long-term water retention.

8.7.2.2 Groundwater Pathways

The local potentiometric surface shows the groundwater flow pattern to the west, although facility-wide potentiometric data indicate flow to the southeast and southwest. The closest potential discharge location is at an unnamed tributary to Cobbs Ponds, approximately 2,080 ft northeast of the AOC. An unnamed tributary to Sand Creek lies approximately 2,720 ft northwest of the AOC. The unnamed tributary to the Mahoning River (e.g., within Load line 4) lies about 2,700 ft southwest of the AOC. Groundwater elevations at the Atlas Scrap Yard ranged from 967.54-973.63 ft amsl according to the January 2010 facility-wide potentiometric data presented in the *Facility-Wide Groundwater Monitoring Program Report on the January 2010 Sampling Event* (EQM 2010). Potentiometric data indicate the groundwater table occurs within the unconsolidated zone throughout the AOC. Groundwater discharge to surface water features (e.g., via base flow to streams or springs) does not occur within the AOC boundary.

Contaminant leaching pathways from soil to the water table are through poorly sorted, interbedded, silty clay loam and clay loam glacial till, with overall hydraulic conductivity average of 3.89E-04 cm/s. Based on the results of the SESOIL modeling, the maximum concentrations for 2-nitrotoluene, 3-nitrotoluene, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-methylnaphthalene, and naphthalene in leachate directly below the source and above the water table were above the respective screening criteria. These chemicals did not exceed the screening criteria at the downgradient receptor location (tributary to Cobbs Ponds) and were eliminated as CMCOCs. Observed groundwater concentrations at Atlas Scrap Yard provide confirmation of modeling results. Further evaluation of groundwater at the AOC will be performed in a separate report.

8.7.3 Potential Receptors

Atlas Scrap Yard is located in the central portion of the facility and is currently used for railroad tie and salvaged inert materials storage. An evaluation using Resident Receptor (Adult and Child) FWCUGs was used to provide an Unrestricted (Residential) Land Use evaluation. Unrestricted (Residential) Land Use is considered protective for all categories of Land Use at Camp Ravenna. Ecological receptors within Atlas Scrap Yard are potentially exposed to chemicals in surface soil (0-1 ft bgs) at concentrations exceeding ESVs.

8.7.4 Uncertainties

Uncertainties are inherent in the CSM depending on the density and availability of data. The CSM for Atlas Scrap Yard is overall well defined using existing data, and major data gaps do not remain to be resolved.

8.8 CONCLUSIONS OF THE REMEDIAL INVESTIGATION

Historical investigations and the PBA08 RI have adequately characterized Atlas Scrap Yard. Further investigation is not warranted at this AOC for the following reasons: (1) the nature and extent of impacted media has been sufficiently characterized; (2) the fate and transport modeling did not identify soil CMCOCs requiring further evaluation or remediation to protect groundwater; (3) there are no CERCLA-release related human health COCs identified in soil requiring further evaluation in an FS or remediation; and (4) remedial actions to protect ecological resources are not warranted. Accordingly, NFA is necessary for soil, sediment, and surface water at Atlas Scrap Yard to attain Unrestricted (Residential) Land Use.

The next step in the CERCLA process is to prepare a PP to solicit public input with respect to NFA for soil, sediment, and surface water. This PP will provide a brief summary of the history, characteristics, risks, and the basis for NFA. Comments on the PP received from state and federal agencies and the public will be considered when preparing a ROD to document the final remedy. The ROD will also include a responsiveness summary addressing comments received on the PP.

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9.0 AGENCY COORDINATION AND PUBLIC INVOLVEMENT

The U.S. Army is the lead agency responsible for executing the CERCLA process and for ultimately completing an approved ROD for soil, sediment, and surface water at Atlas Scrap Yard. This section reviews actions that have been conducted and presents activities that are planned to ensure the regulatory agencies and members of the public have been provided with appropriate opportunities to stay informed of the progress of the Atlas Scrap Yard environmental investigation, restoration efforts, and final selection of a remedy.

9.1 STATE ACCEPTANCE

State acceptance considers comments received from agencies of the state of Ohio on the proposed remedial alternatives. Ohio EPA is the lead regulatory agency for supporting the remedy for soil, sediment, and surface water at Atlas Scrap Yard. This RI Report has been prepared in consultation with the Ohio EPA.

Ohio EPA has provided input during the ongoing investigation and report development to ensure the remedy ultimately selected for Atlas Scrap Yard is protective of human health and the environment and fulfills the requirements of the DFFO (Ohio EPA 2004). Ohio EPA provided comments on this RI Report and will also provide comments on the subsequent PP and ROD. The U.S. Army will obtain Ohio EPA concurrence prior to selecting a final remedy for soil, sediment, and surface water at the AOC.

9.2 COMMUNITY ACCEPTANCE

Community acceptance considers comments provided by community members. CERCLA 42 U.S.C. 9617(a) emphasizes early, constant, and responsive community relations. The U.S. Army has prepared a *Community Relations Plan* (USACE 2003b) to facilitate communication between Camp Ravenna and the community surrounding Ravenna, Ohio during environmental investigations and potential remedial actions. The plan was developed to ensure the public has convenient access to information regarding project progress. The community relations program interacts with the public through news releases, public meetings, public workshops, and Restoration Advisory Board meetings with local officials, interest groups, and the general public.

CERCLA 42 U.S.C. 9617(a) requires an Administrative Record to be established "at or near the facility at issue." Relevant documents have been made available to the public for review and comment. The Administrative Record for this project is available at the following location:

Camp Ravenna
Attn: Environmental Office
1438 State Route 534
Newton Falls, Ohio 44444-9297
(330) 872-8003

Access to Camp Ravenna is controlled but can be obtained by prior notification and arrangement. In addition, an Information Repository of current information and final documents is available to any interested reader at the following libraries:

Reed Memorial Library
167 East Main Street
Ravenna, Ohio 44266

Newton Falls Public Library
204 South Canal Street
Newton Falls, Ohio 44444-1694

Additionally, the RVAAP restoration program has an online resource for restoration news and information. This website is available at: www.rvaap.org.

Comments will be received from the community upon issuance of the PP. As required by the CERCLA regulatory process and the *RVAAP Community Relations Plan* (USACE 2003b), the U.S. Army will hold a public meeting and request public comments on the PP for Atlas Scrap Yard. These comments will be considered prior to the final selection of a remedy. Responses to these comments will be addressed in the responsiveness summary of the ROD.

10.0 REFERENCES

American Cancer Society 2003. *Cancer Facts & Figures 2003*. Website: www.cancer.org. 2003.

ANRCP (Amarillo National Resource Center for Plutonium) 1999. *Bioremediation of RDX in the Vadose Zone Beneath the Pantex Plant*. January 1999.

Anonymous 1944. Construction Camp. Drawing BR 5448. December 8, 1944.

APCO (Atlas Powder Company) 1955. Plot Plan Roads and Grounds Maintenance Area. Drawing B-1006-1. January 8, 1955, revised January 5, 1959.

Army National Guard-ILE Cleanup, U.S. Army (ARNG) 2014. *Final Technical Memorandum: Land Uses and Revised Risk Assessment Process for the Ravenna Army Ammunition Plant (RVAAP) Installation Restoration Program, Portage /Trumbull Counties, Ohio (Tech Memo).* (Memorandum between ARNG-ILE Cleanup and the Ohio Environmental Protection Agency; dated 4 February 2014).

ATSDR (Agency for Toxic Substances and Disease Registry) 1995. *Public Health Statement for Polycyclic Aromatic Hydrocarbons (PAHs)*. United States Department of Health and Human Services, Public Health Service. August 1995.

ATSDR 1997. *Toxicological Profile for HMX*. United States Department of Health and Human Services, Public Health Service. September 1997.

Bradley, L. J. N., B. H. McGee, and S.L. Allen 1994. *Background Levels of Polycyclic Aromatic Hydrocarbons (PAH) and Selected Metals in New England Urban Soils*. Journal of Soil Contamination, Volume 3, Issue 4. 1994.

BTAG (United States Army Biological Technical Assistance Group) 2005. *Technical Document for Ecological Risk Assessment: Process for Developing Management Goals*. August 2005.

DOE (United States Department of Energy) 1992. *An Analytical Solution for Transient One-, Two-, or Three-Dimensional Transport in a Homogenous, Anisotropic Aquifer with Uniform, Stationary Regional Flow*. Oak Ridge National Laboratory, Oak Ridge, Tennessee. 1992.

DOE 1997. *Preliminary Remediation Goals for Ecological Endpoints*. Oak Ridge National Laboratory, Oak Ridge Tennessee. August 1997.

Dragun, James 1988. *The Soil Chemistry of Hazardous Materials*. Hazardous Materials Control Research Institute, Silver Spring, MD. 1988.

E2M (Engineering-environmental Management, Inc.) 2008. *Site Inspection Report for the Military Munitions Response Program at the Ravenna Army Ammunition Plant*. May 2008.

EQM (Environmental Quality Management, Inc.) 2010. *Facility-Wide Groundwater Monitoring Program Report on the January 2010 Sampling Event, Ravenna Army Ammunition Plant, Ravenna, Ohio*. July 2010.

ERDC (United States Army Engineer Research and Development Center) 2007. *Development of Environmental Data for Navy, Air Force, and Marine Munitions*. Cold Regions Research and Engineering Laboratory, Arlington, Virginia. June 2007.

Funk, S.B., et al. 1993. *Initial-Phase Optimization for Bioremediation of Munition Compound-Contaminated Soils*. Applied and Environmental Microbiology, Volume 59, No. 7. July 1993.

GSC (General Sciences Corporation) 1998. *SESOIL for Windows*, Version 3.0, Laurel, MD. 1998.

Hetrick, D. M., et al. 1986. *Model Predictions of Watershed Hydrologic Components: Comparison and Verification*. Journal of the American Water Resources Association. October 1986.

Hetrick, D.M. and S.J. Scott 1993. *The New SESOIL User's Guide*, Wisconsin Department of Natural Resources, PUBL-SW-200, Madison, WI. 1993.

IEPA (Illinois Environmental Protection Agency) 2005. Urban area polycyclic aromatic hydrocarbons study tiered approach to corrective action objectives. 2005.

ITRC (Interstate Technology & Regulatory Council). 2012. *Incremental Sampling Methodology*. ISM-1. Washington, D.C.: Interstate Technology & Regulatory Council, Incremental Sampling Methodology Team. www.itrcweb.org.

Kammer, H.W. 1982. *A Hydrologic Study of the Ravenna Arsenal, Eastern Portage and Western Trumbull Counties, Ohio*. Master Thesis, Kent State University. 1982.

Kaplan, D.L. and A.M. Kaplan 1982. *Thermophilic biotransformation of 2,4,6-trinitrotoluene under simulated composting conditions*. Applied and Environmental Microbiology, 44(3). May 1982.

Lyman, Warren J., et al. 1990. *Handbook of Chemical Property Estimation Methods*. American Chemical Society, Washington, D.C. 1990.

MADEP (Massachusetts Department of Environmental Protection) 2002. *Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil*. May 2002.

McCormick, et al. 1978. *Identification of Biotransformation Products from 2,4-Dinitrotoluene*. Applied and Environmental Microbiology, Volume 35, Issue 5. May 1978.

McCormick, N. G., J. H. Cornell, and A. M. Kaplan 1981. *Biodegradation of Hexahydro-1,3,5-Trinitro-1,3,5-Trazine*. Applied and Environmental Microbiology. November 1981.

MKM (MKM Engineers, Inc.) 2007. *Characterization of 14 AOCs at Ravenna Army Ammunition Plant*. March 2007.

NDEP (Nevada Division of Environmental Protection) 2006. *Selection of Pyrene as a Noncarcinogenic Toxicological Surrogate for PAHs. Technical memorandum from T.L. Copeland DABT (consulting toxicologist) to B. Rakvica P.E. NDEP Bureau of Corrective Actions)*. February 2006.

NYSDEC (New York State Department of Environmental Conservation) 2006. *New York State Brownfield Cleanup Program Development of Soil Cleanup Objectives Technical Support Document*. September 2006.

OGE (O'Brien and Gere Engineers, Inc.) 1988. *Hazardous Waste Site Remediation, the Engineer's Perspective*. 1988.

OHARNG (Ohio Army National Guard) 2008. *Integrated Natural Resources Management Plan and Environmental Assessment for the Ravenna Training and Logistics Site, Portage and Trumbull Counties, Ohio*. March 2008

Ohio EPA (Ohio Environmental Protection Agency) 1996. *Draft Evaluation of Background Metal Concentrations in Ohio Soils.* June 1996.

Ohio EPA 2001. *Ohio Rapid Assessment Method for Wetlands v. 5.0, User's Manual and Scoring Forms*. Division of Surface Water, 401/Wetland Ecology Unit. February 2001.

Ohio EPA 2002. Fact Sheet: Clean Hard Fill, DSIWM Doc. 0563. Division of Solid and Infectious Waste Management. May 2002.

Ohio EPA 2003. *Guidance for Conducting Ecological Risk Assessments (Ohio EPA)*. Division of Emergency and Remedial Response. February 2003.

Ohio EPA 2004. *Director's Final Findings and Orders for the Ravenna Army Ammunition Plant*. June 2004.

Ohio EPA 2008. *Guidance for Conducting Ecological Risk Assessments (Ohio EPA)*. Division of Emergency and Remedial Response. April 2008.

Petranka, J. W. 1998. *Salamanders of the United States and Canada.* Smithsonian Institution Press, Washington D.C., 587 pp. 1998.

SAIC 2011. Historical Records Review Report for the 2010 Phase I Remedial Investigation Services at Compliance Restoration Sites (9 Areas of Concern). December 22, 2011.

Shacklette, H.T., and Boerngen, J.G., 1984. *Element concentrations in soils and other surficial materials of the conterminous United States*: U.S. Geological Survey Professional Paper 1270. 1984.Teaf, Christopher M.; Douglas J. Covert; and Srikant R. Kothur 2008. *Urban Polycyclic Aromatic Hydrocarbons (PAHS): A Florida Perspective.* Proceedings of the Annual International Conference on Soils, Sediments, Water and Energy: Volume 13, Article 23. 2008.

USABRDL (United States Army Biomedical Research and Development Laboratory) 1989. *Organic Explosives and Related Compounds: Environmental and Health Considerations*. March 1989.

USACE (United States Army Corps of Engineers) 1994. *Evaluation of Pre-extraction Analytical Holding Times for Tetryl in Soil.* April 1994.

USACE 1998. *Phase I Remedial Investigation Report for High-Priority Areas of Concern at the Ravenna Army Ammunition Plant, Ravenna Ohio.* February 1998.

USACE 1999. *Plant Community Survey for the Ravenna Army Ammunition Plant Summary Report*. Prepared for Ohio Army National Guard, Adjutant General's Department, Columbus, Ohio. August 1999.

USACE 2001a. *Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. March 2001.

USACE 2001b. *Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. April 2001.

USACE 2003a. *Phase II Remedial Investigation Report for the Load Line 1 at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. June 2003.

USACE 2003b. *Ravenna Army Ammunition Plant Ravenna, Ohio Community Relations Plan*. September 2003.

USACE 2003c. *RVAAP Facility Wide Ecological Risk Work Plan*. April 2003.

USACE 2004. *Phase II Remedial Investigation Report for Load Line 12 at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. March 2004.

USACE 2005a. *Facility-Wide Biological and Water Quality Study 2003 Ravenna Army Ammunition Plant, Ravenna, Ohio, Part I-Streams, Part II-Ponds*. November 2005.

USACE 2005b. *RVAAP Facility-Wide Human Health Risk Assessor Manual – Amendment 1*. December 2005.

USACE 2006. *Environmental Transport and Fate Process Descriptors for Propellant Compounds*. June 2006.

USACE 2009. *PBA 2008 Supplemental Investigation Sampling Analysis Plan Addendum No. 1 Ravenna Army Ammunition Plant, Ravenna, Ohio*. December 2009.

USACE 2010a. *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant, RVAAP, Ravenna, Ohio*. March 2010.

USACE 2010b. *Risk Assessment Handbook Volume II: Environmental Evaluation*. December 2010.

USACE 2010c. *Phase III Remedial Investigation Report for Sediment and Surface Water at the RVAAP-12 Load Line 12 at the Ravenna Army Ammunition Plant, Ravenna, Ohio.* December 2010.

USACE 2012a. *Phase III Remedial Investigation Report and Feasibility Study for Soil, Sediment, and Surface Water at RVAAP-29 Upper and Lower Cobbs Ponds.* 2012.

USACE 2012b. *Phase III Remedial Investigation Report for Wet Sediment and Surface Water at RVAAP-12 Load Line 12*. 2012.

USACE 2012c. *Revised Final United States Army Corps of Engineers Ravenna Army Ammunition Plant (RVAAP) Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals*. February 2012.

USACE 2012d. *Draft Remedial Investigation/Feasibility Study Report for RVAAP-67 Facility-Wide Sewers.* September 2012.

USACHPPM (United States Army Center for Health Promotion and Preventative Medicine) 1998. *Relative Risk Site Evaluation for Newly Added Sites at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. Hazardous and Medical Waste Study No. 37-EF-5360-99. October 1998.

USACHPPM 2000. *Wildlife Toxicity Assessment for 2,4,6-Trinitrotoluene*. November 2000.

USACHPPM 2001a. *Wildlife Toxicity Assessment for High Melting Explosive (HMX)*. November 2001.

USACHPPM 2001b. *Wildlife Toxicity Assessment for 1,3,5-Trinitrobenzene.*November 2001.

USATHAMA (United States Army Toxic and Hazardous Materials Agency) 1978. *Installation Assessment of Ravenna Army Ammunition Plant, Records Evaluation Report No. 132*. November 1978.

USDA (United States Department of Agriculture) 1978. *Soil Survey of Portage County, OH*. 1978.

USDA 2009. *Forest Service. Resource Bulletin NRS-36*. http://www.nrs.fs.fed.us/. 2009.

USDA 2010. *Soil Map of Portage County, Version 4*. Website: www.websoilsurvey.nrcs.usda.gov. January 2010.

USDA 2011. *Natural Resources Conservation Service. PLANTS database.* http://plants.usda.gov. November 2011.

USEPA (United States Environmental Protection Agency) 1985. *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water, Revised 1985 Parts 1 and 2, EPA/600/6-85/002*. Office of Research and Development, Environmental Research Laboratory, Athens, Georgia. September 1985.

USEPA 1987. *Health Advisory for Nitrocellulose*. Office of Drinking Water. September 1987.

USEPA 1988. *Health Advisory for Octahydro-1,3,5,7-Tetranitro 1,3,5,7-Tetrazocine (HMX).* PB90-273525. Office of Drinking Water. November 1988.

USEPA 1989. *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A)*. December 1989.

USEPA 1990. *National Oil and Hazardous Substances Pollution Contingency Plan, Final Rule*, FR Vol. 55, No. 46, available from U.S. Government Printing Office, Washington, D.C. March 1990.

USEPA 1991. *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals).* EPA/540/R-92/003, U.S. Environmental Protection Agency Office of Emergency and remedial Response, Washington, DC. December 1991.

USEPA 1993. *Wildlife Exposure Factors Handbook*. Office of Research and Development, Washington, D.C., Volume 1 of 2. December 1993.

USEPA 1994. *The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3*. EPA/600/R-94/168b, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC. September 2004.

USEPA 1996a. *Ecological Significance and Selection of Candidate Assessment Endpoints*. ECO Update. Volume 3, Number 1. EPA 540/F-95/037. January 1996.

USEPA 1996b. *Soil Screening Guidance: Technical Background Document*. Office of Solid Waste and Emergency Response, Washington, D.C. May 1996.

USEPA 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. Interim Final. June 1997.

USEPA 1998. *Toxicological Review of Hexavalent Chromium in Support of Summary Information on IRIS*. August 1998.

USEPA 1999. *Ohio Wetland Restoration and Mitigation Strategy Blueprint.* Wetland Grant Program Federal Grant No. CD985853-01-0. Prepared by Ohio Department of Natural Resources and Ohio Environmental Protection Agency. September 1999.

USEPA 2000. *Amended Guidance on Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders*. Website: http://www.epa.gov/region4/waste/fedfac/ecoproc2.pdf. June 2000.

USEPA 2001. *Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment*. Originally published November 1995. Website: http://www.epa.gov/region4/waste/ots/ecolbul.html. November 2001.

USEPA 2003a. *Ecological Soil Screening Level for Aluminum*. OSWER Directive 9285.7-60. November 2003.

USEPA 2003b. *Region 5 RCRA Ecological Screening Levels*. http://www.epa.gov/reg5rcra/ca/ESL.pdf. August 2003.

USEPA 2005a. *Ecological Soil Screening Levels for Cadmium*. OSWER Directive 9285.7-65. March 2005.

USEPA 2005b. *Ecological Soil Screening Levels for Lead*. OSWER Directive 9285.7-70. March 2005.

USEPA 2007a. *Guidance for Developing Ecological Soil Screening Levels Attachment 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs*. OSWER Directive 9285.7-55. April 2007.

USEPA 2007b. *Ecological Soil Screening Levels for Zinc*. OSWER Directive 9285.7-73. June 2007.

USEPA 2010. *Integrated Risk Information System (IRIS) Database*. Office of Research and Development, Washington, D.C. 2010.

USEPA 2011. *Western Ecology Division. Ecoregions of EPA Region 3.* http://www.epa.gov/wed/pages/ecoregions/reg3_eco.htm. 2011.

USEPA 2012. EPA Regional Screening Level (RSL). Website: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm. November 2012.

USFS (United States Forest Service) 2011. *Forest Inventory Data Online (FIDO). Forest Inventory and Analysis National Program*. http://www.fia.fs.fed.us/tools-data/default.asp. February 2011.

USGS (United States Geological Survey) 1968. *Mineral Resources of the Appalachian Region*. U.S. Geological Survey Professional Paper No. 580. 1968.

USGS 2004. *U.S. Geological Survey Certificate of Analysis Devonian Ohio Shale, SDO-1*. Online: <http://minerals.cr.usgs.gov/geo_chem_stand/ohioshale.html>. December 2004.

Vosnakis, Kelly A.S., and Elizabeth Perry 2009. *Background Versus Risk-Based Screening Levels – An Examination of Arsenic Background Soil Concentrations in Seven States*. International Journal of Soil, Sediment, and Water. Volume 2, Issue 2, Article 2. August 2009.

Weston Solutions, Inc., 2012. *Background Soil Determination Summary for Three Locations in Cuyahoga County, Ohio*. USEPA Region V, Chicago, IL and Ohio EPA Division of Environmental response and Revitialization, Twinsburg, OH. July 2012.

Wilbur, Watson, and Associates Architects and Engineers. Ravenna Ordnance Plant, Construction Camp Utilities Map; Plan number 6934: 1075.1. February 2, 1942.

Winslow, J.D., and G.W. White, 1966. *Geology and Ground-water Resources of Portage County, Ohio*. Geological Survey Professional Paper. 1966.