N00164.AR.001955
NSA CRANE
5090.3a

FINAL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT FOR SOLID WASTE MANAGEMENT UNIT 22 LEAD AZIDE POND NSA CRANE IN
4/1/2014
TETRA TECH

FINAL
Resource Conservation and Recovery Act
Facility Investigation Report
For
SWMU 22 – Lead Azide Pond

Naval Support Activity Crane
Crane, Indiana

Naval Facilities Engineering Command
Midwest

Contract Number N62470-08-D-1001

Contract Task Order F279

April 2014

RESOURCE CONSERVATION AND RECOVERY ACT
FACILITY INVESTIGATION REPORT
FOR
SWMU 22 - LEAD AZIDE POND

NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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CONTRACT NUMBER N62470-08-D-1001
CONTRACT TASK ORDER F279

APRIL 2014

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ABBREVIATIONS AND ACRONYMS

µg/L	Micrograms per liter
°F	degrees Fahrenheit
2ADNT	2-amino-4,6-dinitrotoluene
4ADNT	4-amino-2,6-dinitrotoluene
ABG	Ammunition Burning Grounds
ASD	Applied Science Department
AST	Aboveground storage tank
atm-m^3/mole	Atmosphere-cubic meter per mole
BAF	Bioaccumulation factor
ATSDR	Agency for Toxic Substances and Disease Registry
BCF	Bioconcentration factor
bgs	below ground surface
BTEX	Benzene, toluene, ethylbenzene, and total xylenes
CAAA	Crane Army Ammunition Activity
CLEAN	Comprehensive Long-Term Environmental Action Navy
CNIC	Commander Naval Installation Command
COC	Chemical of concern
COPC	Chemical of potential concern
CSF	Cancer Slope Factor
CSM	Conceptual site model
CTE	Central tendency exposure
CTO	Contract Task Order
DCE	Dichloroethene
DI	Deionized
DNX	Hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine
DNT	2,4-dinitrotoluene
DO	Dissolved oxygen
DoD	Department of Defense
DPT	Direct push technology
DQR	Data quality review
DRO	Diesel range organics
DON	Department of the Navy
EC_{50}	Effects concentration 50 percent

Eco SSL	Ecological soil screening level
EEQ	Ecological effects quotient
EI	Environmental indicator
EPC	Exposure point concentrations
ERA	Ecological risk assessment
ERO	Extended range organics
f_{oc}	Fraction of organic carbon
FOL	Field operations leader
FSP	Field sampling plan
HASP	Heatlh and safety plan
HHRA	Human health risk assessment
HI	Hazard index
HMX	High melting explosive
HQ	Hazard quotient
IAS	Initial Assessment Study
IDEM	Indiana Department of Environmental Management
IDW	Investigation-derived waste
ILCR	Incremental Lifetime Cancer Risk
IUPPS	Indiana Underground Plant Protection Services
K_d	Soil-water distribution coefficient
K_{oc}	Organic carbon partition coefficient
K_{ow}	Octanol/water partition coefficient
LEL	Lowest effects level
LOAEL	Lowest observed adverse effect level
MCL	Maximum contaminant level
mg/kg	Milligrams Per Kilogram
mg/L	Milligrams per liter
MI	Mobility index
MNX	Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine
msl	Mean sea level
NAD	Naval Ammunition Depot
NAD83	North American Datum of 1983
NAPEC	Naval Ammunition Production Engineering Center
NAVD88	North American Vertical Datum of 1988
NAVFAC	Naval Facilities Engineering Command
NEESA	Naval Energy and Environmental Support Activity

NFA	No further action
NG	Nitroglycerin
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No observable adverse effect level
NOEC	No observed effect concentration
NSA	Naval Support Activity
NSWC	Naval Surface Warfare Center
NTU	Nephelometric Turbidity Unit
ORP	Oxidation-reduction potential
PAH	Polycyclic aromatic hydrocarbons
PEC	Probable effects concentration
PEL	Probable effects level
PID	Photoionization detector
PM	Project Manager
PPE	Personal protective equipment
PPRTV	Provisional Peer-Reviewed Toxicity Value
ppm	Parts per million
PR	Preliminary review
PVC	Polyvinyl chloride
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
RAGS	Risk Assessment Guidance for Superfund
RBTL	Risk-based target level
RCRA	Resource Conservation and Recovery Act
RCRIS	Resource Conservation and Recovery Information System
RD	Reductive dechlorination
RDX	Royal Demolition Explosive
RFI	RCRA Facility Investigation
RISC	Risk Integrated System of Closure
RME	Reasonable maximum exposure
RSL	Regional screening level
SAP	Sampling and analysis plan
SCS	Soil Conservation Service
SEL	Severe effects level
SLERA	Screening-level ecological risk assessment

SOP	Standard operating procedure
SP	Special Program
SPCS	State Plane Coordinate System
SQG	Soil quality guideline
SSL	Soil screening level
SWMU	Solid Waste Management Unit
TAL	Target analyte list
TCE	Trichloroethene
TEC	Threshold effects concentration
TEL	Threshold effects level
Tetra Tech	Tetra Tech NUS, Inc.
TNT	2,4,6-trinitrotoluene
TNX	Hexahydro-1,3,5-trinitroso-1,3,5-triazine
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
TRV	Toxicity reference value
UCL	Upper confidence limit
UFP	Unified Federal Policy
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
UTL	Upper tolerance limit
VOC	Volatile organic compound
VSI	Visual Site Inspection
WRS	Wilcoxon Rank Sum
WES	Waterways Experiment Station
WWII	World War II

EXECUTIVE SUMMARY

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for Solid Waste Management Unit (SWMU) 22 – Lead Azide Pond - was prepared for Naval Support Activity (NSA) Crane, located in Crane, Indiana, through Naval Facilities Engineering Command (NAVFAC) Midwest under Contract Task Order (CTO) F201 of the Comprehensive Long-Term Environmental Action Navy (CLEAN), Contract Number N62470-08-D-1001.

SWMU 22 is located in the north-central portion of NSA Crane. SWMU 22 is the area referred to as the Explosive Actuated Device (EAD)/Booster Area or the "Backline." The principal buildings in SWMU 22 are Buildings 136, 138, 2520, 2803, and 2855 through 2863 and 2905, as well as several ancillary buildings and an inert storage building (Building 2089). SWMU 22 is situated along an east-west trending ridge. It is bounded on the east, north, and south by drainages to Turkey Creek and on the west by Highway 45.

The Booster Area was designed and constructed to load 5-inch rockets during World War II. EADs were loaded with explosives such as lead azide, lead styphnate, tetryl, Royal Demolition Explosive (RDX), and black powder. Building 136 was used for the propellant portion of the EAD loading process, Building 138 was the pressing building for warheads, and Building 2520 was the final assembly building. A conveyor tunnel connected Buildings 136 and 2520 in support of the former process. Other primary explosives used in the Booster Area, principally in Building 138, included RDX, pentaerythritol tetranitrate (PETN), 2,4,6-trinitrotoluene (TNT), and nitroglycerin. The buildings associated with the Backline (i.e., the buildings between Buildings 136 and 2520) are scheduled for demolition.

An unlined retention pond (i.e., the Lead Azide Pond) was located at the northern end of the Backline. It received overflow wastewater from sumps associated with the process buildings. The retention pond was removed in 1981.

Field activities for SWMU 22 were conducted during three separate field events in January and April 2011, May 2012, and January 2013, in accordance with the UFP-SAP (Field Sampling Plan and Quality Assurance Plan) for SWMU 22 - Lead Azide Pond (Tetra Tech, 2011) and SAP Addendum (Tetra Tech, 2012). The field activities included:

- Mobilization/demobilization activities, including utility clearance.
- Surface and subsurface soil sampling using direct-push technology (DPT) and hand auger methods.

- Soil boring and monitoring well installation using hollow-stem auger (HSA) and air rotary drilling methods.
- Monitoring well development.
- Groundwater sampling.
- Water level measurement.
- Surface water and sediment sampling.
- In-situ hydraulic conductivity testing.
- Surveying.

Prior to evaluating the nature and extent of contaminants in soils, sediment, surface water, and groundwater, and conducting human health and ecological risk assessments for the subareas, the laboratory analytical data went through a Data Quality Review (DQR), including data verification and validation and a data usability assessment. In addition, metals concentrations in surface and subsurface soils were compared to the representative background soil data sets developed for NSA Crane.

Table ES-1 includes a summary of the human health risk assessment (HHRA) and screening-level ecological risk assessment (SLERA). A baseline HHRA was performed to characterize the potential risks to likely human receptors under current and potential future land use scenarios for SWMU 22. The HHRA identified no chemicals of potential concern (COPCs) for direct contact to surface soil and subsurface soil. RDX in subsurface soil was the only chemical identified as exceeding the screening levels for migration from soil to groundwater. RDX was not considered to be a chemical of concern (COC) for migration from soil to groundwater even though RDX was detected in groundwater because risks from RDX in groundwater were within acceptable levels. COPCs for direct contact to groundwater were RDX, arsenic, cadmium, hexavalent chromium, lead, and perchlorate; COPCs for direct contact to surface water were RDX, arsenic, and cadmium; and the COPC for direct contact to sediment was arsenic. The calculated cancer risks and hazard indices were for these COPCs were within acceptable risk levels. Analysis of lead in groundwater did not exceed the USEPA goal regarding lead exposures. Similarly, the SLERA, performed to characterize the potential risks to likely ecological receptors at SWMU 22 identified no chemicals of potential concern (COPC) in in surface soil, sediment, and surface water.

Based on the results of the human health and ecological risk assessments, NFA is recommended for SWMU 22. The NFA for SWMU 22 does not include potential sources of RDX and perchlorate upgradient of SWMU 22. Such potential sources would be addressed under separate investigations and remedial actions for those sources.

TABLE ES-1

SUMMARY OF RECEPTOR-SPECIFIC HUMAN RISKS AND HAZARDS, ECOLOGICAL RISKS, AND RECOMMENDATIONS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor Population	Environmental Media	Overall Carcinogenic Risk (Human)	Overall Hazard Index (Human)	Overall Risk (Ecological)	Critical Pathways & Chemicals of Concern	Recommendations
Current/Future Construction Worker (Adult)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Groundwater	2E-09	0.003	NA	NA	NFA
Current/Future Industrial Worker (Adult)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
Current/Future Trespassers (Adolescent)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Surface Water	3E-08	0.002	NA	NA	NFA
	Sediment	2E-07	0.002	NA	NA	NFA
Future Recreational User (Child)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Surface Water	4E-08	0.004	NA	NA	NFA
	Sediment	9E-07	0.02	NA	NA	NFA
Future Recreational User (Adult)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Surface Water	5E-08	0.001	NA	NA	NFA
	Sediment	4E-07	0.003	NA	NA	NFA
Future Recreational User (Lifelong)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Surface Water	9E-08	NA	NA	NA	NFA
	Sediment	1E-06	NA	NA	NA	NFA
Hypothetical Resident (Child)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Groundwater	5E-05	3(1)	NA	NA	NFA
	Surface Water	2E-08	0.002	NA	NA	NFA
	Sediment	4E-07	0.01	NA	NA	NFA
Hypothetical Resident (Adult)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Groundwater	9E-05	1	NA	NA	NFA
	Surface Water	5E-08	0.001	NA	NA	NFA
	Sediment	4E-07	0.003	NA	NA	NFA
Hypothetical Resident (Lifelong)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA	NFA
	Groundwater	1E-04	NA	NA	NA	NFA
	Surface Water	7E-08	NA	NA	NA	NFA
	Sediment	8E-07	NA	NA	NA	NFA
Mammals and Birds	Surface Soil	NA	NA	Acceptable	NA	NFA
Terrestrial Plants and Invertebrates	Surface Soil	NA	NA	Acceptable	NA	NFA
Sediment Invertebrates	Sediment	NA	NA	Acceptable	NA	NFA
Mammals and Birds	Sediment	NA	NA	Acceptable	NA	NFA
Aquatic Organisms	Surface Water	NA	NA	Acceptable	NA	NFA
Mammals and Birds	Surface Water	NA	NA	Acceptable	NA	NFA

NFA = No further action
CMS = Corrective Measures Study
1 - Target organs HI ≤ 1.

1.0 INTRODUCTION

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for Solid Waste Management Unit (SWMU) 22 – Lead Azide Pond - was prepared for Naval Support Activity (NSA) Crane, located in Crane, Indiana, through Naval Facilities Engineering Command (NAVFAC) Midwest under Contract Task Order (CTO) F279 of the Comprehensive Long-Term Environmental Action Navy (CLEAN), Contract Number N62470-08-D-1001. The RFI was conducted in accordance with the Unified Federal Policy (UFP) - Sampling and Analysis Plan (SAP) (Field Sampling Plan and Quality Assurance Plan) for SWMU 22 – Lead Azide Pond (Tetra Tech, 2011) and SAP Addendum (Tetra Tech, 2012).

1.1 PURPOSE

The purpose of this RFI Report is to describe the site investigation activities conducted at SWMU 22 and to present the results and interpretation thereof for SWMU 22. In addition, human health and ecological risks associated with SWMU 22 were evaluated through a baseline human health risk assessment (HHRA) and screening-level ecological risk assessment (SLERA).

1.2 SITE BACKGROUND

Locations and descriptions of NSA Crane and SWMU 22 are presented in the following subsections.

1.2.1 Facility Location and Description

NSA Crane is located in a rural sparsely populated region of south-central Indiana, approximately 75 miles southwest of Indianapolis, 60 miles northwest of Louisville, Kentucky, and immediately east of Burns City and Crane Village, Indiana. A location map of the NSA Crane facility is provided as Figure 1-1. NSA Crane is the third largest United States naval installation in the world. The base includes over 3,000 buildings and covers more than 63,000 acres in northern portion of Martin County and smaller portions of Greene, Daviess, and Lawrence Counties. More than 5,000 military and DoD civilian and contractor personnel work at NSA Crane (CNIC, 2010). Currently, NSA Crane hosts several commands and divisions, including Naval Surface Warfare Center (NSWC) Crane Division, which provides material, technical, and logistical support to the Department of the Navy for equipment, shipboard weapons systems, and nonexpendable ordnance items. In addition, NSA Crane supports the Crane Army Ammunition Activity (CAAA) with production, renovation, storage, shipment, demilitarization, and disposal of conventional ammunition.

The facility was commissioned in 1941 as the Naval Ammunition Depot (NAD) Burns City to serve as an inland munitions production and storage center for the Navy. Operations at the facility originally included production, testing, and storage of ordnance. The facility was constructed on land publicly acquired under the White River Land Utilization Project (35,000 acres) and land purchased from private ownership (26,830 acres) beginning in 1934. Prior to its acquisition by the Navy, the land was largely used for timber and agriculture (Tetra Tech, 2001). The name of the facility was changed in 1943 to NAD Crane, in 1975 to the Naval Weapons Support Center, and in 1992 to Naval Surface Warfare Center (NSWC) Crane. In 2003, NSWC Crane operations fell under the command structure of NSA Crane during regional reorganization by the Navy. DoD ammunition procurement responsibility was transferred to the Army in 1977. The Army assumed ordnance production, storage, and related responsibilities at the facility, which continues to the present.

1.2.2 SWMU 22 Location and Description

Figure 1-2 shows layout of SWMU 22. SWMU 22 is the area referred to as the Explosive Actuating Device (EAD)/Booster Area or the "Backline." The principal buildings in SWMU 22 are Buildings 136, 138, 2520, 2803, and 2855 through 2863 and 2905, as well as several ancillary buildings and an inert storage building (Building 2089). The Booster Area was designed and constructed to load 5-inch rockets during World War II. EADs were loaded with explosives such as lead azide, lead styphnate, tetryl, Royal Demolition Explosive (RDX), and black powder. Building 136 was used for the propellant portion of the EAD loading process, Building 138 was the pressing building for warheads, and Building 2520 was the final assembly building. A conveyor tunnel connected Buildings 136 and 2520 in support of the former process. Other primary explosives used in the Booster Area, principally in Building 138, included RDX, pentaerythritol tetranitrate (PETN), 2,4,6-trinitrotoluene (TNT), and nitroglycerin.

An unlined retention pond (i.e., the Lead Azide Pond) was located at the northern end of the Backline. It received overflow wastewater from sumps associated with the process buildings. The retention pond was removed in 1981. The buildings associated with the Backline (buildings between Buildings 136 and 2520) were demolished in 2012.

1.3 PREVIOUS INVESTIGATIONS

Surface water and sediment samples were collected in 1979 from the drainage ditch below (i.e., northeast) the former pond (USAEHA, 1979). Surface water from the drainage ditch had lead concentrations ranging from 0.18 to 1.99 milligrams per liter (mg/L) and RDX concentrations of 0.02 to

4.4 mg/L. Sediment from the drainage ditch had a lead concentration of 2,860 milligrams per kilogram (mg/kg), and a sediment sample from the bottom of the pond had a lead concentration of 12,900 mg/kg.

According to the Initial Assessment Study (IAS) (NEESA, 1983) sludge samples from the Lead Azide Pond (date and location of collection not identified) had concentrations of lead varying from 0.03 parts per million (ppm) to 17 ppm, barium from less than 0.1 to 1.0 ppm, antimony from 0.5 to 2.0 ppm, and chromium from less than 1.0 to about 1,300 ppm. (Note: units of ppm are as presented in the IAS.)

A water sample from a drainage outfall north of Building 2520 collected during a storm water event in April 1996 had an RDX concentration of 4.1 micrograms per liter (µg/L). Lead was not detected in this sample. Surface water samples collected as part of the Storm Water Pollution Prevention Plan from the same location in 2005, 2006, 2007, 2008, and 2009 had no detections of RDX greater than laboratory detection limits (DLs). Lead was detected at concentrations of 0.0048, 0.001, and 0.001 mg/L in 2005, 2006, and 2007, respectively. Lead was not detected in storm water sampled in 2008 and 2009.

1.4 REPORT ORGANIZATION

This RFI report is organized as follows:

- Section 1.0 of this report is the introduction, including the purpose of the report, background information for the facility and site, summaries of previous investigations, and report organization.

- Section 2.0 describes the study area field sampling activities and procedures associated with data collection.

- Section 3.0 describes the general physical characteristics for SWMU 22.

- Section 4.0 presents the data quality review.

- Section 5.0 presents the nature and extent of contamination.

- Section 6.0 presents the fate and transport analysis and conceptual site model (CSM).

- Section 7.0 presents the HHRA.

- Section 8.0 presents the SLERA.

- Section 9.0 provides a summary and conclusions of the RFI.

Supporting documentation for this report is presented in Appendices A through G. The information included in each appendix is as follows:

- Appendix A – Field investigation documentation (boring logs, well construction diagrams, groundwater level measurement forms, sample log sheets, and slug test data).

- Appendix B – Miscellaneous field documentation (equipment calibration forms, work permits, Field Task Modification Request (FTMR) forms, and survey data).

- Appendix C – Data Quality Review (DQR).

- Appendix D – Analytical data.

- Appendix E – Supporting documentation for the HHRA.

- Appendix F – Supporting documentation for the SLERA.

The DQR (Appendix C) included evaluation of the laboratory analytical data collected during RFI activities conducted between January 2011 and May 2013. Complete analytical data sets are provided in Appendix D.

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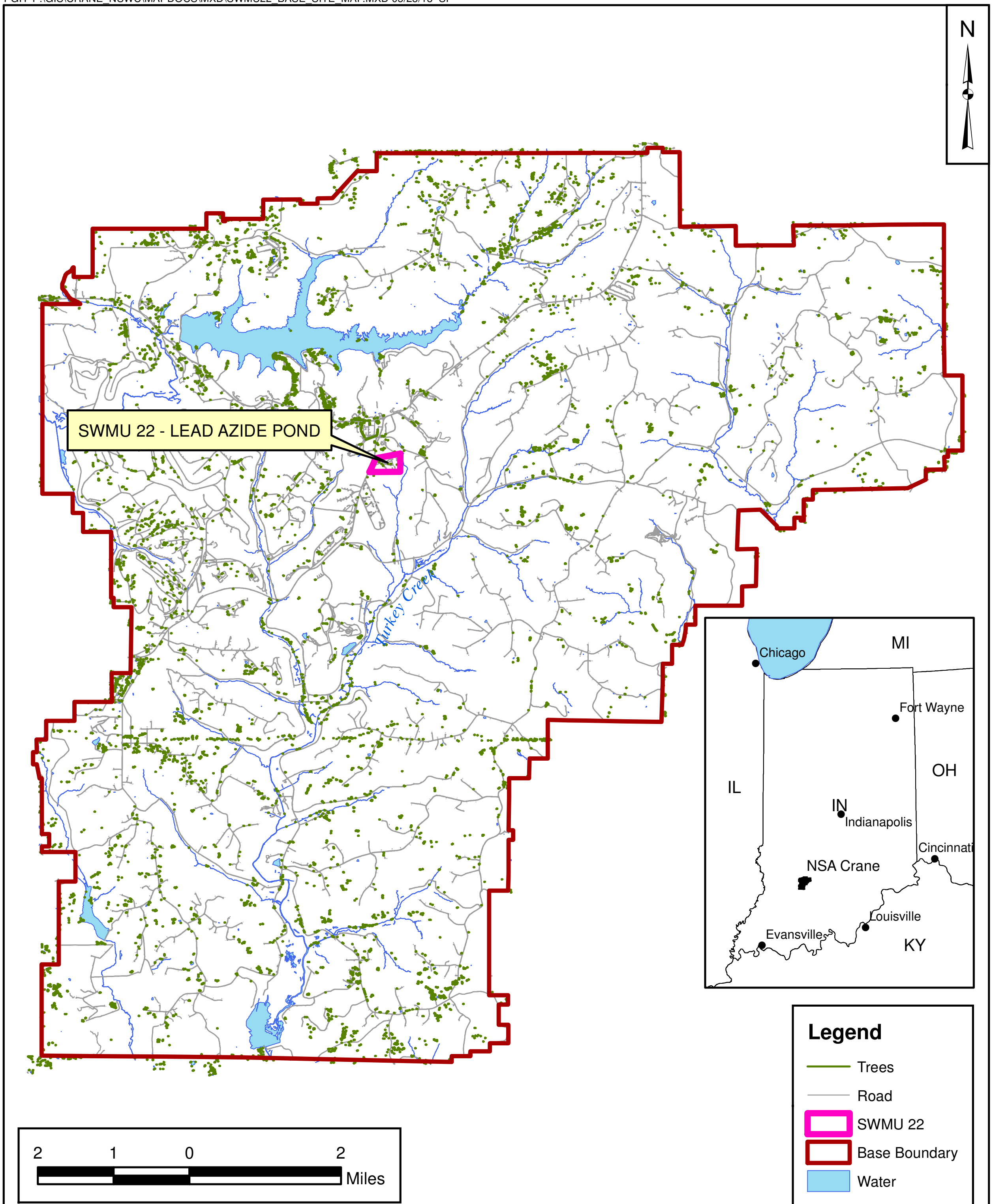

DRAWN BY J. ENGLISH	DATE 07/14/09	TETRA TECH	CONTRACT NUMBER CTO F279	
CHECKED BY S. HILL	DATE 05/23/13	BASE AND SITE LOCATION MAP SWMU 22 - LEAD AZIDE POND NSA CRANE CRANE, INDIANA	APPROVED BY	DATE
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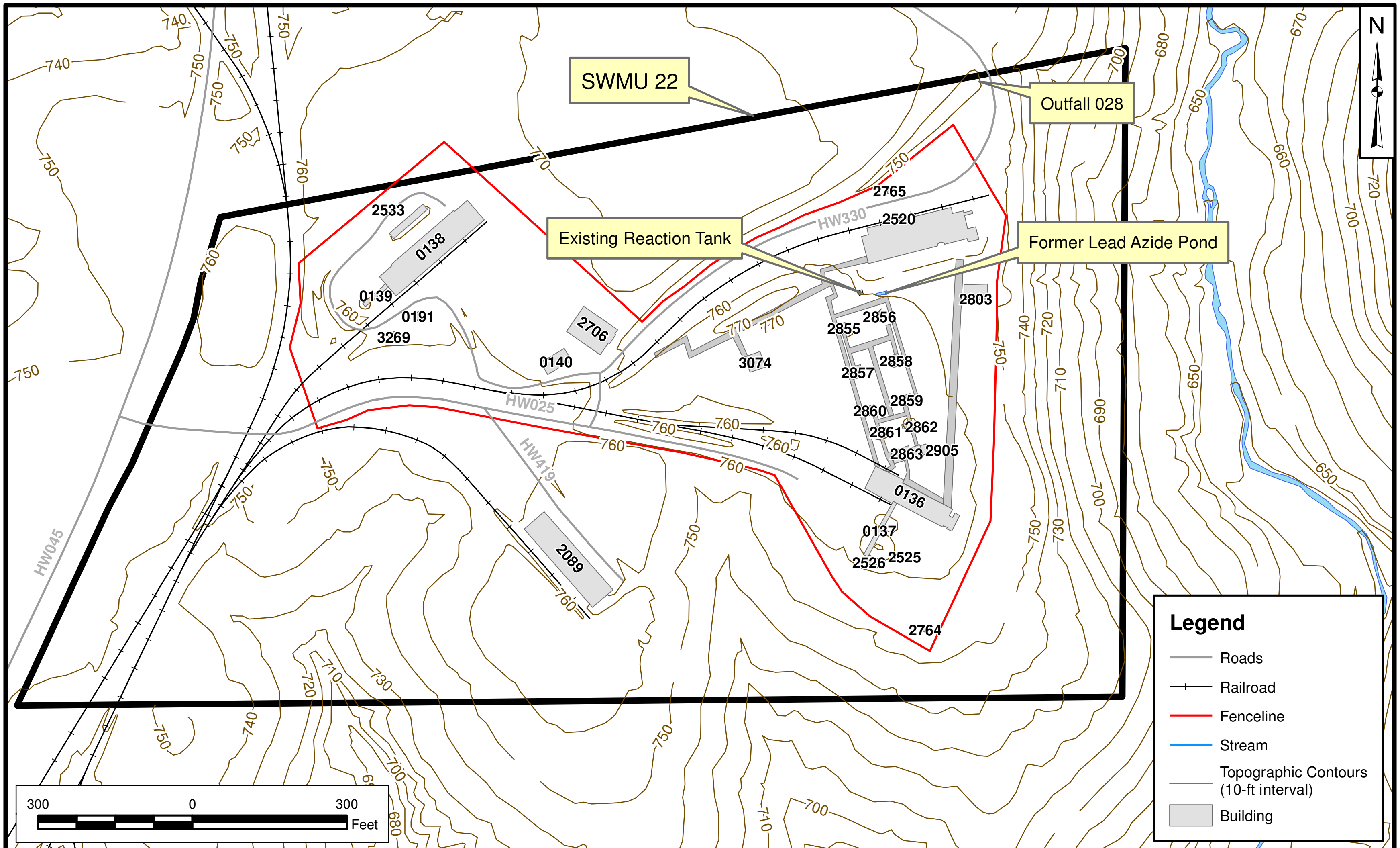

DRAWN BY T. WHEATON	DATE 08/26/09	TETRA TECH	CONTRACT NUMBER CTO F279
CHECKED BY S. HILL	DATE 05/23/13	SITE LAYOUT - ELEVATION CONTOUR MAP SWMU 22 - LEAD AZIDE POND NSA CRANE CRANE, INDIANA	APPROVED BY ____ DATE ____
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2.0 FIELD INVESTIGATION

This section presents sampling activities, sampling procedures, and field documentation used during field activities performed for NSA Crane SWMU 22 – Lead Azide Pond.

2.1 OVERVIEW

Field activities for SWMU 22 were conducted during three separate field events in January and April 2011, May 2012, and January 2013. RFI field activities were conducted in accordance with the procedures and methodologies in the Navy- and Indiana Department of Environmental Management (IDEM)-approved UFP-SAP (Field Sampling Plan and Quality Assurance Plan) for SWMU 22 - Lead Azide Pond (Tetra Tech, 2011) and SAP Addendum (Tetra Tech, 2012), with deviations from the UFP-SAP as noted in Section 2.13. Additional sampling was performed under Field Task Modification Requests dated December 2012 and provided in Appendix A. Standard Operating Procedures (SOPs) that governed the field work were as provided in the SAP and SAP Addendum.

The RFI field activities included the following:

- Mobilization/demobilization activities, including utility clearance.
- Surface and subsurface soil sampling using direct-push technology (DPT) and hand auger methods.
- Soil boring and monitoring well installation using hollow-stem auger (HSA) and air rotary drilling methods.
- Monitoring well development.
- Groundwater sampling.
- Water level measurement.
- Surface water and sediment sampling.
- In-situ hydraulic conductivity testing.
- Surveying.

Boring logs, well construction diagrams, sample log sheets, and slug test data are provided in Appendix A, and chain-of-custody forms, equipment calibration forms, groundwater level measurement forms, work permits, FTMR forms, and survey data are provided in Appendix B.

2.2 MOBILIZATION/DEMOBILIZATION

Prior to each field event, field team members reviewed the approved UFP-SAP and Health and Safety Plan (HASP) prior to the start of field activities and attended an orientation given by the Field Operations Leader (FOL) to ensure that personnel were familiar with the scope of field activities. The FOL coordinated with base personnel and Indiana Underground Plant Protection Services (IUPPS) to obtain utility clearance for the areas under investigation. Safety and building availability (explosives safety) permits were obtained from Army explosive safety officers. Work permits were requested from and issued by the NSA Crane fire department (Appendix B). Equipment requirements, including transport to the site, decontamination, and demobilization of all necessary equipment, were managed by the FOL.

2.3 SOIL INVESTIGATION

2.3.1 Surface and Subsurface Soil Sampling

Soil samples were collected using both hand auger and DPT methods. Soil samples were collected for chemical analyses and for lithologic logging. Boring logs and soil sample log sheets for the soil samples are provided in Appendix A. Summaries of soil sample analyses and depths are provided in Tables 2-1 and 2-3. Figure 2-1 shows the locations of soil samples collected during the RFI at SWMU 22.

The soil samples were collected in accordance with the SAP (Tetra Tech, 2011). Surface soil samples were collected from 0 to 2 feet below ground surface (bgs), and subsurface soil samples were collected from below 2 feet bgs. If refusal on bedrock was encountered before the desired subsurface sample depth, the sample was collected from the 2-foot soil interval (if possible) above the bedrock surface.

The following discussion summarizes the soil samples collected during the three RFI field events.

January 2011

A total of 22 soil samples were collected as part of January 2011 field activities. Two surface soil samples (0 to 2 feet bgs) were collected at locations 22SS01 and 22SS02 using a stainless steel hand auger. Twenty soil samples were collected from 11 soil boring locations (Figure 2-1). Ten soil boring locations were sampled using DPT sampling methods. Due to access limitations, samples at location 22SB007 were collected using a hand auger. At three locations (22SB001, 22SB005, and 22SB008), sampler refusal was encountered before the target depth, and one subsurface soil sample interval was not collected. The January 2011 soil samples were analyzed for explosives, perchlorate, and RCRA metals. At two locations (22SB001 and 22SB008), samples were also analyzed for pH.

May 2012

A total of 13 soil samples were collected as part of May 2012 field activities. Of the 20 soil samples proposed (SAP Worksheet 18), 13 soil samples were collected from eight soil boring locations, and two samples were collected from surface soil locations (Figure 2-1). At four locations (22SB012, 22SB013, 22SB015, and 22SB017), sampler refusal was encountered and the bottom soil interval sample(s) was not collected. One location, 22SB019, not included in the SAP Addendum, was added in the field based on Navy recommendation because it was in a drainage swale that may have been impacted by past site operations [see FTMR in Appendix B]. Soil samples from two locations (22SB014 and 22SB018) were collected using split-spoon sampling techniques with a track-mounted HSA drilling rig. Location 22SB014 was converted to monitoring well 22MWT03, and the soil samples from this location were collected during boring advancement for well installation. Location 22SB018 was not accessible with the truck-mounted DPT rig and was sampled using the track-mounted HSA rig. Two surface soil locations (22SS022 and 22SS025) were listed in the SAP as sediment/surface water locations; both locations were dry (i.e., no water present) at the time of sampling and therefore proposed sediment samples were collected as surface soil samples. Location 22SS022 was collected using a soil probe, and 22SS025 was collected using a disposable plastic trowel. The remaining six soil boring locations were sampled using DPT methods. All May 2012 soil samples were analyzed for explosives, PETN, nitrogylcerin, and RCRA metals. At two locations (22SB001 and 22SB008) pH analysis was also conducted.

January 2013

A total of seven soil samples were collected as part of January 2013 field activities. Of the nine soil samples proposed, seven soil samples were collected from six soil boring locations (Figure 2-1). Surface soil samples were collected from five locations (22SS004, 22SS005, 22SS006, 22SS007, and 22SS008). At locations 22SS005 and 22SS007, subsurface soil samples were proposed to be collected from 2 to 3 feet bgs, but sampler refusal was encountered at both locations at less than 2 feet bgs. Surface and subsurface (2 to 3 feet bgs) soil samples were collected from location 22SB020. The January 2013 soil samples were analyzed for RDX and TNT. The 0- to 2-foot sample from location 22SB020 was also analyzed for chromium speciation.

2.3.2 Soil Boring Advancement and Abandonment

Soil borings were advanced to collect soil samples for lithological characterization and chemical analyses. A total of 20 soil borings were advanced at SWMU 22 for the RFI, as summarized in Table 2-1. Locations of soil samples are illustrated on Figure 2-1.

The soil borings were advanced using DPT methods, HSA with split-spoon sampling, or where access or terrain prohibited use of the DPT rig, a hand auger, in accordance with SOP-08 (Borehole Advancement and Soil Coring Using DPT and Hand Auger Techniques) of the UFP-SAP (Tetra Tech, 2011). Soil samples were collected during borehole advancement at 2-foot (split-spoon) or 4-foot (DPT) intervals. Upon retrieval, the soil samples from the borings were screened with a photoionization detector (PID) for volatile organic compounds (VOCs), and the PID readings were recorded on the boring logs. In addition, descriptions of soil classification, lithology changes, moisture content, depth to water, drilling methods, and total depth of each borehole were included on each boring log. Boring logs are provided in Appendix B.

Soil borings for soil sampling only were abandoned following advancement. Soil borings advanced via DPT probing or hand augering were backfilled with the excess soil removed during borehole advancement. If additional fill material was needed, bentonite chips were used to backfill the boring to within a few inches of the surface. The ground surface at each abandoned boring location was restored to its original condition (i.e., soil, asphalt or concrete patch).

2.4 GROUNDWATER INVESTIGATION

2.4.1 Monitoring Well Installation and Development

Six monitoring wells were installed for the RFI at SWMU 22. A summary of monitoring well construction is provided in Table 2-2, and monitoring well locations are shown on Figure 2-1.

Bedrock drilling and logging were conducted in accordance with SOP-13 (Drilling and Geologic Logging of Boreholes) of the UFP-SAP (Tetra Tech, 2011). The well boreholes for the monitoring wells were drilled using HSA techniques to drill through overburden material and air coring techniques to drill in bedrock. In the overburden, 4.25- or 10-inch inside diameter HSAs were advanced to the top of bedrock, and split-spoon samples were collected continuously during auger advancement for soil characterization and screening for VOCs with a PID. Prior to advancing the boreholes into bedrock, temporary casing was installed to the top of bedrock, or the 10-inch inside diameter HSAs was used as temporary casing. One borehole (22MWT005) was cored using NX-sized, wire-line, air coring techniques for characterization of bedrock lithology and fracturing patterns. The cored borehole and the remaining boreholes were reamed or advanced using 6-inch-diameter air rotary techniques.

The six monitoring wells (22MWT01 through 22MWT006) were installed in the boreholes in accordance with SOP-12 (Monitoring Well Installation) of the UFP-SAP (Tetra Tech, 2011). The monitoring wells were constructed of 2-inch-diameter, Schedule 40, flush-joint, polyvinyl chloride (PVC) riser pipe and 10-foot-long slotted screens with a slot size of 0.010-inch. Sand filter packs were installed in the annulus around the well screens from approximately 0.5 to 1 foot below the bottom of the well screen to 2 feet above the top of the well screen. A 2-foot-thick bentonite seal was installed above the filter pack, and the remaining annulus was sealed with cement-bentonite grout to within 2 to 3 feet the ground surface.

A 6-inch steel protective surface casing with a locking cap and pad lock was set in a 4-foot by 4-foot by 6-inch-thick concrete pad around each well to protect the PVC well casing. Four steel bollards were placed just outside the corners of each concrete pad and filled with concrete. The protective casings and bollards were painted with enamel safety yellow paint. Stainless steel tags, listing the well IDs, dates installed, total depths, screen lengths, coordinates, survey information, and contact information were installed on the protective casings. Copies of the boring log and well construction sheets are provided in Appendix A.

The monitoring wells were developed to remove fine sediment from within and around the well screens. The wells were developed no sooner than 48 hours after installation (i.e., grouting), in accordance with SOP-14 of the UFP-SAP (Tetra Tech, 2011). The wells were developed by surging and pumping, or for wells that were slow to recover, repeated pumping or bailing dry over several days. All purge water removed from the wells during the development process was stored in a portable holding tank and discharged into a designated manhole for treatment at the NSA Crane water treatment facility. Monitoring well development logs can be found in Appendix A.

2.4.2 Groundwater Purging and Sampling

All six newly installed monitoring wells were purged and sampled during the May 2012 field effort, and well 22MWT005 was purged and sampled in April and May 2013 (for hexavalent chromium). Purging was performed using low-flow techniques with a bladder pump, except 22MWT005, in accordance with SOP-16 (Low Flow Well Purging and Stabilization) of the UFP-SAP (Tetra Tech, 2011). Well 22MWT005 was purged and sampled using a dedicated, disposable bailer due to a low water level in the well. Sampling of groundwater was performed in accordance with SOP-17 (Groundwater Sampling). A summary of groundwater samples and analyses is provided in Table 2-1.

The wells were purged and sampled using bladder pumps with Teflon® bladders and Teflon®-lined polyethylene tubing, except for wells 22MWT005 and 22MWT006. These two wells had an insufficient water column for purging and sampling with a bladder pump and so were purged and sampled using dedicated disposable bailers. During purging of all wells, water quality parameters of pH, specific conductance, temperature, dissolved oxygen (DO), turbidity, and oxidation-reduction potential (ORP) were measured and recorded at 5- to 10-minute intervals using a multi-parameter water quality meter and flow-through cell. Water levels and pumping rates were measured during purging and recorded at 5- to 10-minute intervals. Purging continued at each well until a minimum of one well volume was removed from the well and the parameters stabilized within the limits of pH +/-0.1 unit, specific conductance +/-5 percent, temperature +/-5 percent, turbidity less than 10 Nephelometric Turbidity Units (NTUs), and dissolved oxygen +/-10 percent. If, after 2 hours of purging, the stabilization conditions were not met, purging was considered complete and sampling was performed. At well locations where turbidity readings remained greater than 10 NTUs, sample aliquots were collected for dissolved metals and field-filtered with a 0.45-micron in-line filter prior to preservation. Sample containers were filled directly from the low-flow bladder pump by allowing the pump discharge to flow gently down the inside of each container with minimal turbulence.

Pertinent field data including sampling methods, purge information, and pump intake depths were recorded on low-flow purge data sheets and groundwater sample log sheets (Appendix A).

2.4.3 Groundwater Level Measurements

One round of synoptic water level measurements was obtained from the SMWU 22 monitoring wells as part of the RFI. Groundwater level measurements were taken within a 24-hour period using an electronic water level meter. Water level elevations were recorded to within 0.01-foot accuracy from marked reference points on the well riser pipes. Water levels were recorded on a groundwater level measurement form, provided in Appendix A. Groundwater elevations are summarized in Table 2-2, and interpretation of the groundwater flow direction is discussed in Section 3.

2.4.4 In-Situ Hydraulic Conductivity Testing

In-situ hydraulic conductivity testing (i.e., slug tests) was conducted to estimate the bulk hydraulic conductivity of the shallow bedrock aquifer at SWMU 22. The hydraulic conductivity estimates assist with determination of the advective groundwater flow rate.

Rising-head slug tests were performed in three wells (22MWT002, 22MWT003, and 22MWT006) in July 2013. The rising-head tests were performed by inserting a solid plastic slug into the well and allowing the water level to recover to its initial position. The solid slug was then removed, and the rate of rise in the water level back to equilibrium was measured. The changes in water levels were induced as quickly as possible to approximate an instantaneous change in head. Water level data (i.e., water levels and elapsed times) were collected electronically using a Schlumberger Water Services Diver pressure transducer.

Slug test data were used to calculate values of horizontal hydraulic conductivity for the aquifer in the immediate vicinity of each well tested. The data were analyzed using the Bouwer-Rice Method (Bouwer and Rice, 1976) with the Windows®-based program AquiferTest. Slug test results are provided in Appendix A and discussed in Section 3.

2.5 SURFACE WATER/SEDIMENT INVESTIGATION

A total of 23 surface water and 18 co-located sediment samples were collected for the SWMU 22 RFI. Surface water and sediment samples were collected from the headwater to Turkey Creek and four drainage areas that flow to the headwater of Turkey Creek. With the exception of sediment sample 22SD26, which was collected from the settling basin northwest of Building 138, sediment samples were co-located with surface water sample locations. At a number of the proposed surface water and sediment locations, the stream was dry; therefore, no surface water was collected. Similarly, at a number of the surface water locations, the stream bed consisted of exposed bedrock and therefore no sediment sample was collected.

The surface water and sediment samples were collected in accordance with SOPs 05 (Surface Water Sampling) and 07 (Sediment Sampling) of the UFP-SAP (Tetra Tech, 2011). Locations were sampled in order from downstream to upstream, and surface water samples were collected prior to sediment sampling at each location. Surface water quality parameters (pH, specific conductivity, temperature, DO, turbidity, and ORP) were measured and recorded at each location, and all surface water samples were collected by direct filling of the sample bottles. Sediment samples were collected at the same locations as surface water samples, except as noted above. Field data including water quality parameter measurements, sampling methods, and locations were recorded on sediment and surface water sample log sheets (Appendix A). Sample locations were marked with a labeled pin flag to facilitate relocation of the locations for surveying purposes. Sampling methods, depths of the stream channel, and estimated flow rates were also recorded on the sample log sheets (see Appendix A).

A summary of surface water and sediment samples is provided in Table 2-1, and locations of surface water and sediment samples are illustrated on Figure 2-1.

The following discussion summarizes the surface water and sediment samples collected during the three field events.

January 2011

Nineteen surface water samples were collected at SWMU 22 during the January 2011 field effort. Samples 22SW005 and 22SW008 were not collected due to the absence of water. Surface water samples were analyzed for explosives, perchlorate, and total and dissolved RCRA metals including mercury. (The dissolved metals fraction was collected by collecting surface water in an unpreserved bottle, then filtering the sample through a 0.45-micron filter into a pre-preserved sample bottle with a peristaltic pump in the field trailer at NSA Crane.)

Twelve sediment samples were collected as part of the sampling effort. Sediment samples were collected at depths of 0 to 6 inches bgs, except at locations 22SD006, 22SD007, and 22SD008, where an upper sediment sample was collected at 0 to 6 inches and a second sample was collected from 6 to 24 inches bgs. The January 2011 sediment samples were analyzed for explosives, RCRA metals, and total organic carbon (TOC). At location 22SD006, pH analysis was conducted for both sample intervals (0 to 6 inches and 6 and 24 inches).

May 2012

Four surface water samples were collected during the May 2013 field effort and analyzed for total and dissolved RCRA metals, pH, explosives, PETN, and nitroglycerin. Six sediment samples were collected as part of the May 2012 sampling effort and analyzed for TOC, PETN, and nitroglycerin. Samples from select locations were also analyzed for explosives, pH, and RCRA metals.

Surface water locations 22SW10 and 22SW17 and sediment location 22SD18 were sampled during both January 2011 and May 2012. During the May 2012 event, additional analyses for TOC, PETN, and nitroglycerin were conducted at both sediment locations, and additional analyses for PETN and nitroglycerin were conducted at both surface water locations; RCRA metals was also analyzed for location 22SW17.

January 2013 Field Effort

One surface water sample was proposed for the January 2013 field effort but was not collected due to the absence of water at the location. One sediment sample was collected as part of the January 2013 sampling effort and analyzed for RDX and TNT.

2.6 SETTLEMENT BASIN INVESTIGATION

One sediment sample (22SD026) was collected from the base of the settling basin located north of Building 138. The sediment was sampled using a stainless steel pitcher attached to a section of pipe to reach to the bottom of the basin. Field data including sampling methods, conditions in the basin, and location of the sample within the basin were recorded on a sediment sample log sheet (Appendix A). The settling basin sediment sample was analyzed for explosives, PETN, nitroglycerin, and RCRA metals.

2.7 FIELD SAMPLE DOCUMENTATION

SWMU 22 RFI field activities were documented in accordance with SOP-03 (Sample Custody and Documentation of Field Activity) of the UFP-SAP (Tetra Tech, 2011). Documentation included boring logs, well construction sheets, well development sheets, medium-specific sample log sheets, chain-of-custody records, equipment calibration log sheets, and work permits. Copies of this documentation are provided in Appendices A and B.

2.8 SAMPLE HANDLING, PACKAGING, AND SHIPPING

Sample handling activities included field-related considerations concerning the selection of sample containers, preservatives, allowable holding times, sample custody, and maintaining samples at the appropriate storage temperature. Sample handling activities were conducted in accordance with SOP-04 (Sample Preservation, Packaging, and Shipment) of the UFP-SAP (Tetra Tech, 2011). Sample containers were provided by the laboratory. Following collection of a sample, sample containers were sealed in Ziploc® plastic bags, and glass containers were wrapped in plastic bubble wrap. Sample containers were then packed in ice in a large, plastic, garbage bag within a cooler. A temperature blank was placed in each cooler prior to shipment. The chain-of-custody form for the associated samples was sealed in a Ziploc® bag and taped to the inside of the cooler lid. A signed and dated custody seal was applied to each end of the cooler and then covered with strapping tape to provide a tamper-evident chain-of-custody seal. Samples were shipped to the laboratories [APPL, Inc. of Clovis, California, and ALS of Rochester York, New York (chromium speciation only)] via overnight delivery. Tetra Tech maintained custody of the samples until they were relinquished to FedEx® for shipment. FedEx® tracking numbers (airbill numbers) were recorded on the appropriate chain-of-custody forms, and the sender's copy of the airbill was maintained for shipment tracking, if needed. Samples were received within sample holding times and at required temperatures.

2.9 QUALITY CONTROL SAMPLES

Quality assurance (QA) and quality control (QC) samples were generated and collected during sampling activities for the SWMU 22 RFI to monitor both field and laboratory procedures, in accordance with the UFP-SAP. Field QA/QC samples included field duplicates, equipment blanks, rinsate blanks, trip blanks, and temperature blanks. Matrix spike/matrix spike duplicate (MS/MSD) samples were also collected for laboratory QA/QC, at the rate of 1 in 20 per medium. QA/QC samples are defined as follows:

- <u>Field Duplicates</u> – Field duplicates consisted of two samples collected either independently at a sampling location at approximately the same time in the case of soil and sediment VOC samples, groundwater, and surface water samples, or as a single sample split into two portions in the case of non-VOC soil and sediment samples. Field duplicates were collected at the rate of 1 in 20 per medium and were used to assess the overall precision of the sampling and analysis program.

- <u>Trip Blanks</u> – Laboratory-prepared trip blanks, consisting of analyte-free water, were used to indicate whether contamination of VOC samples had occurred during bottleware shipment or storage. One trip blank was placed in each cooler containing samples for VOC analysis.

- <u>Equipment Rinsate Blanks</u> – Equipment rinsate blanks were collected at the rate of 1 in 20 for non-dedicated equipment and once per batch for disposable equipment. Equipment rinsate blanks were obtained under representative field conditions by collecting the rinse water generated by running reagent-grade water through or over sample collection equipment after decontamination and before use. When pre-cleaned, dedicated, or disposable sampling equipment was used (i.e., no decontamination was required), one equipment rinsate blank was collected as a batch blank. Equipment rinsate blanks were analyzed for the same chemical constituents as the associated environmental samples.

- <u>Temperature blanks</u> – Temperature blanks were used to determine if samples were adequately cooled during shipment and consisted of a sample container of water supplied by the laboratory and placed in each cooler. The temperature of each container was checked upon receipt at the laboratory.

2.10 FIELD INSTRUMENT MEASUREMENTS

Field measurements recorded during the SWMU 22 field sampling activities included temperature, pH, specific conductance, ORP, DO, and turbidity for groundwater and surface water samples; PID readings for soil samples; and groundwater level measurements. The following field instruments were used to obtain these measurements:

- Multi-parameter water-quality meter (Horiba U-52)
- Water level indicator (Heron Dipper-T)
- PID (MiniRAE Plus with 10.6-electron volt lamp)

2.10.1 Equipment Calibration

Field instruments (water quality meters and PIDs) were calibrated daily prior to use according to manufacturers' requirements. Copies of equipment calibration logs are provided in Appendix B.

2.10.2 Field Investigation Preventative Maintenance Procedures/Schedules

An appropriate daily maintenance check was made on each piece of equipment. No instruments were damaged or defective through the course of the several field events, which may have impacted the accuracy of readings.

2.11 SURVEYING

SWMU 22 RFI soil, sediment, and surface water sample locations and monitoring wells were surveyed by an Indiana-licensed surveyor to obtain both horizontal locations and vertical elevations. NSA Crane-established survey control points were used. Horizontal coordinates were surveyed to the nearest 0.1 foot and referenced to the Indiana State Plane Coordinate System (SPCS), North American Datum of 1927 (NAD 27). Vertical elevations were surveyed to the nearest 0.01 foot and referenced to Mean Sea Level, North American Vertical Datum of 1988 (NAVD88). Vertical elevations were measured for the tops of PVC well casings, tops of steel protection casings, and the ground surface for all of the newly installed wells. A copy of the survey data is provided in Appendix A.

2.12 DECONTAMINATION

Non-dedicated (reusable) sampling equipment was decontaminated before beginning work, during drilling and sampling activities (i.e., between sample intervals and between sampling/boring locations), and at the completion of the drilling and sampling in accordance with SOP-20 (Decontamination of Field Sampling Equipment). Equipment included drilling rigs, downhole tools, and soil, sediment, and water sampling equipment.

Decontamination of sampling equipment (e.g., split-spoon samplers, DPT Macroore® samplers, hand augers, etc.) included the following:

- Potable water and phosphate-free detergent wash (scrub if necessary)
- Potable water rinse
- Deionized (DI) water rinse
- Air dry (if possible)

Field analytical equipment such as pH, conductivity, and temperature probes were rinsed first with analyte-free water then with the sample prior to making measurements. Water level meters were rinsed with DI water.

Drilling equipment (e.g., HSAs, drilling rods, drilling rigs, etc.) was decontaminated using high-pressure steam. The drilling equipment was decontaminated at the centralized decontamination pad, which consisted of plastic sheeting bermed to collect decontamination liquids and solids.

2.13 FIELD CORRECTIVE ACTIONS/DEVIATIONS

Corrective action includes the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or "out-of-QC" performance that can affect data quality, and the process of modifying procedures to address unexpected/unusual field conditions encountered. Corrective action in the field resulted when substantive changes were made to the sampling network (i.e., more/fewer samples collected, sampling locations other than those specified, etc.) and when sampling procedures or field analytical procedures required modification. The Project Manager (PM) was responsible for assessing the suspected problems in consultation with the project QA/QC Manager and for making a decision based on the potential for the situation to affect the quality of the resulting data

Several deviations from the SAP and SAP Addendum occurred during the SWMU 22 RFI field events. The nature of and disposition of these changes were as follows:

- Settling Basin Sample 22SD026 – A sediment sample was collected at settling basin 026 located northwest of Building 138. The basin samples was not included in the SAP, but after field inspection by the NSA Crane Environmental Restoration Site Manager and the Tetra Tech FOL, the decision was made to collect a sediment sample to evaluate potential releases from Building 138 to the basin. This change was documented in FTMR 12May2012-01 (Appendix B).

- Soil Boring Location 22SB019 – This location was added to replace the 22SB012 original location. The boring was moved approximately 30 feet northeast of the original location, off of the concrete pad. This change was also documented in FTMR 12May2012-01 (Appendix B).

- Subsurface Samples at Locations 22SS003, 22SS005, and 22SS07 – Subsurface soil samples were collected from surface soil locations 22SS003, 22SS005, and 22SS007 for vertical characterization at these locations. This change was documented in FTMR F279-03 (Appendix B).

- Additional Surface Soil, Surface Water, Sediment and Groundwater Samples – Additional samples were collected to assess residual contamination in site media that may be contributing to groundwater contamination, based on results of the January 2011 and May 2012 sampling events. The additional samples included six surface soil samples (22SS003 through 22SS008), a surface water sample from previously sampled location 22SW025, a sediment sample from 22SD017, and a groundwater sample from 22MWT005. These changes were documented in FTMR 002 (Appendix B)

- Soil Boring Location 22SB012 – The proposed location for boring 22SB012 had a thick concrete pad under the gravel, and the boring could not be advanced through the concrete with the DPT rig. The initial boring location was abandoned, and the boring moved to a drainage swale approximately 35 feet west of the original location. The new location was selected because observations of surface topography showed potential drainage pathways leading northwest to the swale from the Building 138 area.

2.14 INVESTIGATION-DERIVED WASTE HANDLING

Several types of investigation-derived waste (IDW) were generated during the SWMU 22 RFI, including personal protective equipment (PPE), sampling equipment decontamination fluids, development and purge water, DPT plastic sleeves, and drill cuttings. Management of each type of IDW was as follows:

- PPE, tubing, and DPT plastic sleeves were decontaminated, double bagged, and placed in NSA Crane dumpsters.

- Purge water and drilling and sampling equipment decontamination fluids were collected and discharged through 1-micron filter socks to the sanitary sewer system via the sewer drain behind Building 3245.

- Cuttings from drilling activities were used as backfill. At each boring, cuttings produced were scanned for VOCs. VOC readings were at background levels for all borings, and cuttings were used as backfill because the borings terminated above the water table. Any remaining cuttings were spread on the ground in the immediate vicinity of the boring.

2.15 SITE MANAGEMENT AND FACILITY SUPPORT

The FOL coordinated day-to-day activities and ensured that all field team members (including subcontractors) were familiar with the approved UFP-SAP and HASP during investigation activities. Coordination of sampling tasks, QA/QC, field documentation, fire and explosive safety permits, field change orders, and daily fieldwork status reports to the PM was also the responsibility of the FOL. Face-to-face meetings and electronic media were used to provide NSA Crane personnel with the most immediate and effective communication regarding site preparation, mobilization\demobilization, and sampling activities.

2.16 RECORDKEEPING

The FOL was responsible for the maintenance and security of field records. In addition to field log sheets, a site logbook was maintained and served as the overall record of field activities, weather conditions, identification of personnel, arrival and departure times of site workers, management issues, etc. Various field notebooks were also maintained by field personnel for the various field activities (e.g., soil sampling, monitoring well installation, etc.) Field records (chain-of-custody forms, sample logs sheets, field forms, logbooks, etc.) were consolidated into a central project file for CTO F279.

2.17 RESTORATION AND REVEGETATION

Areas disturbed by the drilling actives were restored to their original conditions. Soil cuttings and soil excavated for well pad construction and bollard installation were spread on the ground near the area as these materials were generated. The Tetra Tech FOL performed a site walk at the end of field activities and worked with the drilling subcontractor to ensure that restoration or revegetation of areas impacted by drilling activities was completed.

TABLE 2-1

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSIS
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Sample Identification	Sample Type	Date Sampled	Sample Depth Interval Sampled (feet bgs)	Energetics					Metals			Miscellaneous		Comments
					Nitroaromatics / Nitramines	RDX/HMX	RDX/TNT	NG/PETN	Perchlorate	RCRA Metals	RCRA Metals (dissolved)	Chrom. $^{+}3/^{+}6$	pH	TOC	
22SS001	22SS0010002	Surface Soil	21-Jan-11	0-2	X				X	X					Field Duplicate 22SSDUP01
22SS002	22SS0020002	Surface Soil	21-Jan-11	0-2	X				X	X					
22SS003	22SS0030002	Surface Soil	23-Jan-13	NA											Advanced as a SB020 (no SS003 sample)
22SS004	22SS0040002	Surface Soil	23-Jan-13	0-2			X								
22SS005	22SS0050002	Surface Soil	23-Jan-13	0-2			X								
22SS006	22SS0060002	Surface Soil	23-Jan-13	0-2			X								
22SS007	22SS0070002	Surface Soil	23-Jan-13	0-2			X								
22SS008	22SS0080002	Surface Soil	23-Jan-13	0-2			X								
22SS022	22SS0220002	Surface Soil	12-May-12	0-2	X			X		X				X	Listed as sediment in SAP, no flow sampled as surface soil
22SS025	22SS0250002	Surface Soil	11-May-12	0-2	X			X		X				X	Field Duplicate 22SSDUP01. Listed as sediment in SAP, no flow sampled as surface soil
22SB001	22SB0010002	Surface Soil	19-Jan-11	0-2	X				X	X			X		
	22SB0010305	Subsurface Soil	19-Jan-11	3-5	X				X	X			X		Field Duplicate 22SSDUP001
	22SB001XXXX	Subsurface Soil	NA	NA	--				--	--			--		Sample not collected due to boring refusal before sample depth
22SB002	22SB0020002	Surface Soil	19-Jan-11	0-2	X				X	X					
	22SB0020607	Subsurface Soil	19-Jan-11	6-7	X				X	X					
22SB003	22SB0030002	Surface Soil	19-Jan-11	0-2	X				X	X					
	22SB0030305	Subsurface Soil	19-Jan-11	3-5	X				X	X					
22SB004	22SB0040002	Surface Soil	19-Jan-11	0-2	X				X	X					
	22SB0040305	Subsurface Soil	19-Jan-11	3-5	X				X	X					
22SB005	22SB0050002	Surface Soil	19-Jan-11	0-2	X				X	X					
	22SB005XXXX	Subsurface Soil	NA	NA	--				--	--					Sample not collected due to boring refusal before sample depth
22SB006	22SB0060002	Surface Soil	19-Jan-11	0-2	X				X	X					
	22SB0060304	Subsurface Soil	19-Jan-11	3-4	X				X	X					
22SB007	22SB0070002	Surface Soil	21-Jan-11	0-2	X				X	X					
	22SB0070304	Subsurface Soil	21-Jan-11	3-4	X				X	X					
22SB008	22SB0080002	Surface Soil	19-Jan-11	0-2	X				X	X			X		
	22SB008XXXX	Subsurface Soil	NA	NA	--				--	--			--		Sample not collected due to boring refusal before sample depth
22SB009	22SB0090002	Surface Soil	19-Jan-11	0-2	X				X	X					
	22SB0090305	Subsurface Soil	19-Jan-11	3-5	X				X	X					
22SB010	22SB0100002	Surface Soil	19-Jan-11	0-2	X				X	X					
	22SB0100305	Subsurface Soil	19-Jan-11	3-5	X				X	X					
22SB011	22SB0110002	Surface Soil	19-Jan-11	0-2	X				X	X					
	22SB0110304	Subsurface Soil	19-Jan-11	3-4	X				X	X					
22SB012	22SB0120002	Surface Soil	10-May-12	0-2	X			X		X			X		Field Duplicate 22FD051212-01
	22SB012XXXX	Subsurface Soil	NA	NA	--			--		--			--		Sample not collected due to boring refusal before sample depth

TABLE 2-1

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSIS
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Sample Identification	Sample Type	Date Sampled	Sample Depth Interval Sampled (feet bgs)	Energetics					Metals			Miscellaneous		Comments
					Nitroaromatics / Nitramines	RDX/HMX	RDX/TNT	NG/PETN	Perchlorate	RCRA Metals	RCRA Metals (dissolved)	Chrom. $^{+}3/^{+}6$	pH	TOC	
22SB013	22SB0130002	Surface Soil	9-May-12	0-2	X			X		X					
	22SB013XXXX	Subsurface Soil	NA	NA	--			--		--					Sample not collected due to boring refusal before sample depth
22SB014	22SB0140002	Surface Soil	9-May-12	0-2	X			X		X					
	22SB0140203	Subsurface Soil	10-May-12	2-3	X			X		X					
22SB015	22SB0150002	Surface Soil	10-May-12	0-2	X			X		X					
	22SB015XXXX	Subsurface Soil	NA	NA	--			--		--					Sample not collected due to boring refusal before sample depth
	22SB015XXXX	Subsurface Soil	NA	NA	--			--		--					Sample not collected due to boring refusal before sample depth
22SB016	22SB0160002	Surface Soil	9-May-12	0-2	X			X		X					
	22SB0160305	Subsurface Soil	9-May-12	3-5	X			X		X					
	22SB0160608	Subsurface Soil	9-May-12	6-8	X			X		X					
22SB017	22SB0170002	Surface Soil	9-May-12	0-2	X			X		X					
	22SB0170305	Subsurface Soil	9-May-12	3-5	X			X		X					
	22SB017XXXX	Subsurface Soil	NA	NA	--			--		--					Sample not collected due to boring refusal before sample depth
22SB018	22SB0180002	Surface Soil	10-May-12	0-2	X			X		X					
	22SB0180406	Subsurface Soil	11-May-12	4-6											
22SB019	22SB0190002	Surface Soil	10-May-12	0-2	X			X		X					Sample added due to field observations
22SB020	22SB0200002	Surface Soil	23-Jan-13	0-2			X					X			Field Duplicate 22FD012313-01
	22SB0200203	Subsurface Soil	23-Jan-13	2-3			X								
22SD001	22SD0010006	Sediment	20-Jan-11	0-.5	X					X				X	
22SD002	22SD0020006	Sediment	20-Jan-11	0-.5	X					X				X	
22SD003	22SD0030006	Sediment	20-Jan-11	0-.5	X					X				X	
22SD004	22SD0040006	Sediment	20-Jan-11	0-.5	X					X				X	
22SD005	22SD0050006	Sediment	20-Jan-11	0-.5	X					X				X	
22SD006	22SD0060006	Sediment	18-Jan-11	0-.5	X					X			X	X	
	22SD0060624	Sediment	18-Jan-11	.5-2	X					X			X	X	
22SD007	22SD0070006	Sediment	18-Jan-11	0-.5	X					X				X	
	22SD0070624	Sediment	18-Jan-11	.5-2	X					X				X	
22SD008	22SD0080006	Sediment	18-Jan-11	0-.5	X					X				X	
	22SD0080624	Sediment	18-Jan-11	.5-2	X					X				X	
22SD009	22SD0090006	Sediment	20-Jan-11	0-.5	X					X				X	Field Duplicate 22SDDUP01
22SD010	22SD0100006	Sediment	20-Jan-11	0-.5	X					X				X	
22SD010	22SD0100006	Sediment	12-May-12	0-.5				X						X	
22SD011	22SD0110006	Sediment	20-Jan-11	0-.5	X					X				X	
22SD017	22SD0170006	Sediment	11-May-12	0-.5				X		X				X	
22SD017	22SD0170006	Sediment	23-Jan-13	0-.5			X								
22SD018	22SD0180006	Sediment	9-Apr-11	0-.5	X					X				X	Field Duplicate 22FD04091102
22SD018	22SD0180006	Sediment	12-May-12	0-.5				X						X	
22SD022	22SD0220006	Sediment	NA	NA	--			--		--				--	Listed as sediment in SAP, no flow sampled as surface soil, see above 22SS022

TABLE 2-1

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSIS
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Sample Identification	Sample Type	Date Sampled	Sample Depth Interval Sampled (feet bgs)	Energetics					Metals			Miscellaneous		Comments
					Nitroaromatics / Nitramines	RDX/HMX	RDX/TNT	NG/PETN	Perchlorate	RCRA Metals	RCRA Metals (dissolved)	Chrom. $^{+}3/^{+}6$	pH	TOC	
22SD023	22SD0230006	Sediment	11-May-12	0-.5	X			X		X			X	X	
22SD024	22SD0240006	Sediment	11-May-12	0-.5	X			X		X				X	
22SD025	22SD0250006	Sediment	NA	NA	--			--		--				--	Listed as sediment in SAP, no flow sampled as surface soil, see above 22SS022
22SD026	22SD0260006	Sediment	11-May-12	0-.5	X			X		X				X	Sample added due to field observations
22SW001	22SW001	Surface Water	20-Jan-11	--	X				X	X	X				
22SW002	22SW002	Surface Water	20-Jan-11	--	X				X	X	X				
22SW003	22SW003	Surface Water	20-Jan-11	--	X				X	X	X				
22SW004	22SW004	Surface Water	20-Jan-11	--	X				X	X	X				
22SW005	22SW005	Surface Water	20-Jan-11	NA	--				--	--	--				Dry, not sampled
22SW006	22SW006	Surface Water	18-Jan-11	--	X				X	X	X				
22SW007	22SW007	Surface Water	18-Jan-11	--	X				X	X	X				
22SW008	22SW008	Surface Water	18-Jan-11	--	--				--	--	--				Dry, not sampled
22SW009	22SW009	Surface Water	20-Jan-11	--	X				X	X	X				Field Duplicate 22SWDUP01
22SW010	22SW010	Surface Water	20-Jan-11	--	X				X	X	X				
22SW010	22SW010	Surface Water	12-May-12	--				X							
22SW011	22SW011	Surface Water	20-Jan-11	--	X				X	X	X				
22SW012	22SW012	Surface Water	9-Apr-11	--		X									
22SW013	22SW013	Surface Water	9-Apr-11	--		X									
22SW014	22SW014	Surface Water	9-Apr-11	--		X									
22SW015	22SW015	Surface Water	9-Apr-11	--		X									
22SW016	22SW016	Surface Water	9-Apr-11	--		X									
22SW017	22SW017	Surface Water	9-Apr-11	--		X									
22SW017	22SW017	Surface Water	11-May-12	--				X		X					
22SW018	22SW018	Surface Water	9-Apr-11	--	X					X	X				Field Duplicate 22FD04091101
22SW018	22SW018	Surface Water	12-May-12	NA				--							Dry, not sampled
22SW019	22SW019	Surface Water	9-Apr-11	--		X									
22SW020	22SW020	Surface Water	9-Apr-11	--		X									
22SW021	22SW021	Surface Water	9-Apr-11	--		X									
22SW022	22SW022	Surface Water	12-May-12	NA											Dry, not sampled
22SW023	22SW023	Surface Water	11-May-12	--	X			X		X			X		
22SW024	22SW024	Surface Water	11-May-12	--	X			X		X					Field Duplicate 22SWDUP01
22SW025	22SW025	Surface Water	11-May-12	NA											Dry, not sampled
22SW025	22SW025	Surface Water	23-Jan-13	NA											Dry, not sampled
22MWT001	22GWT001	Groundwater	22-May-12	15-25	X			X	X	X	X				
22MWT002	22GWT002	Groundwater	22-May-12	11-21	X			X	X	X	X				Field Duplicate 22GWDUP01
22MWT003	22GWT003	Groundwater	23-May-12	13-23	X			X	X	X					
22MWT004	22GWT004	Groundwater	23-May-12	15-25	X			X	X	X	X				
22MWT005	22GWT005	Groundwater	21-May-12	9-19	X			X	X	X	X				
22MWT005	22GWT005	Groundwater	23-Jan-13	9-19								X			Field Duplicate 22FD012312-02
22MWT005	22GWT005	Groundwater	16-Apr-13	9-19								X			
22MWT006	22GWT006	Groundwater	21-May-12	15-25	X			X	X	X	X				

TABLE 2-2

MONITORING WELL CONSTRUCTION INFORMATION AND WATER LEVEL MEASUREMENTS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Well ID	Installation Date[1]	Northing (feet) (NAD83)	Easting (feet) (NAD83)	Ground Elevation (feet) (NAVD88)	Top of PVC Riser Elevation (feet)	Total Depth (feet bgs)[(2)]	Screened Interval				Water-Bearing Zone	May 21-22, 2012	
							Top (feet bgs)	Bottom (feet bgs)	Top (feet bgs)	Bottom (feet bgs)		Depth to Water (feet btor)	Water Elevation (feet)
Permanent Monitoring Wells													
22MWT001	11-May-12	1315811.32	3027409.14	766.47	768.74	25.0	15.0	25.0	751.47	741.47	Puz	15.34	753.40
22MWT002	10-May-12	1315360.00	3027107.82	756.21	758.78	21.0	11.0	21.0	745.21	735.21	Puz	9.19	749.59
22MWT003	11-May-12	1315525.14	3027497.94	763.88	766.28	25.0	13.0	23.0	750.88	740.88	Puz	17.45	748.83
22MWT004	11-May-12	1315438.43	3027804.94	759.34	761.44	25.0	15.0	25.0	744.34	734.34	Puz	12.62	748.82
22MWT005	9-May-12	1315271.01	3027363.36	756.12	758.67	19.0	9.0	19.0	747.12	737.12	Puz	18.48	740.19
22MWT006	10-May-12	1315734.76	3027588.91	769.25	771.77	25.0	15.0	25.0	754.25	744.25	Puz	17.19	754.58

Notes:

1 - Represents the date when the well was completed.
2 - Total depth of boring, total depth of well may be less.
btor = Below top of riser/reference point.
bgs = Below ground surface.
NAD83 = North American Datum of 1983.
NAVD88 = 1988 North American Vertical Datum.
Puz = Upper Pennsylvanian water-bearing zone.

TABLE 2-3

SOIL, SEDIMENT, AND SURFACE WATER SAMPLING SUMMARY
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Total Depth	Sample Method	Sample Date	Depth Interval(s) of Samples	QA Collected	Comments
Soil Borings	**feet bgs**			**feet bgs**		
22SB001	6	DPT	19-Jan-11	0-2, 3-5	Duplicate at 3-5'	Refusal at 6'
22SB002	7	DPT	19-Jan-11	0-2, 6-7	MS/MSD at 0-2'	Refusal at 7'
22SB003	5	DPT	19-Jan-11	0-2, 3-5	NA	
22SB004	4.5	DPT	19-Jan-11	0-2, 3-5	MS/MSD at 3-5'	Refusal at 4.5'
22SB005	1	DPT	19-Jan-11	0-1	NA	Refusal at 1'
22SB006	3.5	DPT	19-Jan-11	0-2, 3-4	NA	Refusal at 3.5'
22SB007	4	HA	21-Jan-11	0-2, 3-4	NA	Refusal at 4'
22SB008	2	DPT	19-Jan-11	0-2	NA	Refusal at 2'
22SB009	4.5	DPT	19-Jan-11	0-2, 3-5	NA	Refusal at 4.5'
22SB010	5	DPT	19-Jan-11	0-2, 3-5	NA	
22SB011	4	DPT	19-Jan-11	0-2, 3-4	NA	Refusal at 4,
22SB012	2.2	DPT	10-May-12	0-2	Dup	Refusal at 2.2'
22SB013	2	DPT	9-May-12	0-2	NA	Refusal at 2'
22SB014	2.5	Split Spoon	9-May-12	0-2, 2-3	NA	Refusal at 2.5'
22SB015	3	DPT	10-May-12	0-2	NA	Refusal at 3'
22SB016	8	DPT	9-May-12	0-2, 3-5, 6-8	MS/MSD at 0-2' & 3-5'	
22SB017	5	DPT	9-May-12	0-2, 3-5	NA	Refusal at 5'
22SB018	6	Split Spoon	10-May-12	0-2, 4-6	NA	
22SB019	3	DPT	10-May-12	0-2	NA	Refusal at 3'
22SB020	3	HA	23-Jan-13	0-2, 2-3	Duplicate & MS/MSD at 0-2'	

TABLE 2-3

SOIL, SEDIMENT, AND SURFACE WATER SAMPLING SUMMARY
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Total Depth	Sample Method	Sample Date	Depth Interval(s) of Samples	QA Collected	Comments
Surface Soil	**feet bgs**			**feet bgs**		
22SS001	2	HA	21-Jan-11	0-2	Duplicate	
22SS002	2	HA	21-Jan-11	0-2	NA	
22SS004	2	HA	23-Jan-13	0-2	NA	
22SS005	2	HA	23-Jan-13	0-2	NA	
22SS006	2	HA	23-Jan-13	0-2	NA	
22SS007	2	HA	23-Jan-13	0-2	MS/MSD	
22SS008	2	HA	23-Jan-13	0-2	NA	
22SS022	2	Soil Probe	12-May-12	0-2	MS/MSD	
22SS025	2	PT	11-May-12	0-2	Duplicate & MS/MSD	
Surface Water	**inches[1]**			**inches**		
22SW001	4	Direct Fill	20-Jan-11	0-4	NA	
22SW002	4	Direct Fill	20-Jan-11	2-4	NA	
22SW003	6	Direct Fill	20-Jan-11	4-6	NA	
22SW004	1	Direct Fill	20-Jan-11	0-1	NA	
22SW005	NA	NA	20-Jan-11	NA	NA	Dry, not sampled
22SW006	4	Direct Fill	18-Jan-11	0-4	NA	
22SW007	4	Direct Fill	18-Jan-11	0-4	NA	
22SW008	NA	NA	18-Jan-11	NA	NA	Dry, not sampled
22SW009	2	Direct Fill	20-Jan-11	1-2	Duplicate	
22SW010	6	Direct Fill	20-Jan-11	4-6	NA	
22SW010	5	Direct Fill	12-May-12	0-5	NA	

TABLE 2-3

SOIL, SEDIMENT, AND SURFACE WATER SAMPLING SUMMARY
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Total Depth	Sample Method	Sample Date	Depth Interval(s) of Samples	QA Collected	Comments
Surface Water (cont.)	**inches[1]**			**inches**		
22SW011	8	Direct Fill	20-Jan-11	6-8	MS/MSD	
22SW012	18	Direct Fill	9-Apr-11	0-2	NA	
22SW013	12	Direct Fill	9-Apr-11	0-2	NA	
22SW014	12	Direct Fill	9-Apr-11	0-2	NA	
22SW015	2	Direct Fill	9-Apr-11	0-1	NA	
22SW016	6	Direct Fill	9-Apr-11	0-2	NA	
22SW017	1	Direct Fill	9-Apr-11	0-1	NA	
22SW017	6	Direct Fill	11-May-12	0-6	NA	
22SW018	1	Direct Fill	9-Apr-11	0-1	Duplicate & MS/MSD	
22SW018	NA	NA	12-May-12	NA	NA	Dry, not sampled
22SW019	6	Direct Fill	9-Apr-11	0-2	NA	
22SW020	2	Direct Fill	9-Apr-11	0-1	NA	
22SW021	8	Direct Fill	9-Apr-11	0-2	NA	
22SW022	NA	NA	12-May-12	NA	NA	Dry, not sampled
22SW023	6	Direct Fill	11-May-12	0-6	NA	
22SW024	6	Direct Fill	11-May-12	0-6	Duplicate & MS/MSD	
22SW025	NA	NA	11-May-12	NA	NA	Dry, not sampled
22SW025	NA	NA	23-Jan-13	NA	NA	Dry, not sampled
Sediment	**inches bgs**			**inches bgs**		
22SD001	6	ST	20-Jan-11	0-6	NA	
22SD002	6	ST	20-Jan-11	0-6	NA	

TABLE 2-3

SOIL, SEDIMENT, AND SURFACE WATER SAMPLING SUMMARY
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Total Depth	Sample Method	Sample Date	Depth Interval(s) of Samples	QA Collected	Comments
Sediment (cont.)	**inches bgs**			**inches bgs**		
22SD003	6	ST	20-Jan-11	0-6	NA	
22SD004	6	ST	20-Jan-11	0-6	NA	
22SD005	6	ST	20-Jan-11	0-6	NA	
22SD006	24	ST	18-Jan-11	0-6, 6-24	NA	
22SD007	24	ST	18-Jan-11	0-6, 6-24	NA	
22SD008	24	ST	18-Jan-11	0-6, 6-24	NA	
22SD009	6	ST	20-Jan-11	0-6	Duplicate	
22SD010	6	ST	20-Jan-11	0-6	NA	
22SD010	6	PT	12-May-12	0-6	NA	
22SD011	6	ST	20-Jan-11	0-6	MS/MSD	
22SD017	6	PT	11-May-12	0-6	NA	
22SD017	6	PT	23-Jan-13	0-6	NA	
22SD018	6	PT	9-Apr-11	0-6	Duplicate & MS/MSD	
22SD018	6	PT	12-May-12	0-6	NA	
22SD023	6	PT	11-May-12	0-6	NA	
22SD024	6	ST	11-May-12	0-6	NA	
22SD026	6	Scoop	11-May-12	0-6	NA	Settling Basin Sample

Footnotes

1 Stream depth

bgs - Below ground surface
DPT = Direct-push technology
HA = Hand augering

PT = Plastic trowel
ST = Stainless steel trowel
NA = Not applicable

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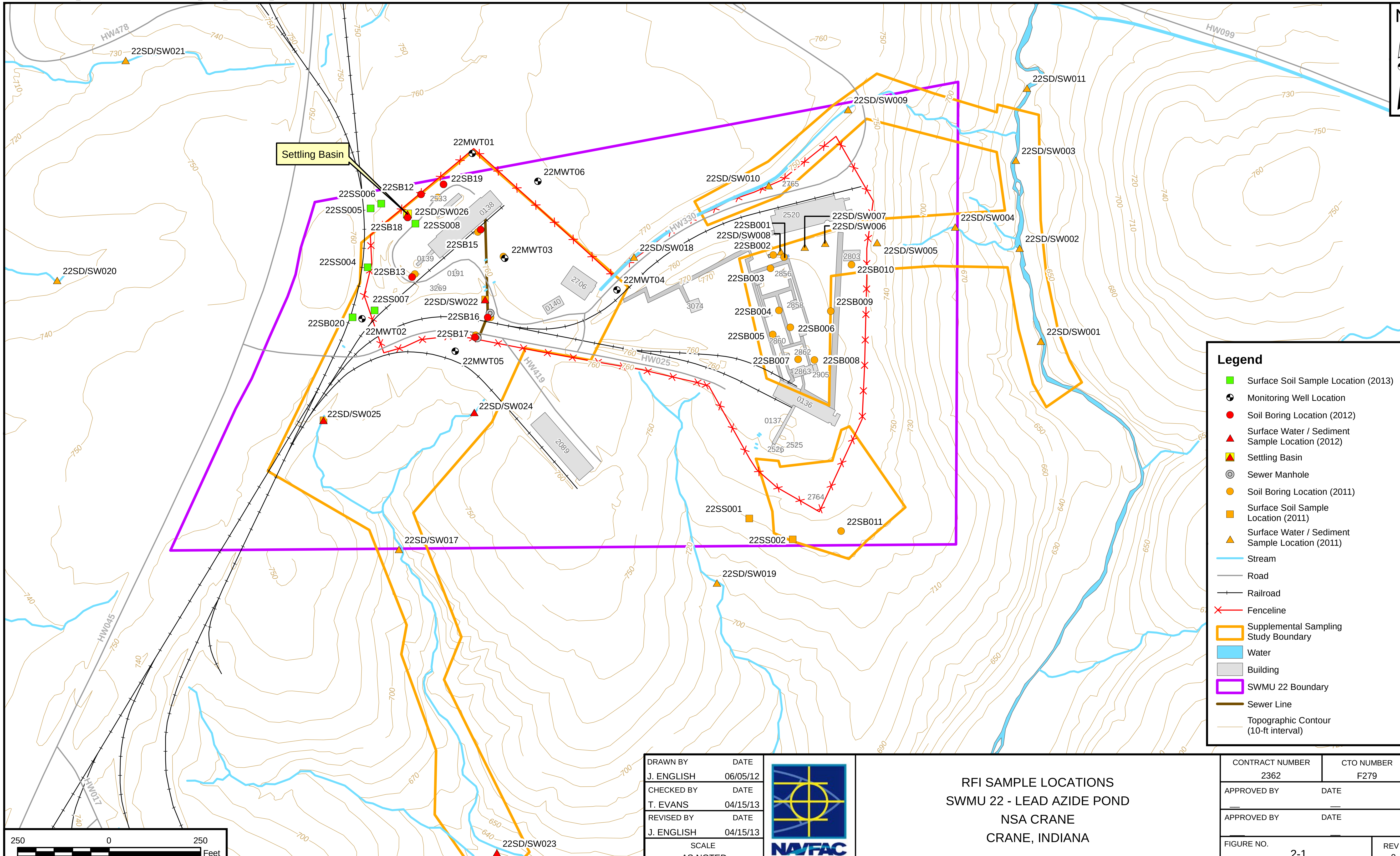

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NAVFAC

RFI SAMPLE LOCATIONS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
2362	F279
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO. 2-1	REV 0

3.0 PHYSICAL CHARACTERISTICS

This section discusses physical characteristics of NSA Crane, including physiography and topography, climate and meteorology, geology, hydrology, land use and demography, and ecology.

3.1 PHYSIOGRAPHY AND TOPOGRAPHY

NSA Crane is located in the unglaciated area of the Crawford Upland Physiographic Province of the Southern Hills and Lowlands Region of Indiana. This province is characterized as a rugged, highly vegetated, dissected plateau bounded by the Mitchell Plain Physiographic Province to the east and the Wabash Lowland Physiographic Province to the west. The boundary between the Crawford Upland and Mitchell Plain is marked by the highly irregular eastward-facing Chester Escarpment. Springs, caverns, caves, and other solution-weathering features can be found along this escarpment and on the eastern edge of the NSA Crane facility. The boundary between the Crawford Upland and Wabash Lowland near the western boundary of NSA Crane is gradual. The terrain at NSA Crane is predominantly rolling, with moderately incised stream valleys throughout and occasional flat areas in the central and northern portions of the base. Topographic relief in the Crawford Upland Province generally ranges from 300 to 350 feet; surface elevations across NSA Crane range from approximately 500 to 850 feet above mean sea level. Greater relief exists in the eastern part of NSA Crane near the Chester Escarpment (Murphy and Wade, 1998a and 1998b).

3.2 CLIMATE AND METEOROLOGY

NSA Crane is located in a humid, continental, climatic zone with warm summers. Temperatures span a wide range from an average maximum of 89 degrees Fahrenheit (°F) in July to an average minimum temperature of 26°F in January. Precipitation is fairly evenly distributed throughout the calendar year; maximum precipitation occurs during the spring and early summer. The average annual precipitation at the facility is 44 inches and consists of 42 inches of rain and 15 inches of snow. The average humidities range from 40 to 90 percent in the summer and 60 to 90 percent in the winter. Long-term climatological records for the area indicate that the monthly prevailing wind direction is from the southwest from April through December and from the northwest during January through March (NOAA, 1988). The annual prevailing wind direction for the region is from the southwest, and the annual average wind speed for the area is about 9.6 miles per hour. The frost line in southern Indiana is approximately 2.5 feet bgs.

3.3 GEOLOGY AND STRATIGRAPHY

The geology at NSA Crane is generally characterized by thin overburden deposits overlying bedrock. The overburden deposits at NSA Crane generally consist of two types, Quaternary-age unconsolidated deposits and unconsolidated residual soil derived from underlying bedrock. With the exception of minor outwash and lacustrine deposits in the northwestern comer of the facility, NSA Crane was unglaciated during the Pleistocene epoch. Bedrock underlying NSA Crane consists of sedimentary rocks from the Lower Pennsylvanian-age Raccoon Creek Group and Upper Mississippian-age Stephensport and West Baden Groups.

The geology at SWMU 22 was interpreted from soil borings advanced during the RFI. Soil boring logs are provided in Appendix A. Figure 3-1 shows the locations of geologic cross sections (A-A’, B-B’, and C-C’) at SWMU 22, and the cross sections are presented as Figures 3-2 through 3-4, respectively.

3.3.1 Unconsolidated Deposits

The Quaternary-age deposits consist of alluvial (stream-derived), colluvial (deposited at the foot of a slope via gravity), and glacial outwash deposits (derived from glaciers) consisting of silt, sand, and gravel; lacustrine (lake) deposits consisting of clay, silt, and sand; and loess (deposited by wind action) deposits consisting of clay and silt. Unconsolidated deposits at NSA Crane can be found to depths up to 65 feet bgs (Nohrstedt et al., 1998).

According to the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) soil surveys, soils at NSA Crane are classified into 23 different soil series. These soil series are defined by various soil characteristics (e.g., grain size, erosion, slope, drainage, parent material, or depositional source, etc.) specific to each series. Within these soil series, various sub-classes or soil map units have been defined. Soils at NSA Crane were derived from underlying sedimentary rocks of the Lower Pennsylvanian Raccoon Creek Group and Upper Mississippian Stephensport and West Baden Groups and consist of clay, silt, sand, and fragmented and/or partially weathered bedrock. The soils at SWMU 22 are principally identified as moderately to well-drained Apalona-Udorthents complex along the ridges and Wellston-Adeyville and Wellston silt loam complexes along the sideslopes (USDA, 2010). Soil erosion could occur within all types of soils located at NSA Crane if located on higher slopes along drainage paths. The Apalona-Udorthents, Wellston-Adeyville, and Wellston series are silt loams derived from loess deposits over bedrock residuum or from weathered bedrock of sandstone, siltstone, or shale.

Background concentrations of select inorganics in soils at NSA Crane were evaluated during a base-wide background soils investigation in 2001 (Tetra Tech, 2001). The objective of the investigation was to identify and chemically characterize native soils based on three factors: depositional environment, grain size, and depth. A total of 16 soil types were identified and evaluated in the report, based on combinations of these three factors. Four depositional environments were identified at NSA Crane, based on the mapped geologic parent material: Pennsylvanian bedrock, Mississippian bedrock, alluvium, and loess. Three predominant grain sizes (clay, silt, and sand) and two depths (surface and subsurface) were also identified as factors possibly contributing to soil chemical characteristics. Soil samples were collected to establish representative background metals concentrations for each of the 16 soil types. Based on the classification scheme developed in the base-wide background soil study (Tetra Tech, 2001), the soils encountered at SWMU 22 fall into three different soil groups. The surface soils (0 to 2 feet bgs) belong to Soil Group 3 (Alluvial, Mississippian, and Pennsylvanian). The subsurface soils (greater than 2 feet bgs) belong to Soil Group 8 (Pennsylvanian subsurface clay and silt) or Soil Group 9 (Pennsylvanian subsurface sand). These groupings and evaluation of SWMU 22 soil concentrations to background soil concentrations are discussed further in Section 4.

The overburden observed at SWMU 22 consists of fine-grained silts, sands, and clays ranging in thickness from approximately 3 to 8 feet.

3.3.2 <u>Bedrock</u>

NSA Crane is located on the eastern edge of the Illinois Structural Basin, where Pennsylvanian and Mississippian age bedrock dips to the west-southwest and southwest at approximately 30 to 35 feet per mile (Kvale, 1992). As stated above, bedrock underlying NSA Crane consists of sedimentary rocks from the Lower Pennsylvanian-age Raccoon Creek Group and Upper Mississippian-age Stephensport and West Baden Groups and dips gently to the west-southwest. A generalized stratigraphic column of bedrock at NSA Crane is shown on Figure 3-5, and surficial geology at NSA Crane is shown on Figure 3-6. The Raccoon Creek Group primarily consists of interbedded sandstone, siltstone, shale, and coal and has a total thickness varying from 0 to more than 300 feet (Fisher, 1996). The underlying Stephensport Group consists of limestone, shale, and sandstone ranging in thickness from 60 to 70 feet (USACE WES, 1995; Palmer, 1969).

The SWMU 22 area is mapped as being underlain by the Mansfield formation of the Raccoon Group, which consists of alternating beds of dark shale, sandstone, mudstone, siltstone, and discontinuous coal units. Drilling at SWMU 22 did not encounter Mississippian rocks. The combined thickness of Pennsylvanian shales, sandstones, and coals at SWMU 22 was estimated to be up to 165 to 170 feet, with a basal elevation of approximately 595 feet. The relief of the unconformity between the Pennsylvanian and Mississippian bedrock has been measured to be as much as 100 feet (Kvale, 1992).

Underlying the overburden at SWMU 22 is weathered sandstone grading into competent bedrock of the Pennsylvanian Raccoon Creek Group. The bedrock observed in borings at SWMU 22 was sandstone with interbedded siltstone. Beds of shale and coal were encountered beneath the sandstone unit.

3.4 SURFACE HYDROLOGY AND DRAINAGE SYSTEM

NSA Crane is located within the Lower East Fork White watershed, approximately 10 miles northwest of the East Fork White River. The East Fork White River flows approximately 40 miles southwest before joining the Muscatatuck River, which eventually joins the Ohio River.

The surface drainage at NSA Crane has formed a dense dendritic pattern throughout the installation. Six creeks in four drainage basins (I through IV) carry surface water off the installation (Figure 3-7). Drainage from the basin in the extreme eastern part of NSA Crane is via several small drainageways. The northern and northwestern drainage basins eventually empty into Furst Creek, which flows in a westerly direction and leaves the installation. Rainey Hollow, Sulphur Creek, and Little Sulphur Creek drain the eastern basin. Drainage Basin IV consists of Boggs and Turkey Creeks, which are the primary drainageways and drain the majority of the installation. SWMU 22 lies within this drainage basin. Drainage swales and ditches convey surface water from developed areas of SWMU 22 to the side slopes of ridges and drainage pathways to the adjacent creek.

3.5 HYDROGEOLOGY

Groundwater resources at NSA Crane had been studied to a limited extent prior to the early 1980s (NEESA, 1983). Six exploratory wells had been drilled across NSA Crane prior to the 1980s to evaluate the potential for groundwater use/development, and limited water quality studies have been performed. NSA Crane uses water from Lake Greenwood for human consumption, process operations, recreation, and several soil and water conservation ponds. However, the geology, occurrences of springs and seeps, and well-developed surface drainage indicate the existence of groundwater that is hydraulically connected to the surface environment. Available groundwater data from the 1940s indicates that limited water is located at 141 and 313 feet bgs, with the shallowest water level observed at 85 feet bgs.

The groundwater at NSA Crane appears to be divided into two distinct regimes, one associated with the overburden/unconsolidated material and one associated with bedrock. The shallow groundwater is probably transient; during periods of excessive prolonged rainfall and during the early spring months, there is probably saturated soil and free water above the soil-rock contact. The shallow groundwater dissipates by percolation into bedrock and into intermittent or perennial streams. The groundwater associated with bedrock is stable and probably fluctuates only a minor amount (less than 10 feet) per year. Possibly more than one zone of saturation exists in the bedrock due to the successive beds of sandstone, shale, and limestone. The shale beds should be the least permeable of the series and, where underlying a permeable sandstone or limestone, would support a saturated or free-water zone. These shale zones grade laterally to zones of sandstone, so the downward percolating water would be free to move continually downward (NEESA, 1983).

Static water levels measured in monitoring wells at SWMU 22 ranged from 7 to 17 feet bgs. Figure 3-8 presents the groundwater potentiometric contours at SWMU22. Groundwater flow is generally to the south, and a hydraulic gradient of 0.03 was estimated from the groundwater contours. The average bulk hydraulic conductivity values observed at SWMU 22 ranged from 2.5×10^{-3} to 9.8×10^{-3} feet per day (8.8×10^{-7} to 3.5×10^{-6} centimeters per second), with a geometric mean of 6.1×10^{-3} feet per day (2.1×10^{-6} centimeters per second). The advective groundwater flow rate (v_x) was determined as follows:

$$v_x = K/n_e \times (dh/dl)$$

where,

K = bulk hydraulic conductivity
n_e = effective porosity
dh/dl = hydraulic gradient.

Assuming an effective porosity of 0.3 (Fetter, 1988), the estimated advective groundwater flow rate at SWMU 22 is 0.22 feet per year (0.07 meters per year).

3.6 LAND USE AND DEMOGRAPHY

The economic base of communities surrounding NSA Crane is in transition from agriculture, mining, and quarrying to manufacturing and service industries. The patterns of settlement, population statistics, and median income are similar throughout the region (Tetra Tech, 2001). Because most of the region is covered by vegetation, the area is classified as rural (Tetra Tech, 2001).

There is no state or local planning within the vicinity of NSA Crane. The only zoning and land use regulations are in the municipalities in the region, and none of the municipalities are close enough to impact NSA Crane. None of the areas adjacent to NSA Crane are zoned, and zoning is not anticipated in the near future. No known land use or community actions have been considered or proposed (Tetra Tech, 2001).

3.7 ECOLOGY

NSA Crane is a heavily forested facility situated within the Western Mesophytic Forest Region, Hill Section, and Beech-Maple Forest Region (Braun, 1950). Lindsey et al. (1970) further subdivided the area of the installation into the south-central Oak and Mixed Woods Division, including the Beech-Maple and Beech-Oak-Maple-Hickory sub-elements. Deam (1940) classified the portion of Martin County in which the facility is located as consisting of the Chestnut Oak Upland, based on the dominant floral components at that time. More recently, Kuchler (1964) mapped this portion of Indiana and classified it as belonging to two distinct vegetation classes, the Oak-Hickory and Beech-Maple forest components of the Broadleaf Forest Classification. This latter classification most closely resembles the current floristic components observed at the facility during the ecological studies conducted as part of this program.

The wildlife habitats and vegetation types present at NSA Crane, including many stages of forest succession, streams, ponds, Greenwood Lake, and grassy open spaces, support a diverse terrestrial and aquatic fauna. The abundance of wildlife at the facility is due in large measure to the mixture of land forms and vegetation types that occur over the installation. In addition, the lack of agricultural pressures has enhanced wildlife abundance and served to provide an installation-wide "wildlife enclosure" condition. There are adequate amounts of forage materials, concealment opportunities, and shelter locations to support a highly diverse wildlife community at the site.

Approximately 30 species of mammals exist at NSA Crane. The white-tailed deer is the most conspicuous large wild mammal at the installation, and other mammals include opossum, raccoon, rabbits, mice, bats, chipmunks, squirrels, beaver, groundhogs, gray fox, and coyotes. Fox, coyotes, and hawks are carnivores whose presence indicates a healthy ecosystem because smaller mammals are present to provide a food source (NEESA, 1983). The endangered Indiana bat may be present in the vicinity of the Turkey Creek watershed.

The birds at NSA Crane are diverse, and previous studies have identified over 100 species present at the facility during breeding seasons (Hengeveld, 1987). Because the facility is largely forested, the species predominantly of those that frequent wooded habitat types. There are also species of waterfowl that use the facility, especially in the vicinity of Lake Greenwood. A large number of bird species frequent the non-forested grassland, oldfield, and scrub/shrub vegetation present over portions of NSA Crane.

Previous studies conducted at NSA Crane (Nelson et al., 1987) identified 21 amphibian species and 22 reptile species (including skinks, lizards, snakes, and turtles).

A total of 46 distinct fish species were collected from the installation during a 1987 inventory of the fish fauna at NSA Crane. Other than Lake Greenwood, the 1987 study observed that the greatest number of individual fish species were recorded from the largest stream (Boggs Creek), and the smallest number of species were recorded from Turkey Creek. Boggs Creek contained 29 species, including eight species of fish characteristic of large river-type systems. This included long-nose gar, paddlefish, bowfin, gizzard shad, ribbon shiner, bigmouth buffalo, channel catfish, and flathead catfish. By contrast, the Turkey Creek survey yielded 16 species of fish, none of which were unusual. The Sulphur Creek drainage was surveyed and yielded a total of 19 species. Four species from this drainage were not found anywhere else on the installation, including southern redbelly dace, blacknose dace, black bullhead, and blackside darter.

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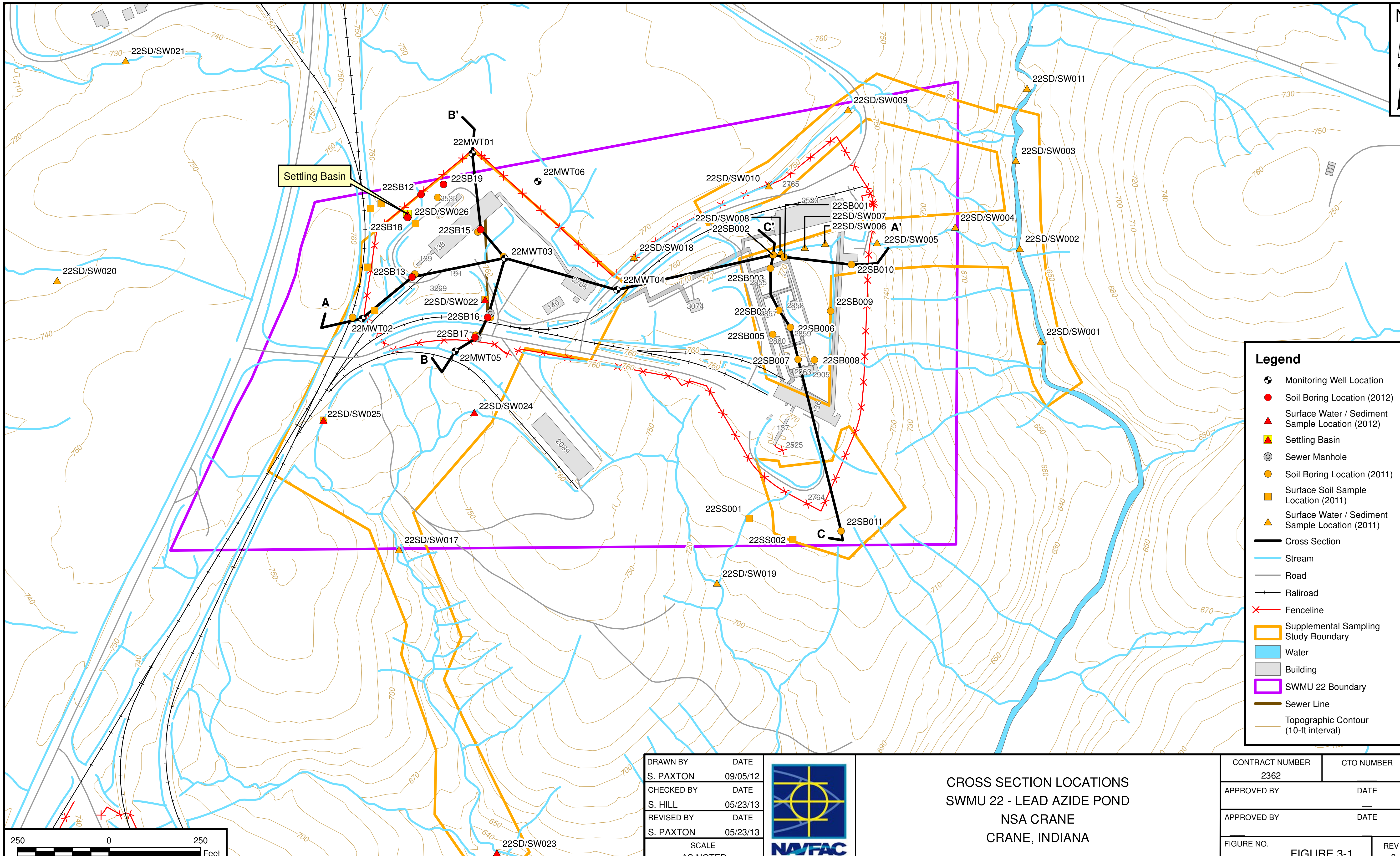

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S. HILL	05/23/13	
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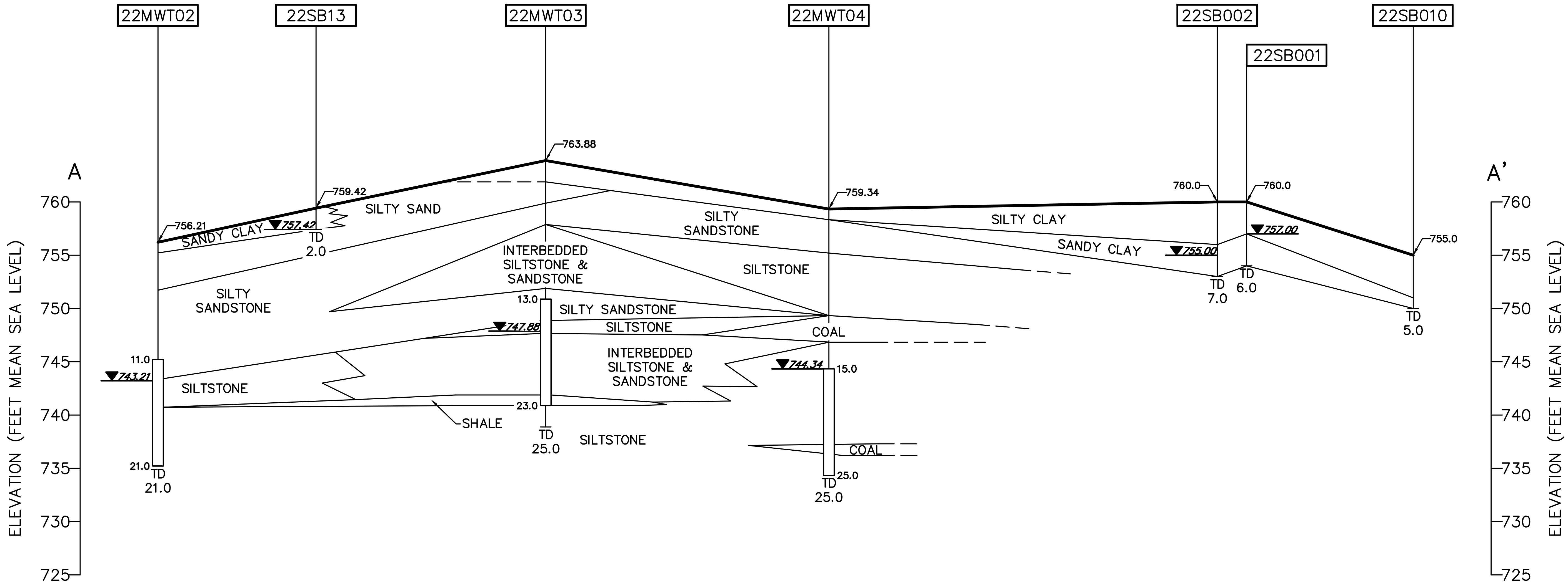
S. PAXTON	05/23/13	
SCALE		
AS NOTED		

NAVFAC

CROSS SECTION LOCATIONS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
2362	
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO.	REV
FIGURE 3-1	0



LEGEND:

MONITORING WELL OR BORING NUMBER

GROUND SURFACE ELEVATION (FT MSL)

GROUND SURFACE

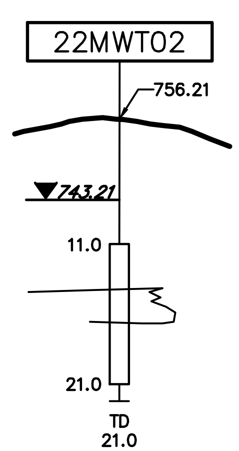
WATER LEVEL (FT MSL)

TOP OF MONITORED INTERVAL (FT BGS)

LITHOLOGIC CONTACT (INFERRED BETWEEN BORINGS)

BOTTOM OF MONITORED INTERVAL (FT BGS)

TOTAL DEPTH OF WELL OR BORING (FT BGS)



0 120 240
HORIZONTAL SCALE IN FEET

0 10 20
VERTICAL SCALE IN FEET

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CHECKED BY DATE			CTO NO.
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 3–2 SIZE B REV. 0

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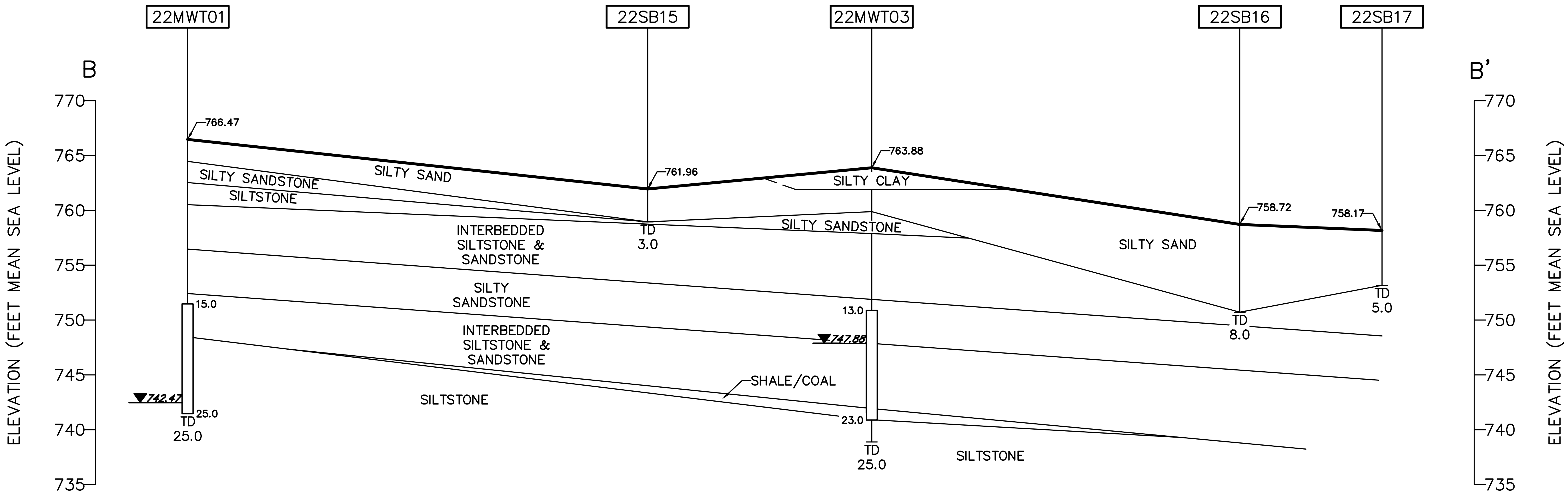

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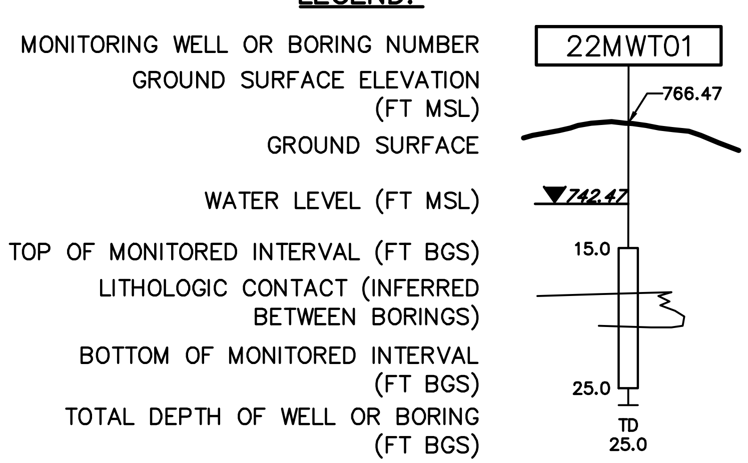

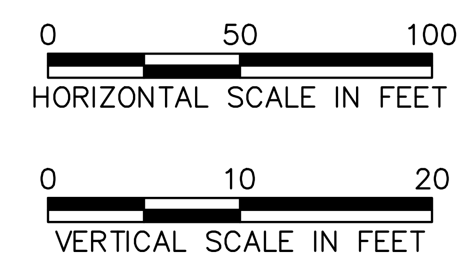

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SCALE AS NOTED			DRAWING NO. FIGURE 3–3 — SIZE B — REV. 0

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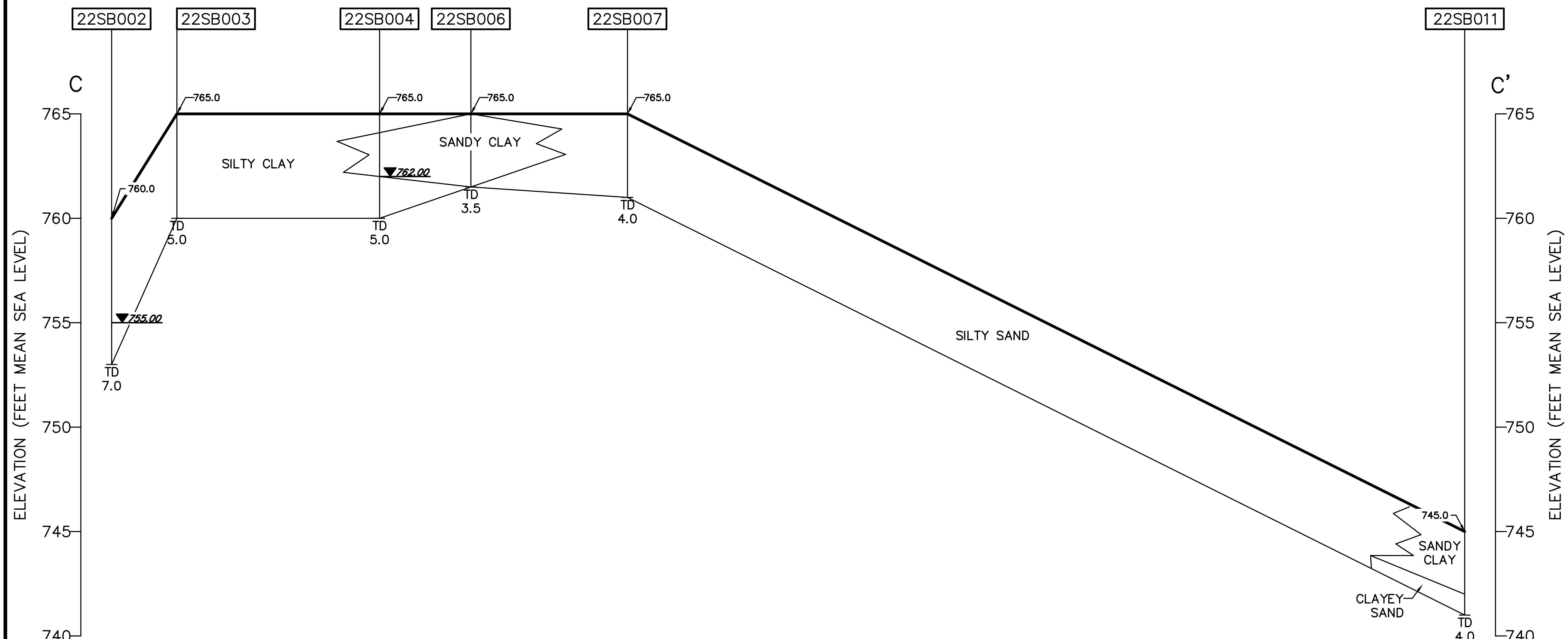

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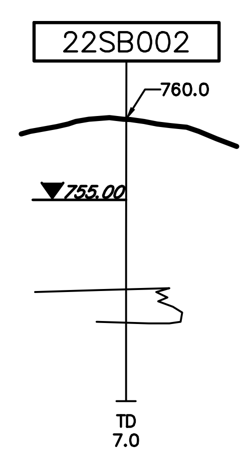

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SCALE AS NOTED			DRAWING NO. FIGURE 3–4	SIZE B / REV. 0

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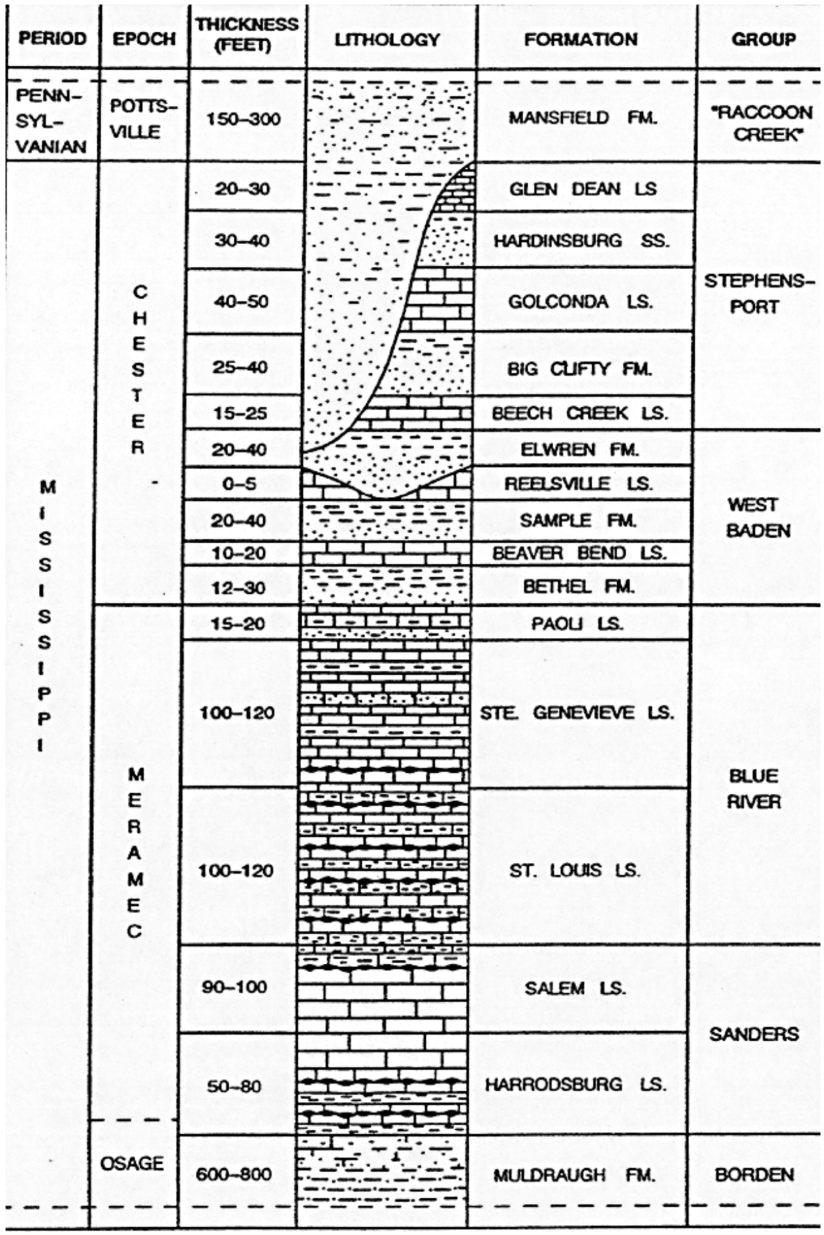

Source: Draft Report, RCRA Facility Investigation
Phase II Groundwater Release Assessment, SWMU 06/09
Demolition Area and Phase III Release
Characterization SWMU 07/09 Old Rifle Range
November 1995 - Figure 13
by William L. Murphy and Roy Wade

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CHECKED BY: S. HILL — DATE: 05/23/13		SWMU 22 - LEAD AZIDE	APPROVED BY — DATE
REVISED BY: S. PAXTON — DATE: 05/23/13		NSA CRANE	APPROVED BY — DATE
SCALE: AS NOTED		CRANE, INDIANA	FIGURE NO. FIGURE 3-5 — REV 0

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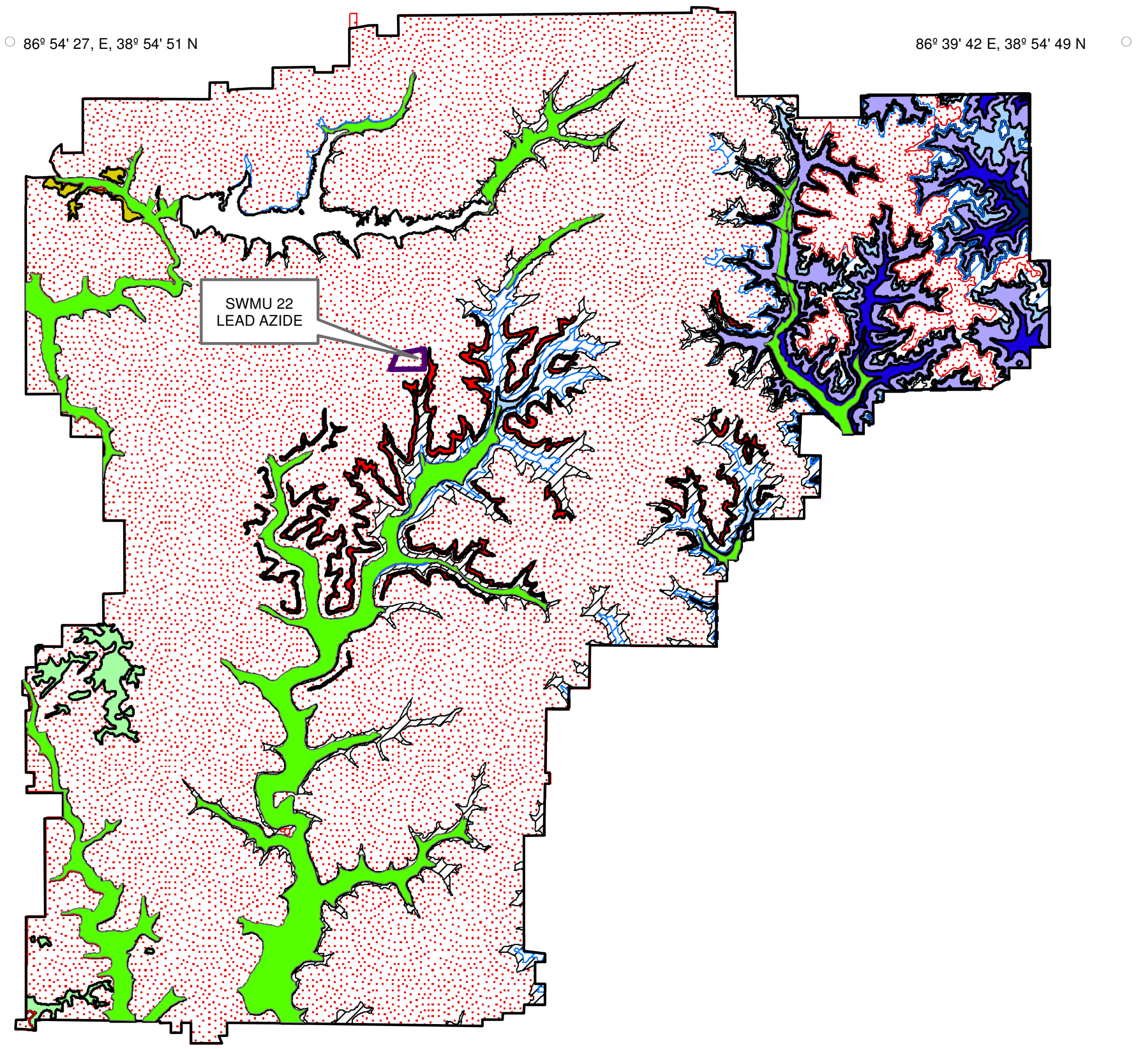

Explanation of Geology

Symbol	Description
Qal	***Alluvium***
Ql	***Loess***
Qo	***Glacial Outwash***
P	***Raccoon Creek Group and undifferentiated***
Ps	***Sandstone-dominated horizon of Lower Pennsylvanian***
M6	***Glenn Dean Ls, Hardinsburg Fm, Haney Ls, Indian Springs Shale Mbr, and undifferentiated***
M5	***Sandstone member of the Big Clifty Fm***
M4	***Beech Creek Ls***
M3	***Elwren Fm, Reelsville Ls, upper Sample Fm, and undifferentiated***
M2	***Lower part of Sample Fm, Beaver Bend Ls, Bethel Fm, and undifferentiated***
M1	***Paoli Ls, Ste Genevieve Ls, and undifferentiated***
	Select Solid Waste Management Units (SWMUs)

12,000 0 12,000 Feet

(Modified from Blunck, 1995)

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S. STROZ	12/01/10	SWMU 22 - LEAD AZIDE	___	F279
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S. HILL	05/23/13	CRANE, INDIANA	___	___
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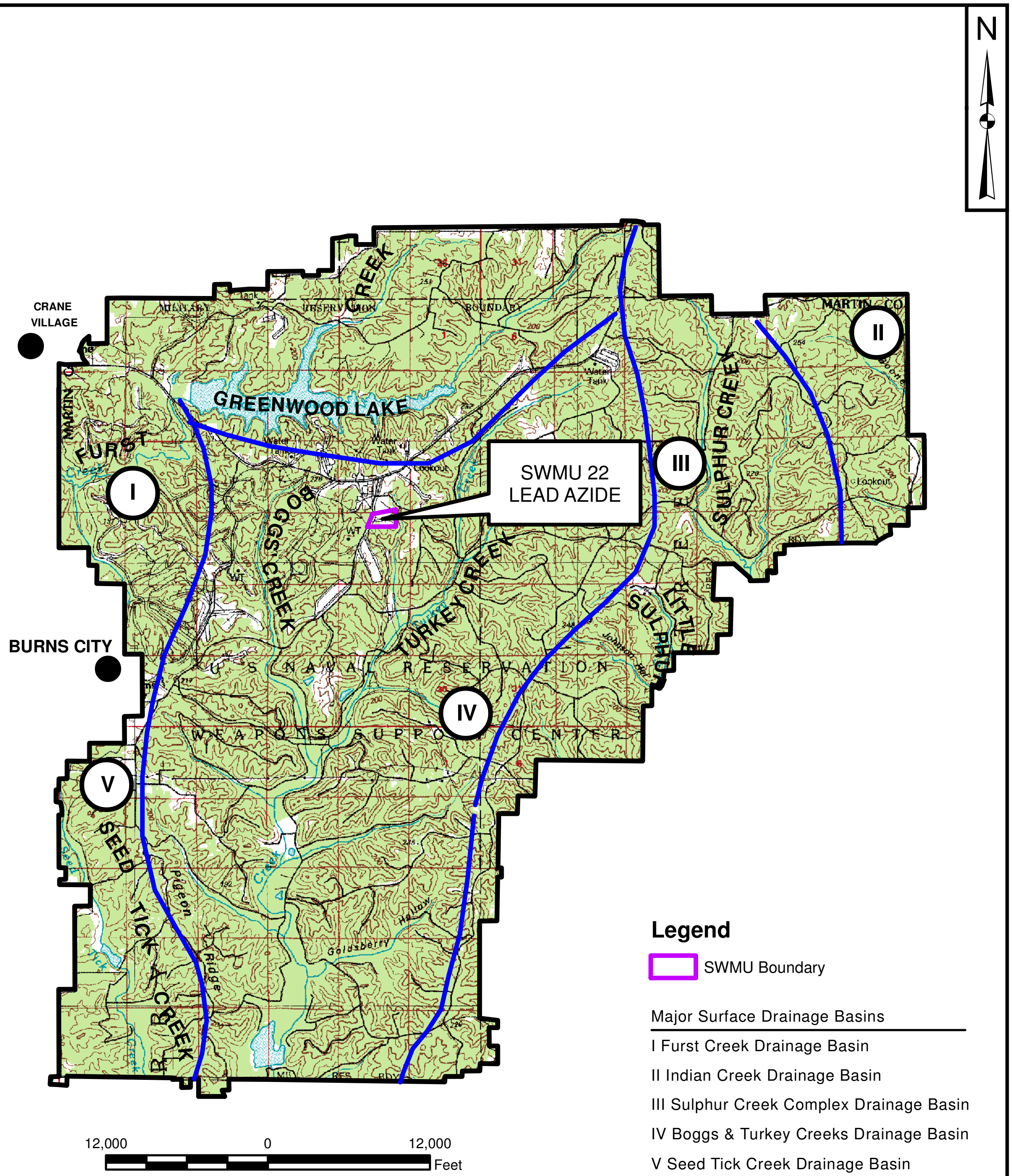

Source: Initial Assessment of Study of Naval Weapons Support Center Crane, Indiana.
Naval Energy and Enviornmental Support Activity, May 1983.

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REVISED BY	DATE			APPROVED BY	DATE
S. PAXTON	05/23/13			___	___
SCALE AS NOTED				FIGURE NO. FIGURE 3-7	REV 0

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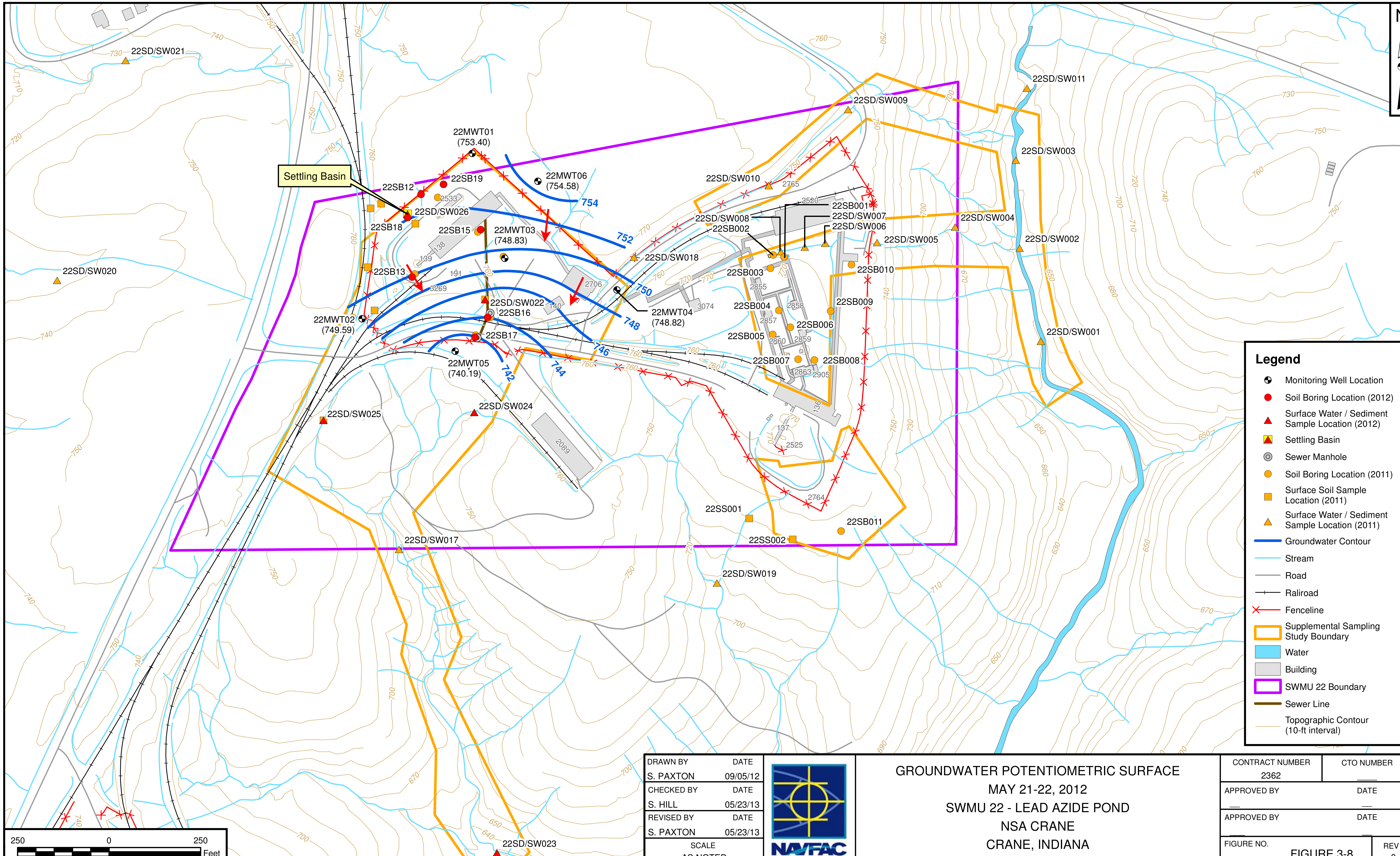


DRAWN BY	DATE
S. PAXTON	09/05/12
CHECKED BY	DATE
S. HILL	05/23/13
REVISED BY	DATE
S. PAXTON	05/23/13
SCALE	
AS NOTED	

NAVFAC

GROUNDWATER POTENTIOMETRIC SURFACE
MAY 21-22, 2012
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
2362	
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 3-8	REV 0

4.0 DATA QUALITY REVIEW

The data collected for the SWMU 22 RFI went through a data quality review (DQR). The review began with data verification and validation. Verification is a process used to ensure that contractual requirements were satisfied which includes reviewing the data received from the laboratory and comparing it the laboratory scope of work to ensure all contractual requirements were met. For this project it was verified that the laboratory satisfactorily adhered to contractual requirements. Validation is a comparison of data quality indicators (DQIs) against prescribed acceptance criteria to assess analytical method performance. The DQIs used are measures to assess the bias and precision of the analytical calibrations and sample analyses. This DQR includes evaluations of data completeness, accuracy, sensitivity, comparability, and representativeness. The data review process culminates with a data usability assessment during which the final usability of the data is established relative to the intended data use. The data usability was assessed in accordance with the UFP-SAP (Tetra Tech, 2011). A description of the data review processes used to determine whether analytical laboratory data were of acceptable technical quality for use in decision making and the results of the DQR are presented in Appendix C.

Overall, the data are considered acceptable for use.

5.0 NATURE AND EXTENT OF CONTAMINATION

This section presents data collected during the SWMU 22 RFI followed by an evaluation of the nature and extent of contamination and whether the contamination was site related. Site-related contaminants are those that were released as a result of operations at SWMU 22 and therefore do not represent naturally occurring conditions or contamination from sources other than SWMU 22.

For metal concentrations in soil, basewide background soil data collected for NSA Crane (Tetra Tech, 2001) were used to determine whether SWMU 22 data represent naturally occurring conditions. The background data are divided into groups representing soils of similar chemical composition and geology. Soil groups to which Crane SWMU 22 soil samples belong were determined as described in the NSA Crane Basewide Soil Background Study (Tetra Tech, 2001). Surface soils at SWMU 22 belong to Soil Group 3; subsurface soils belong to Groups 8 and 9. Because there is only one data point for Soil Group 9, SWMU 22 subsurface soil data were compared to Soil Group 8 background data. Tables 5-1 and 5-2 present summary statistics representing background Soil Groups 3 (surface soil) and 8 (subsurface soil). Organic target analytes are assumed not to occur naturally in soil. If detected, their presence in SWMU 22 soil is interpreted as evidence of site-related contamination unless they are shown to be from another source such as laboratory contamination. Perchlorate data were interpreted similarly, although perchlorate is known to occur naturally as a result of lightning discharges and in nitrate fertilizers. If nitrate compounds containing perchlorate were released as a result of SWMU 22 operations, perchlorate associated with the nitrates would be viewed as a site-related contaminant. More detail is provided in Section 5.1.1.

For mobile media (surface water, sediment, and groundwater), evaluation of site-related contamination usually involves a comparison of conditions upgradient or upstream of the site to downgradient or downstream conditions. If downstream or downgradient target analyte concentrations exceed upstream/upgradient concentrations, there may have been an impact from the site because upgradient/upstream conditions are unaffected by site operations, whereas downgradient/downstream conditions may have been affected by site operations.

5.1 INVESTIGATION RESULTS

Analytical results for samples collected during the SWMU 22 data RFI are summarized in Tables 5-3 through 5-9. Odd-numbered tables, beginning with "5-3", present summary statistics such as the frequency at which each chemical was detected, maximum and minimum measured concentrations, and locations of maximum detected concentrations. Even-numbered tables beginning with "5-4" present data for each chemical that was detected in at least one sample for the applicable environmental medium. Complete site characterization data are presented in Appendix C, Tables C-1 through C-4. Included in the tables are the screening values used to assess whether analytes may represent a concern and to select COPCs in the risk characterization process (Sections 6 and 7).

SWMU 22 data are presented on Figures 5-1 through 5-4. These figures identify with an "**H**" or "**E**" whether a human health or ecological screening criterion, respectively, is exceeded by a result. Only dissolved metals concentrations were compared to ecological screening criteria because the dissolved metals portion of a sample most closely represents the bioavailable metal.

The data quality and overall usability evaluations are presented in Section 4.0. All collected data, except two lead and two chromium results (described later), were found to be suitable for achieving project objectives.

5.1.1 Soil Results and Extent of Soil Contamination

Tables 5-3a and 5-3b are the summary tables identifying the frequency of detection for each analyte in surface and subsurface soil samples, respectively. Table 5-4 is a summary of results for all analytes that were detected in at least one soil sample. Appendix C, Table C-1, is a complete tabulation of all soil data collected for this project and includes results for chemicals that were not detected in any soil sample. Figure 5-1 presents the distribution of concentrations of analytes in soil.

Metals concentrations in SWMU 22 surface and subsurface soil samples were compared to metal-specific 95/95 upper tolerance limits (UTLs) for NSA Crane, as published in the Basewide Soil Background Study (Tetra Tech, 2001). SWMU 22 surface soil data were compared to Soil Group 3 UTLs (alluvial, Mississippian, and Pennsylvanian surface soil), and subsurface soil data were compared to Soil Group 8 UTLs (Pennsylvanian subsurface clay and silt). A 95/95 UTL represents the concentration that separates the lower 95 percent of a data distribution from the upper 5 percent with 95-percent confidence. There is a 5-percent (1 in 20) chance that uncontaminated site soil data for a particular metal would exceed the corresponding UTL.

Human health or ecological risk-based screening values were exceeded for five metals in soil: arsenic, cadmium, chromium (hexavalent), lead, and mercury.

Arsenic, barium, cadmium, selenium, and silver concentrations were all within the applicable background soil concentration ranges (i.e., less than UTLs); therefore, these metals are not considered site-related soil contaminants. Total chromium concentrations ranged from 49 to 25.4 mg/kg which was less than the human health and ecological screening levels for total chromium. These concentrations exceeded the human health soil-to-groundwater criterion of 0.12 mg/kg and the direct contact criterion of 0.29 mg/kg and the ecological criterion of 0.4 mg/kg for hexavalent chromium. The concentration of 1.31 mg/kg detected in the surface soil sample at 22SB020 also exceeded the hexavalent chromium criteria.

Surface soil lead concentrations exceed the 27.0 mg/kg lead surface soil background value in two samples (31.4 mg/kg in 22SS0220002 and 31.7 mg/kg in 22SS0250002). The exceedances are within about 20 percent of the UTL. Metals concentrations in SWMU 22 subsurface soil samples did not exceed the background value.

Surface soil mercury concentrations from 22SS025 (0.6 mg/kg) and 22SB007 (0.079 mg/kg) exceeded the 0.077 mg/kg UTL.

Perchlorate was not detected in any soil samples.

RDX was detected in one surface soil sample, 22SS0250002, at a concentration of 0.37 mg/kg. The concentration exceeded the soil-to-groundwater human health criterion (0.0046 mg/kg) but was less than the direct contact criterion of 5.6 mg/kg. No other organic analytes were detected in surface or subsurface soil samples from SWMU 22.

5.1.2 Groundwater Results and Extent of Groundwater Contamination

Table 5-5 is a summary table identifying the frequency of detection for each target analyte in groundwater samples, and Table 5-6 is a summary of results for all target analytes detected in at least one groundwater sample. Appendix C, Table C-2, is a complete tabulation of all groundwater data collected for this project. Screened intervals for wells are tabulated in Table 2-2. Figure 5-2 displays groundwater data for each sampling location, including dissolved and total metal concentrations

Water levels were the greatest in well 22MWT06 (water elevation 753.40 feet), as shown on Figure 3-8. The groundwater potentiometric surface gradient from this point is toward the south and southwest. There are no SWMU 22 buildings or known operations immediately upgradient of wells 22MWT01 and 22MWT06; therefore, these well are expected to be unaffected by SWMU 22 operations and have been identified as “UPGRADIENT” in Tables 5-6. Wells 22MWT002 through 22MWT005 are either cross gradient within or downgradient of SWMU 22.

Chemicals detected in groundwater at concentrations greater than human health screening values were RDX, arsenic, cadmium, chromium, lead, selenium, perchlorate, TNT, and the TNT biotic degradation product, 4-amino-2,6-dinitrotoluene (4ADNT). The presence of 4ADNT is confirmation that TNT contamination is degrading naturally, but the detection of TNT indicates that degradation is not complete. None of these energetic organic compounds were detected in well 22MWT06, which is furthest upgradient from SWMU 22, but both compounds were detected in well 22MWT01, which is also upgradient of SWMU 22. The presence of energetic compounds in well 22MWT01 is an indication that these contaminants may be entering SWMU 22 groundwater from an upgradient source. The maximum energetic compound concentration (15 µg/L RDX) was detected in well 22MTW02. This well, which is also the only well in which TNT, 4ADNT, and HMX were detected, is downgradient of Building 138; therefore, Building 138, or a source nearby, appears to be the source of the energetic organic groundwater contamination.

Perchlorate was detected in well 22MWT06 at a concentration of 0.44 µg/L and in well 22MWT02 at a concentration of 5.9 µg/L. Because the perchlorate concentration in the downgradient well (22MWT02) is significantly greater than in the upgradient well, SWMU 22 may be a source of perchlorate to groundwater, but not necessarily the sole source. Well 22MWT01, also upgradient of SWMU 22 operations, had perchlorate at 0.25 µg/L, which is an indication that the perchlorate contamination source in groundwater may not be limited to SWMU 22 operations.

Well 22MWT02 had the greatest number of detections and risk-based screening value exceedances. Topography and groundwater elevations indicate that shallow groundwater flow, which generally follows topography, is predominantly southward near Building 138. Groundwater flow may intercepted by unnamed drainage channels south of SWMU 22.

Maximum total metals concentration for arsenic (11 µg/L), cadmium (7.1 µg/L), chromium (19.3 µg/L), lead (49.7 µg/L), and selenium (8.1 µg/L) were detected in well 22MWT06. Because well 22MWT06 is upgradient of SWMU 22 operations, it is likely that these elevated metals concentrations are not attributable to SWMU 22 operations. Barium concentrations were less than human health risk-based screening values in every well; therefore, barium is not discussed further. The dissolved concentrations of these metals were generally equal to or less than the corresponding total metal concentrations, an indication that the elevated metals concentrations are attributable to suspended solids in the groundwater in at least some samples. Concentrations of arsenic, cadmium, chromium, lead, and selenium decrease from well 22MWT06 to well 22MWT03 to well 22MWT05. This type of pattern is typical of a contaminant source being located at or upgradient of well 22MWT06, with the contaminants becoming more dilute as groundwater migrates further from the contaminant source. The elevated metals concentrations, however, could also be attributed to groundwater sample turbidity that varies from location to location. The groundwater sample log sheet indicates that the groundwater sample from well 22MWT06 was visibly turbid and became more so as the well was bailed. Based on these observations, SWMU 22 is not considered a source of metals contamination in groundwater, but there could be a source of metals contamination north of SWMU 22. This area north of well 22MWT06 has not been investigated as a potential contaminant source.

5.1.3 Settling Basin Sediment Results

Sediment data are presented in Tables 5-7 and 5-8, including one sediment sample collected from a settling basin located west of Building 138. The basin sampling location is numbered 22SD026. If the settling basin were to leak, however, the basin could represent a contamination source for groundwater.

The settling basin sediment sample was analyzed for energetic compounds and metals. Four nitroaromatic compounds were detected. Of these four compounds, only TNT and its degradation product, 4ANDT, were detected at concentrations exceeding risk-based screening values. The presence of the parent compound and breakdown product is evidence that TNT is degrading but that degradation is not yet complete. Both of these compounds exhibit measurable solubility in water; therefore, the settling basin could serve as a contamination source for groundwater if water in the basin leaks into the surrounding soil. However, TNT was not detected in groundwater at SWMU 22.

Arsenic and chromium concentrations in the settling basin sediment sample were greater than residential risk-based criteria, but neither of the concentrations (5.6 mg/kg for arsenic and 16.2 mg/kg for chromium) exceed naturally occurring background UTLs for surface or subsurface soil. Because of the fine-grained nature of sediment, naturally occurring sediment would be expected to have a natural metals content even greater than soil; therefore, the sediment metal concentrations are within the range of naturally occurring soil concentrations.

5.1.4 Stream Sediment/Surface Water Results and Extent of Sediment/Surface Water Contamination

Several sediment and surface water samples were collected from water conveyances associated with SWMU 22. These samples were analyzed for energetic compounds and metals. For metals analyses, the surface water samples were analyzed both before and after filtration to determine whether the metals were primarily in the suspended solids or dissolved portion of each sample, respectively.

Sediment data are presented in Tables 5-7 and 5-8. Surface water data are presented in Tables 5-9 and 5-10. Tables 5-7 and 5-9 are summaries identifying the frequency of detection for each target analyte in sediment and surface water, respectively. Tables 5-8 and 5-10 are summaries of results for all target analytes detected in at least one sediment or surface water sample, respectively. Appendix C, Tables C-3 and C-4 are complete tabulations of all sediment and surface water characterization data, respectively.

5.1.4.1 Sediment

Concentrations of two metals in sediment samples collected at three locations exceeded surface soil background values, arsenic at locations 22SD011 (12.3 mg/kg) and 22SD023 (14.7 mg/kg) and mercury at location 22SD009 (0.26 mg/kg). Naturally occurring metals concentrations are usually greater in sediment than in soil because sediment typically has smaller grain sizes that adsorb metals more completely than soil.

The surface soil background value for arsenic is 11.83 mg/kg; the arsenic concentration at upgradient location 22SD011 (12.3 mg/kg) was slightly greater than this value. Only the 14.7 mg/kg arsenic concentration at location 22SD023 exceeded the upgradient concentration. Location 22SD023 receives drainage from other areas as well as SWMU 22, and further upstream/up drainage from this location, at location 22SD024, the arsenic concentration was 5.9 mg/kg. These suggest that the SWMU 22 arsenic concentrations in sediment do not represent site-related contamination. The mercury background value is 0.073 mg/kg. The mercury concentration at location 22SD009 was greater than the background value by approximately a factor of four. Mercury is used in explosives initiators and in pumps and other industrial equipment and could therefore have been released at SWMU 22. The available evidence suggests mercury might be a site-related sediment contaminant. Elevated sediment mercury concentrations are bounded by upstream and downstream locations where mercury concentrations do not exceed background levels (see Figure 5-3).

Organic analytes were not detected in any of the stream sediment samples. Perchlorate was not analyzed in sediment because it is so soluble in water that it is readily washed out of sediments.

5.1.4.2 Surface Water

All eight of the metals analyzed for, HMX, and RDX were detected in at least one unfiltered surface water sample, and all eight metals and perchlorate were detected in at least one filtered surface water sample. Organic analytes were not analyzed for in filtered samples.

As expected, the metals concentrations were typically greater in unfiltered samples than in filtered samples because unfiltered sample concentrations can include suspended solids that may have been entrained in the samples. Filtered samples do not include suspended solids. Some exceptions did occur, but only two were significant. The dissolved chromium (0.93 µg/L) and lead (2.2 µg/L) concentrations in sample 22SW003 were significantly greater than the total concentrations (0.43 µg/L chromium and 0.22 µg/L lead) for that sample.

Barium, lead, and selenium concentrations in surface water did not exceed applicable screening criteria at any location; therefore, these metals are not discussed further.

Arsenic was detected in several surface water samples (see Figure 5-4), one of which was the upstream sampling location 22SW011 (0.41 µg/L). There is no known source of arsenic contamination at SWMU 22, and the surface water arsenic concentrations are relatively uniform across and downstream of SWMU 22. Soil, sediment, and groundwater arsenic concentrations appear to be within naturally occurring arsenic concentration ranges. However, the upstream arsenic concentration at location 22SW011 (0.41 µg/L) is one-fourth of the maximum total arsenic concentration (1.5 µg/L at 22SW004). This suggests that arsenic at 22SW004 might be a site-related surface water contaminant.

One dissolved cadmium result (0.26 µg/L) exceeded the 0.25 µg/L ecological screening value, but the total metals concentration from the same sample (0.24 µg/L) did not. No other dissolved cadmium results exceeded ecological screening values. The total cadmium concentration at location 22SW024 (1.7 µg/L) exceeded the 0.69 µg/L human health screening criterion by a factor of approximately three. Location 22SW017, about 500 feet downstream, also had detectable cadmium (0.29 µg/L). All other cadmium results were less than 0.3 µg/L. Location 22SW011, which is unaffected by SWMU 22 operations, had no detectable cadmium. Based on these observations, cadmium might be a site-related contaminant. If cadmium was released to the environment as a result of SWMU 22 activities, the source of cadmium is in the western half of SWMU 22.

Total chromium concentrations exceeded the 0.031 µg/L human health risk-based screening criterion in 13 samples. The maximum chromium concentration was 3 µg/L at location 22SW004. This concentration exceeds the 0.45 µg/L upgradient concentration at location 22SW011 by nearly an order of magnitude. These are indications that chromium could be a site-related contaminant, but the data are inconclusive. If chromium is a site-related contaminant, the data indicate that the contamination source is on the eastern side of SWMU 22.

RDX concentrations exceeded the human health risk-based screening criterion at seven locations (see Figure 5-4). RDX does not occur naturally and, therefore, considered a site-related contaminant. However, although observed RDX concentrations in surface water might represent site-related contamination, there also could be a contributing source of RDX contamination north of SWMU 22. Locations 22SW011 and 22SW013 are upgradient of SWMU 22 and are likely not to have been affected by SWMU 22. The RDX concentrations at these locations are the third and fourth highest RDX surface water concentrations. HMX was detected in surface water but at concentrations that did not exceed screening criteria. Although the 11 µg/L HMX concentration at location 22SW013, upgradient of SWMU 22, did not exceed a screening value, it is significantly greater than HMX concentrations at any other location. This supports a conclusion that energetic contamination is present in surface water as a result of SWMU 22 operations, but it also indicates that there is a potential contamination source north of SWMU 22. RDX contamination is unbounded in the stream channel east of SWMU 22 that flows north to south but is bounded everywhere else. The most downstream sampling location east of SWMU 22 had HMX and RDX concentrations of 0.82 and 0.78 µg/L, respectively.

Perchlorate was detected at one surface water sampling location (22SW02), but the concentration did not exceed its screening value. The presence of this target analyte is an additional indication that SWMU 22 operations resulted in release of energetic contaminants.

5.2 SUMMARY

The matrix below summarizes the status of various target analtyes with regard to whether they are considered to be site-related contamination. If a target analyte is not included for a particular environmental medium, it is not considered to be a contaminant for that medium.

Site-Related Contaminants and Affected Media

Medium	Metal	Status
Soil	Lead	Minor SWMU 22-related contaminant but appears to be environmentally insignificant. Contamination appears to be limited to the former pond area. Evaluated in the risk assessments (Sections 7 and 8).

Medium	Metal	Status
Soil (continued)	Mercury	Site contaminant. Evaluated in the risk assessments (Sections 7 and 8).
	RDX	Site contaminant. Evaluated in the risk assessments (Sections 7 and 8).
Groundwater	HMX, RDX, TNT, 4-amino-2,6-dinitrotoluene, perchlorate	Site-related contaminants but may be coming on site from an upgradient source. Building 138 appears to be a source of energetic compound contamination at SWMU 22. Evaluated in the risk assessments (Sections 7 and 8).
Sediment in Settling Basin	Nitroaromatic compounds	Contamination source for groundwater if water in the basin leaks into the surrounding soil. Contamination is limited to the settling basin. Evaluated in the risk assessments (Sections 7 and 8).
Stream Sediment	Mercury	Low level mercury contamination is present. The available evidence is inconclusive as to whether this metal is actually related to site operations. Contamination is bounded by upgradient and downgradient non-detects. Evaluated in the risk assessments (Sections 7 and 8).
Surface Water	RDX	Site-related contaminant but also possibly associated with a contaminant source upgradient of SWMU 22. Evaluated in the risk assessments (Sections 7 and 8).
	HMX, perchlorate	Site-related contaminant but also possibly associated with a contaminant source upgradient of SWMU 22. Did not exceed screening values.
	Arsenic, cadmium, chromium	Possible site-related contaminants but data are inconclusive. Evaluated in the risk assessments (Sections 7 and 8).

TABLE 5-1

STATISTICAL SUMMARY OF BACKGROUND SOIL ANALYTICAL RESULTS
SOIL GROUP 3 - ALLUVIAL, MISSISSIPPIAN, AND PENNSYLVANIAN SURFACE SOIL
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Metal (mg/kg)	Frequency of Detection	Minimum Detection	Maximum Detection	Average of All Results	Average of Positive Detections	Location of Maximum	Distribution of Data	95% Upper Tolerance Limit
ARSENIC	15/15	2.4	10.2	6.1	6.1	BG3SBM0701	NORMAL	11.83
BARIUM	15/15	46.1	153.0	89.0	89.0	BG3SBM0601	LOGNORMAL	211
CADMIUM	10/15	0.1	3.6	0.6	0.9	BG3SBM0201	LOGNORMAL	6.05
CHROMIUM	15/15	8.5	21.7	14.6	14.6	BG1SBA0101	LOGNORMAL	28.7
LEAD	15/15	9.4	21.5	15.0	15.0	BG1SBA0101	LOGNORMAL	27.0
MERCURY	7/15	0.0	0.1	0.0	0.1	BG1SBP0601-MAX	NORMAL	0.077
SELENIUM	5/15	0.5	0.6	0.5	0.6	BG1SBP0901	NORMAL	0.81
SILVER	15/15	0.05	0.11	0.065	0.065	BG1SBP0401	LOGNORMAL	0.130

This table is excerpted from the NSA Crane Soil Basewide Background Report (Tetra Tech, 2001)

TABLE 5-2

STATISTICAL SUMMARY OF SOIL ANALYTICAL RESULTS
SOIL GROUP 8 - PENNSYLVANIAN SUBSURFACE CLAY AND SILT
SWMU 22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Metal (mg/kg)	Frequency of Detection	Minimum Detection	Maximum Detection	Average of All Results	Average of Positive Detections	Location of Maximum	Distribution of Data	95% Upper Tolerance Limit
ARSENIC	9/9	1.40	8.50	5.51	5.51	BG1SBP0204	NORMAL	12.5
BARIUM	9/9	25.1	83.4	56.96	56.96	BG1SBP0505	NORMAL	115
CADMIUM	8/9	0.05	0.64	0.26	0.28	BG1SBP0206	NORMAL	0.8
CHROMIUM	9/9	14.20	27.10	19.92	19.92	BG1SBP0206	NORMAL	33.0
LEAD	9/9	8.60	15.20	11.84	11.84	BG1SBP0603	NORMAL	19.6
MERCURY	1/9	0.14	0.14	0.04	0.14	BG1SBP0103	LOGNORMAL	0.18
SELENIUM	8/9	0.37	0.88	0.47	0.51	BG1SBP0206	NORMAL	1.07
SILVER	8/9	0.05	0.10	0.053	0.056	BG1SBP0206	LOGNORMAL	0.14

This table is excerpted from the NSA Crane Soil Basewide Background Report (Tetra Tech, 2001)

TABLE 5-3a

SUMMARY STATISTICS FOR SOIL ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA
PAGE 1 OF 2

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-detect	Maximum Non-detect	Average of Detections	Overal Average	Standard Deviation
EXPLOSIVES (mg/kg)										
1,3,5-Trinitrobenzene	0/23					0.158	0.158		0.0790	1.12E-09
1,3-Dinitrobenzene	0/23					0.126	0.126		0.0630	2.25E-09
2,4,6-Trinitrotoluene	0/23					0.166	0.166		0.0830	2.51E-09
2,4-Dinitrotoluene	0/23					0.166	0.166		0.0830	2.51E-09
2,6-Dinitrotoluene	0/23					0.166	0.166		0.0830	2.51E-09
2-Amino-4,6-Dinitrotoluene	0/23					0.15	0.15		0.0750	2.25E-09
2-Nitrotoluene	0/23					0.132	0.132		0.0660	0.000
3-Nitrotoluene	0/23					0.142	0.142		0.0710	2.38E-09
4-Amino-2,6-Dinitrotoluene	0/23					0.15	0.15		0.0750	2.25E-09
4-Nitrotoluene	0/23					0.16	0.16		0.0800	0.000
HMX	0/23					0.16	0.16		0.0800	0.000
Nitrobenzene	0/23					0.15	0.15		0.0750	2.25E-09
Nitroglycerin	0/10					0.17	0.17		0.0850	1.76E-09
PETN	0/10					1.16	1.16		0.579	1.22E-08
RDX	1/23	0.37 J	0.37 J	22SS025	22SS0250002	0.16	0.16	0.370	0.0926	6.05E-02
Tetryl	0/23					0.182	0.182		0.0910	1.59E-09
METALS (mg/kg)										
Arsenic	23/23	2.4 J	9.8 J	22SS025	22SS0250002			4.60	4.60	1.99E+00
Barium	23/23	12.8 J	144 J	22SB014	22SB0140002			51.8	51.8	3.38E+01
Cadmium	23/23	0.057 J	0.78	22SS025	22SS0250002			0.221	0.221	1.57E-01
Chromium (Total)	23/23	3.4 J	25.4 J	22SS025	22SS0250002			11.8	11.8	5.80E+00
Chromium (Hexavalent)	1/1	1.31	1.31	22SB020	22SB0200002			1.31	1.31	
Lead	23/23	2.8 J	31.7 J	22SS025	22SS0250002			10.1	10.1	7.53E+00
Mercury	9/23	0.02 J	0.6 J	22SS025	22SS0250002	0.02	0.079	0.0974	0.0505	0.120
Selenium	23/23	0.086 J	0.48 J	22SS025	22SS0250002			0.257	0.257	0.112
Silver	5/23	0.021 J	0.038 J	22SB011	22SB0110002	0.04	0.04	0.0284	0.0218	0.00483
MISCELLANEOUS PARAMETERS										
Percent Moisture (%)	10/10	9.1	22.8	22SS025	22SS0250002			15.29	15.3	3.73
Perchlorate (mg/kg)	0/13					0.004	0.004		0.00200	0.000
pH	3/3	7.3	8.2	22SB008	22SB0080002			7.73	7.73	0.451
Total Organic Carbon (mg/kg)	2/2	4100	11000	22SS022	22SS0220002			7550	7550	4879
Total Solids (%)	1/1	83.9	83.9	22SB020	22SB0200002			83.9	83.9	

TABLE 5-3a

SUMMARY STATISTICS FOR SOIL ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Associated Samples:
22SB0010002
22SB0020002
22SB0030002
22SB0040002
22SB0050002
22SB0060002
22SB0070002
22SB0080002
22SB0090002
22SB0100002
22SB0110002
22SB0120002
22SB0130002
22SB0140002
22SB0150002
22SB0160002
22SB0170002
22SB0180002
22SB0190002
22SS0010002
22SS0020002
22SS0220002
22SS0250002

J = Value is estimated.
mg/kg = Milligram per kilogram.
% = Percent

TABLE 5-3b

SUMMARY STATISTICS FOR SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-detect	Maximum Non-detect	Average of Detections	Overall Average	Standard Deviation
EXPLOSIVES (mg/kg)										
1,3,5-Trinitrobenzene	0/14					0.158	0.158		0.079	1.12E-09
1,3-Dinitrobenzene	0/14					0.126	0.126		0.063	2.25E-09
2,4,6-Trinitrotoluene	0/15					0.166	0.2		0.0841	2.51E-09
2,4-Dinitrotoluene	0/14					0.166	0.166		0.083	2.51E-09
2,6-Dinitrotoluene	0/14					0.166	0.166		0.083	2.51E-09
2-Amino-4,6-Dinitrotoluene	0/14					0.15	0.15		0.075	2.25E-09
2-Nitrotoluene	0/14					0.132	0.132		0.066	0.000
3-Nitrotoluene	0/14					0.142	0.142		0.071	2.38E-09
4-Amino-2,6-Dinitrotoluene	0/14					0.15	0.15		0.075	2.25E-09
4-Nitrotoluene	0/14					0.16	0.16		0.08	0.000
HMX	0/14					0.16	0.16		0.08	0.000
Nitrobenzene	0/14					0.15	0.15		0.075	2.25E-09
Nitroglycerin	0/5					0.17	0.17		0.085	1.76E-09
PETN	0/5					1.158	1.158		0.579	1.22E-08
RDX	0/15					0.16	0.2		0.0813	6.05E-02
Tetryl	0/14					0.182	0.182		0.091	1.59E-09
METALS (mg/kg)										
Arsenic	14/14	1.1 J	6.1 J	22SB011	22SB0110304			3.54	3.54	1.39
Barium	14/14	2.3 J	72.6 --	22SB018	22SB0180406			40.36	40.36	21.26
Cadmium	14/14	0.086 J	0.25 J	22SB016	22SB0160305			0.143	0.143	0.052
Chromium	14/14	5.3	17.7 J	22SB016	22SB0160305			9.79	9.79	3.52
Lead	14/14	2.8 J	10.9 --	22SB017	22SB0170305			6.7	6.7	2.65
Mercury	3/14	0.021 J	0.033 J	22SB017	22SB0170305	0.025	0.086	0.027	0.0231	0.0085
Selenium	14/14	0.06 J	0.46 J	22SB016	22SB0160305			0.215	0.215	0.108
Silver	2/14	0.022 J	0.023 J	22SB011	22SB0110304	0.04	0.04	0.023	0.020	0.001
MISCELLANEOUS PARAMETERS										
Percent Moisture (%)	5/5	8.1	15	22SB016, 22SB018	22SB0160608, 22SB0180406			12.18	12.18	3.23
Perchlorate (mg/kg)	0/9			--	--	0.004	0.004		0.002	
pH	1/1	7.9	7.9	22SB001	22SB0010305			7.9	7.9	

TABLE 5-3b

SUMMARY STATISTICS FOR SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Associated Samples:
22SB0010305
22SB0020607
22SB0030305
22SB0040305
22SB0060304
22SB0070304
22SB0090305
22SB0100305
22SB0110304
22SB0140203
22SB0160608
22SB0160305
22SB0170305
22SB0180406
22SB0200203

J = Value is estimated.
mg/kg = Milligram per kilogram.
% = Percent

TABLE 5-4

SUMMARY OF SOIL ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SOILSAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	ECO [1]	ECO REF	HH [2]		22SB001		22SB002		22SB003		22SB004	
SAMPLE ID			Direct Contact[7]	Soil-to-Ground-water[8]	22SB0010002	22SB0010305	22SB0020002	22SB0020607	22SB0030002	22SB0030305	22SB0040002	22SB0040305
SAMPLE DATE					01/19/2011	01/19/2011	01/19/2011	01/19/2011	01/19/2011	01/19/2011	01/19/2011	01/19/2011
SUBMATRIX					SS	SB	SS	SB	SS	SB	SS	SB
EXPLOSIVES (mg/kg)												
RDX	12	(6)	5.6	0.0046	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
METALS (mg/kg)												
Arsenic	17	(5)	0.61	0.026	**3.6 J**	**4.1 J**	**4.6 J**	**3.8 J**	**7.9 J**	**3.4 J**	**2.5 J**	**2 J**
Barium	330	(3)	1,500	2,400	**30.9 J**	**38.4 J**	**44.6 J**	**19.3 J**	**32.1 J**	**23.3 J**	**17.6 J**	**51.1 J**
Cadmium	0.36	(3)	7	10.4	**0.23 J**	**0.16 J**	**0.15 J**	**0.1 J**	**0.12 J**	**0.11 J**	**0.14 J**	**0.16 J**
Chromium (Total)	78	(5)	100,000[9]	NA	**5.6 J**	**6 J**	**8 J**	**8.7 J**	**14.1 J**	**10.7 J**	**3.4 J**	**12.1 J**
Chromium (Hexavalent)	0.4	(4)	0.29	0.12	NA	NA	NA	NA	NA	NA	NA	NA
Lead	11	(3)	400	270[10]	**8.9 J**	**6.5 J**	**10.2 J**	**9 J**	**10.8 J**	**7 J**	**2.8 J**	**4.7 J**
Mercury	0.013	(6)	2.3	0.66	**0.04 U**	**0.044 U**	**0.026 U**	**0.032 U**	**0.046 U**	**0.04 U**	**0.02 U**	**0.086 U**
Selenium	0.52	(3)	39	5.3[10]	**0.17 J**	**0.16 J**	**0.28 J**	**0.29 J**	**0.23 J**	**0.13 J**	**0.088 J**	**0.15 J**
Silver	4.2	(3)	39	12	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ
MISCELLANEOUS PARAMETERS												
Percent Moisture (%)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	NA	NA	NA	NA	**7.3**	**7.9**	NA	NA	NA	NA	NA	NA

TABLE 5-4

SUMMARY OF SOIL ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SOILSAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA
PAGE 2 OF 6

LOCATION	ECO [1]	ECO REF	HH [2]		22SB005	22SB006		22SB007		22SB008	22SB009	
SAMPLE ID SAMPLE DATE SUBMATRIX			Direct Contact[7]	Soil-to-Ground-water[8]	22SB0050002 01/19/2011 SS	22SB0060002 01/19/2011 SS	22SB0060304 01/19/2011 SB	22SB0070002 01/21/2011 SS	22SB0070304 01/21/2011 SB	22SB0080002 01/19/2011 SS	22SB0090002 01/19/2011 SS	22SB0090305 01/19/2011 SB
EXPLOSIVES (mg/kg)												
RDX	12	(6)	5.6	0.0046	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
METALS (mg/kg)												
Arsenic	17	(5)	0.61	0.026	**3.3 J**	**2.4 J**	**1.1 J**	**6**	**2**	**3.7 J**	**2.7 J**	**4.9 J**
Barium	330	(3)	1,500	2,400	**12.8 J**	**38 J**	**2.3 J**	**89 J**	**14.8 J**	**34.3 J**	**15.4 J**	**23.3 J**
Cadmium	0.36	(3)	7	10.4	**0.18 J**	**0.19 J**	**0.092 J**	**0.16**	**0.1**	**0.33 J**	**0.075 J**	**0.14 J**
Chromium (Total)	78	(5)	100,000[9]	NA	**13.4 J**	**10.6 J**	**7.4 J**	**11**	**5.3**	**8.9 J**	**5.9 J**	**9.2 J**
Chromium (Hexavalent)	0.4	(4)	0.29	0.12	NA	NA	NA	NA	NA	NA	NA	NA
Lead	11	(3)	400	270[10]	**6.1 J**	**4.6 J**	**2.8 J**	**11.8**	**4.9**	**11.2 J**	**4.1 J**	**7 J**
Mercury	0.013	(6)	2.3	0.66	**0.028 U**	**0.021 U**	**0.025 U**	**0.079 U**	**0.046 U**	**0.035 U**	**0.042 U**	**0.04 U**
Selenium	0.52	(3)	39	5.3[10]	**0.18 J**	**0.17 J**	**0.06 J**	**0.31**	**0.11 J**	**0.23 J**	**0.094 J**	**0.14 J**
Silver	4.2	(3)	39	12	0.04 UJ	0.04 UJ	0.04 UJ	0.04 U	0.04 U	**0.035 J**	0.04 UJ	**0.022 J**
MISCELLANEOUS PARAMETERS												
Percent Moisture (%)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA	**8.2**	NA	NA

TABLE 5-4

SUMMARY OF SOIL ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SOILSAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	ECO [1]	ECO REF	HH [2]		22SB010		22SB011		22SB012	22SB013	22SB014	
SAMPLE ID SAMPLE DATE SUBMATRIX			Direct Contact[7]	Soil-to-Ground-water[8]	22SB0100002 01/19/2011 SS	22SB0100305 01/19/2011 SB	22SB0110002 01/19/2011 SS	22SB0110304 01/19/2011 SB	22SB0120002 05/10/2012 SS	22SB0130002 05/09/2012 SS	22SB0140002 05/09/2012 SS	22SB0140203 05/10/2012 SB
EXPLOSIVES (mg/kg)												
RDX	12	(6)	5.6	0.0046	0.16 U	0.16 U	0.16 U	0.16 U	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
METALS (mg/kg)												
Arsenic	17	(5)	0.61	0.026	**2.9 J**	**3.1 J**	**7 J**	**6.1 J**	**2.9 J**	**5.6 J**	**4.2 J**	**2.5 J**
Barium	330	(3)	1,500	2,400	**55.3 J**	**60.5 J**	**65.8 J**	**40.6 J**	**22.4 J**	**126 J**	**144 J**	**52.3 J**
Cadmium	0.36	(3)	7	10.4	**0.079 J**	**0.1 J**	**0.19 J**	**0.12 J**	**0.13 J**	**0.24 J**	**0.28 J**	**0.086 J**
Chromium (Total)	78	(5)	100,000[9]	NA	**8 J**	**7.6 J**	**12.4 J**	**9 J**	**7 J**	**19.8 J**	**18.7 J**	**7.5 J**
Chromium (Hexavalent)	0.4	(4)	0.29	0.12	NA	NA	NA	NA	NA	NA	NA	NA
Lead	11	(3)	400	270[10]	**4.7 J**	**5.5 J**	**11.5 J**	**8.9 J**	**4.5 J**	**7 J**	**8 J**	**2.8 J**
Mercury	0.013	(6)	2.3	0.66	**0.031 U**	**0.025 U**	**0.038 U**	**0.067 U**	**0.026 J**	**0.021 J**	**0.03 J**	**0.04 U**
Selenium	0.52	(3)	39	5.3[10]	**0.14 J**	**0.16 J**	**0.38 J**	**0.26 J**	**0.2 J**	**0.4 J**	**0.32 J**	**0.21 J**
Silver	4.2	(3)	39	12	0.04 UJ	0.04 UJ	**0.038 J**	**0.023 J**	0.04 UJ	0.04 UJ	**0.021 J**	0.04 UJ
MISCELLANEOUS PARAMETERS												
Percent Moisture (%)	NA	NA	NA	NA	NA	NA	NA	NA	**16**	**13**	**18.9**	**8.1**
Total Organic Carbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	NA	NA	NA	NA	NA	NA	NA	NA	**7.7**	NA	NA	NA

TABLE 5-4

SUMMARY OF SOIL ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SOILSAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA
PAGE 4 OF 6

LOCATION SAMPLE ID SAMPLE DATE SUBMATRIX	ECO [1]	ECO REF	HH [2] Direct Contact[7]	HH [2] Soil-to-Ground-water[8]	22SB015 22SB0150002 05/10/2012 SS	22SB016 22SB0160002 05/09/2012 SS	22SB016 22SB0160305 05/09/2012 SB	22SB016 22SB0160608 05/09/2012 SB	22SB017 22SB0170002 05/09/2012 SS	22SB017 22SB0170305 05/09/2012 SB	22SB018 22SB0180002 05/10/2012 SS	22SB018 22SB0180406 05/11/2012 SB
EXPLOSIVES (mg/kg)												
RDX	12	(6)	5.6	0.0046	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 U
METALS (mg/kg)												
Arsenic	17	(5)	0.61	0.026	**4.7 J**	**5 J**	**4.6 J**	**3.4 J**	**5.2 J**	**5.3 J**	**6 J**	**3.2**
Barium	330	(3)	1,500	2,400	**47 J**	**79.2 J**	**69.5 J**	**54 J**	**39.9 J**	**43 J**	**73.5 J**	**72.6**
Cadmium	0.36	(3)	7	10.4	**0.2 J**	**0.26**	**0.25 J**	**0.19 J**	**0.18**	**0.22**	**0.27 J**	**0.18**
Chromium (Total)	78	(5)	100,000[9]	NA	**12.6 J**	**19.5 J**	**17.7 J**	**8.7 J**	**16.7 J**	**15.8 J**	**17.3 J**	**11.4**
Chromium (Hexavalent)	0.4	(4)	0.29	0.12	NA	NA	NA	NA	NA	NA	NA	NA
Lead	11	(3)	400	270[10]	**6.1 J**	**10.6**	**10.6 J**	**8.7 J**	**17.3**	**10.9**	**9.4 J**	**4.5**
Mercury	0.013	(6)	2.3	0.66	**0.04 U**	**0.02 J**	**0.021 J**	**0.027 J**	**0.04 J**	**0.033 J**	**0.054 J**	**0.04 U**
Selenium	0.52	(3)	39	5.3[10]	**0.28 J**	**0.35 J**	**0.46 J**	**0.29 J**	**0.34 J**	**0.35 J**	**0.38 J**	**0.24**
Silver	4.2	(3)	39	12	0.04 UJ	0.04 U	0.04 UJ	0.04 UJ	0.04 U	0.04 U	**0.022 J**	0.04 U
MISCELLANEOUS PARAMETERS												
Percent Moisture (%)	NA	NA	NA	NA	**14.3**	**9.1**	**13.4**	**15**	**12.2**	**9.4**	**16.3**	**15**
Total Organic Carbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-4

SUMMARY OF SOIL ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SOILSAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	ECO [1]	ECO REF	HH [2]		22SB019	22SB020		22SS001	22SS002	22SS004	22SS005
SAMPLE ID SAMPLE DATE SUBMATRIX			Direct Contact[7]	Soil-to-Ground-water[8]	22SB0190002 05/10/2012 SS	22SB0200002 01/23/2013 SS	22SB0200203 01/23/2013 SB	22SS0010002 01/21/2011 SS	22SS0020002 01/21/2011 SS	22SS0040002 01/23/2013 SS	22SS0050002 01/23/2013 SS
EXPLOSIVES (mg/kg)											
RDX	12	(6)	5.6	0.0046	0.16 UJ	0.2 U	0.2 U	0.16 U	0.16 U	0.2 U	0.2 U
METALS (mg/kg)											
Arsenic	17	(5)	0.61	0.026	**7 J**	**6 J**	**3.2**	**2.4**	**2.4**	NA	NA
Barium	330	(3)	1,500	2,400	**69.4 J**	**73.5 J**	**72.6**	**27.1 J**	**22 J**	NA	NA
Cadmium	0.36	(3)	7	10.4	**0.22 J**	**0.27 J**	**0.18**	**0.1**	**0.057 J**	NA	NA
Chromium (Total)	78	(5)	100,000[9]	NA	**14.8 J**	**17.3 J**	**11.4**	**4.9**	**4.9**	NA	NA
Chromium (Hexavalent)	0.4	(4)	0.29	0.12	NA	**1.31**	NA	NA	NA	NA	NA
Lead	11	(3)	400	270[10]	**8.4 J**	**9.4 J**	**4.5**	**6.5**	**5.1**	NA	NA
Mercury	0.013	(6)	2.3	0.66	**0.032 J**	**0.054 J**	**0.04 U**	**0.068 U**	**0.056 U**	NA	NA
Selenium	0.52	(3)	39	5.3[10]	**0.32 J**	**0.38 J**	**0.24**	**0.14 J**	**0.086 J**	NA	NA
Silver	4.2	(3)	39	12	0.04 UJ	**0.022 J**	0.04 U	0.04 U	0.04 U	NA	NA
MISCELLANEOUS PARAMETERS											
Percent Moisture (%)	NA	NA	NA	NA	**15.4**	**16.3**	**15**	NA	NA	NA	NA
Total Organic Carbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-4

SUMMARY OF SOIL ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SOILSAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION SAMPLE ID SAMPLE DATE SUBMATRIX	ECO [1]	ECO REF	HH [2] Direct Contact[7]	 Soil-to-Groundwater[8]	22SS006 22SS0060002 01/23/2013 SS	22SS007 22SS0070002 01/23/2013 SS	22SS008 22SS0080002 01/23/2013 SS	22SS022 22SS0220002 05/12/2012 SS	22SS025 22SS0250002 05/11/2012 SS
EXPLOSIVES (mg/kg)									
RDX	12	(6)	5.6	0.0046	0.2 U	0.2 U	0.2 U	0.16 U	**0.37 J**
METALS (mg/kg)									
Arsenic	17	(5)	0.61	0.026	NA	NA	NA	**4.1**	**9.8 J**
Barium	330	(3)	1,500	2,400	NA	NA	NA	**56.5**	**48.6 J**
Cadmium	0.36	(3)	7	10.4	NA	NA	NA	**0.52**	**0.78**
Chromium (Total)	78	(5)	100,000[9]	NA	NA	NA	NA	**8.5**	**25.4 J**
Chromium (Hexavalent)	0.4	(4)	0.29	0.12	NA	NA	NA	NA	NA
Lead	11	(3)	400	270[10]	NA	NA	NA	**31.4**	**31.7 J**
Mercury	0.013	(6)	2.3	0.66	NA	NA	NA	**0.054 J**	**0.6 J**
Selenium	0.52	(3)	39	5.3[10]	NA	NA	NA	**0.35 J**	**0.48 J**
Silver	4.2	(3)	39	12	NA	NA	NA	0.04 U	**0.026 J**
MISCELLANEOUS PARAMETERS									
Percent Moisture (%)	NA	NA	NA	NA	NA	NA	NA	**14.9**	**22.8**
Total Organic Carbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	**11000**	**4100**
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA

NOTES:
Only analytes with at least one detection are shown on this table.
Surface soil samples are compared to human health and ecological criteria. Subsurface soil samples are only compared to human health criteria.
(1) Minimum Ecological Risk Criteria
(2) Minimum Human Health Risk Criteria
(3) Ecological Soil Screening Levels
(4) Region 5 (USEPA, 2003a)
(5) Canadian Council of Ministers of the Environment
(6) Los Alamos National Laboratory (LANL) (3.0 database; LANL, 2011)
(7) USEPA Adjusted Direct Contact Residential
(8) USEPA Protection of Groundwater
(9) Indiana Department of Environmental Management Migration to Groundwater
(10) Indiana Department of Environmental Residential Direct Contact
mg/kg - Milligrams per kilogram
NA - Not Available / Not Analyzed
% - Percent
REF - Reference
SB - Subsurface soil
SS - Surface soil
Light gray shading indicates positive result.
Dark shading indicates exceedance of criteria.
DATA QUALIFIERS:
U - Indicates that parameter was not detected at the numerical detection limit.
J - Indicates that the parameter was detected but the concentration is considered an estimate due to imprecision.
UJ - Indicates that the parameter was not detected and the result is estimated.

TABLE 5-5

SUMMARY STATISTICS FOR GROUNDWATER ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA
PAGE 1 OF 2

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-detect	Maximum Non-detect	Average of Detections	Overall Average	Standard Deviation
EXPLOSIVES (µg/L)										
1,3,5-Trinitrobenzene	0/6					0.26	0.26		0.130	0.000
1,3-Dinitrobenzene	0/6					0.262	0.262		0.131	0.000
2,4,6-Trinitrotoluene	1/6	0.47 J	0.47 J	22MWT02	22GWT002	0.266	0.266	0.470	0.189	0.138
2,4-Dinitrotoluene	0/6					0.25	0.25		0.125	0.000
2,6-Dinitrotoluene	0/6					0.25	0.25		0.125	0.000
2-Amino-4,6-Dinitrotoluene	0/6					0.25	0.25		0.125	0.000
2-Nitrotoluene	0/6					0.252	0.252		0.126	0.000
3-Nitrotoluene	0/6					0.266	0.266		0.133	0.000
4-Amino-2,6-Dinitrotoluene	1/6	0.11 J	0.11 J	22MWT02	22GWT002	0.2	0.2	0.110	0.102	0.00408
4-Nitrotoluene	0/6					0.266	0.266		0.133	0.000
HMX	1/6	1.1 J	1.1 J	22MWT02	22GWT002	0.23	0.23	1.10	0.279	0.402
Nitrobenzene	0/6					0.252	0.252		0.126	0.000
Nitroglycerin	0/6					0.26	0.26		0.130	0.000
PETN	0/6					1.214	1.214		0.607	0.000
RDX	4/6	0.19 J	15 J	22MWT02	22GWT002	0.246	0.246	4.01	2.71	6.02
Tetryl	0/6					0.266	0.266		0.133	0.000
TOTAL METALS (µg/L)										
Arsenic	6/6	1.4	11	22MWT06	22GWT006			4.55	4.55	3.56
Barium	6/6	16.4	86.6 J	22MWT05	22GWT005			49.8	49.8	28.1
Cadmium	6/6	0.59	7.1	22MWT06	22GWT006			3.03	3.03	2.58
Chromium (Total)	7/8	4	90.8	22MWT05	22GWT005-20130123	1	1	19.99	17.55	30.09
Lead	6/6	3.2	49.7 J	22MWT06	22GWT006			18.0	18.0	16.7
Mercury	0/6					0.12	0.29		0.088	0.0308
Selenium	6/6	0.41 J	8.1	22MWT06	22GWT006			3.24	3.24	3.04
Silver	0/6					0.06	0.06		0.030	0.000
DISSOLVED METALS (µg/L)										
Arsenic	5/5	0.44	3.3	22MWT06	22GWT006			1.76	1.76	1.42
Barium	5/5	23.6	55.6	22MWT05	22GWT005			32.0	32.0	13.3
Cadmium	5/5	0.45	3.9	22MWT06	22GWT006			1.91	1.91	1.44
Chromium (Total)	5/7	0.59	3	22MWT02	22GWT002	1	1.5	1.68	1.38	0.94
Chromium (Hexavalent)	1/2	0.046	0.046	22MWT005	22GWT005-20130416	10	10	0.05	2.52	3.5
Lead	5/5	0.72	10.6 J	22MWT02	22GWT002			5.82	5.82	3.66
Mercury	0/5					0.12	0.18		0.066	0.013

TABLE 5-5

SUMMARY STATISTICS FOR GROUNDWATER ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Result		Maximum Result		Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-detect	Maximum Non-detect	Average of Detections	Overall Average	Standard Deviation
DISSOLVED METALS (µg/L) (cont.)												
Selenium	5/5	0.24	J	5.7		22MWT06	22GWT006			2.38	2.38	2.26
Silver	0/5							0.06	0.06		0.030	0.000
MISCELLANEOUS PARAMETERS (µg/L)												
Perchlorate	3/6	0.25	J	5.9	J	22MWT02	22GWT002	0.4	0.4	2.20	1.20	2.31

Associated Samples:
22GWT001
22GWT002
22GWT003
22GWT004
22GWT005
22GWT005-20130416
22GWT006

J = Indicates that parameter was detected but the concentration is considered an estimate due to precision.
µg/L - Micrograms per liter

TABLE 5-6

SUMMARY OF GROUNDWATER ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE GROUNDWATER SAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA
PAGE 1 OF 2

LOCATION SAMPLE ID SAMPLE DATE MATRIX SUBMATRIX	HH [1]	HH REF	22MWT01 22GWT001 5/22/2012 GW NA	22MWT02 22GWT002 5/22/2012 GW NA	22MWT03 22GWT003 5/23/2012 GW NA	22MWT04 22GWT004 5/23/2012 GW NA
EXPLOSIVES (µg/L)						
2,4,6-Trinitrotoluene	0.76	(2)	0.266	0.47 J	0.266 UJ	0.266 UJ
4-Amino-2,6-Dinitrotoluene	3	(2)	0.2 UJ	0.11 J	0.2 UJ	0.2 UJ
HMX	78	(2)	0.23 UJ	1.1 J	0.23 UJ	0.23 UJ
RDX	0.61	(2)	0.32 J	**15 J**	0.19 J	0.246 UJ
METALS (µg/L)						
Arsenic	0.045	(2)	**1.4**	**4.9**	**5.5**	**1.9**
Barium	290	(2)	34.2	39.4 J	16.4	40
Cadmium	0.69	(2)	**0.9**	**3.6**	**4.7**	0.59
Chromium (Total)	0.031	(3)	**4**	**6.5**	**6.6**	**5**
Lead	15	(2)	3.2	14.6 J	**21.4**	7.5
Selenium	7.8	(2)	0.45 J	5.3	3.5	1.7
DISSOLVED METALS (µg/L)						
Arsenic	0.045	(2)	**0.44**	**3.2**	NA	**1.4**
Barium	290	(2)	23.6	25.2	NA	27.1
Cadmium	0.69	(2)	**0.99**	**2.9**	NA	0.45
Chromium (Total)	0.031	(3)	**0.59**	**3**	NA	**1.2**
Chromium (Hexavalent)	0.031	(3)	NA	NA	NA	NA
Lead	15	(2)	0.72	10.6 J	NA	6.6
Selenium	7.8	(2)	0.56 J	3.5	NA	1.9
MISCELLANEOUS PARAMETERS (µg/L)						
Perchlorate	1.1	(2)	0.25 J	**5.9 J**	0.4 UJ	0.4 UJ

TABLE 5-6

SUMMARY OF GROUNDWATER ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE GROUNDWATER SAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA
PAGE 2 OF 2

LOCATION	HH (1)	HH REF	22MWT05			22MWT06
SAMPLE ID			22GWT005	22GWT005	22GWT005	22GWT006
SAMPLE DATE			5/21/2012	01/23/2013	04/16/2013	5/21/2012
MATRIX			GW	GW	GW	GW
SUBMATRIX			NA	NA	NA	UPGRADIENT GW
EXPLOSIVES (µg/L)						
2,4,6-Trinitrotoluene	0.76	(2)	0.266 UJ	NA	NA	0.266 UJ
4-Amino-2,6-Dinitrotoluene	3	(2)	0.2 UJ	NA	NA	0.2 UJ
HMX	78	(2)	0.23 UJ	NA	NA	0.23 UJ
RDX	0.61	(2)	0.53 J	NA	NA	0.246 UJ
METALS (µg/L)						
Arsenic	0.045	(2)	**2.6**	NA	NA	**11**
Barium	290	(2)	86.6 J	NA	NA	82 J
Cadmium	0.69	(2)	**1.3**	NA	NA	**7.1**
Chromium (Total)	0.031	(3)	**7.7**	**90.8 J**	1 U	**19.3**
Lead	15	(2)	11.5 J	NA	NA	**49.7 J**
Selenium	7.8	(2)	0.41 J	NA	NA	**8.1**
DISSOLVED METALS (µg/L)						
Arsenic	0.045	(2)	**0.45**	NA	NA	**3.3**
Barium	290	(2)	55.6	NA	NA	28.5
Cadmium	0.69	(2)	**1.3**	NA	NA	**3.9**
Chromium (Total)	0.031	(3)	**2.3**	1.5 U	NA	**1.3**
Chromium (Hexavalent)	0.031	(3)	NA	10 U	**0.034**	NA
Lead	15	(2)	4.2 J	NA	NA	7 J
Selenium	7.8	(2)	0.24 J	NA	NA	5.7
MISCELLANEOUS PARAMETERS (µg/L)						
Perchlorate	1.1	(2)	0.4 UJ	0.4 UJ	0.4 UJ	0.44 J

NOTES:
Only analytes with at least one detection are shown on this table.
(1) Minimum Human Health Risk Criteria
(2) Adjusted USEPA Regional Screening Level Tap Water (USEPA, 2012a)
(3) Adjusted USEPA Regional Screening Level Tap Water for hexavalent chromium (USEPA, 2012a)
µg/L - Micrograms per liter
NA - Not Available / Not Analyzed
Light gray shading indicates detection.
Dark shading indicates exceedance of at least one criterion.

DATA QUALIFIERS:
J - Indicates that the parameter was detected but the concentration is considered an estimate due to imprecision.
U - Indicates that the parameter was not detected at the numerical detection limit.
UJ - Indicates that the parameter was not detected and the result is estimated.

TABLE 5-7

SUMMARY STATISTICS FOR SEDIMENT ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-detect	Maximum Non-detect	Average of Detections	Overal Average	Standard Deviation
EXPLOSIVES (mg/kg)										
1,3,5-Trinitrobenzene	0/18					0.158	0.158			
1,3-Dinitrobenzene	0/18					0.126	0.126			
2,4,6-Trinitrotoluene	0/18					0.166	0.166			
2,4-Dinitrotoluene	0/18					0.166	0.166			
2,6-Dinitrotoluene	0/18					0.166	0.166			
2-Amino-4,6-Dinitrotoluene	0/18					0.15	0.15			
2-Nitrotoluene	0/18					0.132	0.132			
3-Nitrotoluene	0/18					0.142	0.142			
4-Amino-2,6-Dinitrotoluene	0/18					0.15	0.15			
4-Nitrotoluene	0/18					0.16	0.16			
HMX	0/18					0.16	0.16			
Nitrobenzene	0/18					0.15	0.15			
Nitroglycerin	0/18					0.17	0.17			
PETN	0/18					1.158	1.158			
RDX	0/18					0.16	0.16			
Tetryl	0/18					0.182	0.182			
METALS (mg/kg)										
Arsenic	18/18	1.2 J	14.7	22SD/SW023	22SD0230006			4.06	4.06	3.72
Barium	18/18	8.6 J	173 J	22SD/SW003	22SD0030006			37.3	37.3	37.0
Cadmium	18/18	0.071 J	0.88 J	22SD/SW006	22SD0060006			0.269	0.269	0.188
Chromium (Total)	18/18	2.5 J	13.9 J	22SD/SW003	22SD0030006			7.45	7.45	4.71
Lead	18/18	4 J	20 J	22SD/SW008	22SD0080624			9.68	9.68	4.15
Mercury	5/18	0.038 J	0.26	22SD/SW009	22SD0090006	0.03	0.056	0.101	0.045	0.057
Selenium	18/18	0.044 J	0.61	22SD/SW023	22SD0230006			0.184	0.184	0.142
Silver	3/18	0.02 J	0.025 J	22SD/SW001	22SD0010006	0.04	0.04	0.022	0.020	0.001
MISCELLANEOUS PARAMETERS										
Percent Moisture (%)	5/5	21.4	44.1	22SD/SW010	22SD0100006_20120512			28.8	28.8	9.43
pH	3/3	6.1	7.3	22SD/SW006	22SD0060624			6.67	6.667	0.603
Total Organic Carbon (mg/kg)	19/19	670	39000	22SD/SW018	22SD0180006_20120512			11988	11988	10828

TABLE 5-7

SUMMARY STATISTICS FOR SEDIMENT ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Associated Samples:
22SD0010006
22SD0020006
22SD0030006
22SD0040006
22SD0050006
22SD0060006
22SD0060624
22SD0070006
22SD0070624
22SD0080006
22SD0080624
22SD0090006
22SD0100006
22SD0100006_20120512
22SD0110006
22SD0170006
22SD017_20130123
22SD0180006
22SD0180006_20120512
22SD0230006
22SD0240006

J - Indicates that the parameter was detected but the concentration is considered an estimate due to imprecision.
mg/kg - Milligrams per kilogram.
% - Percent

TABLE 5-8

SUMMARY OF ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SEDIMENT SAMPLE
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION SAMPLE ID SAMPLE DATE MATRIX SUBMATRIX	ECO [1]	ECO REF	HH [2]	HH REF	22SD/SW001 22SD0010006 01/20/2011 SD SD	22SD/SW002 22SD0020006 01/20/2011 SD SD	22SD/SW003 22SD0030006 01/20/2011 SD SD	22SD/SW004 22SD0040006 01/20/2011 SD SD	22SD/SW005 22SD0050006 01/20/2011 SD SD
EXPLOSIVES (MG/KG)									
1,3,5-Trinitrobenzene	8	(5)	220	(7)	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
2,4,6-Trinitrotoluene	4	(5)	3.6	(7)	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-Dinitrotoluene	0.0144	(3)	1.6	(7)	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
4-Amino-2,6-Dinitrotoluene	NA	NA	15	(7)	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
METALS (MG/KG)									
Arsenic	9.79	(3)	0.39	(7)	**6.1 J**	**5.2 J**	**3.8 J**	**2.4 J**	**1.8 J**
Barium	48	(6)	1500	(7)	34.8 J	17 J	**173 J**	27.1 J	18.9 J
Cadmium	0.99	(3)	7	(7)	0.31 J	0.11 J	0.2 J	0.1 J	0.16 J
Chromium	43.4	(3)	0.29	(7)	**12.4 J**	**13.2 J**	**13.9 J**	**4.5 J**	**3.2 J**
Lead	35.8	(3)	400	(7)	9 J	6.2 J	7.6 J	5.6 J	4.7 J
Mercury	0.174	(3)	2.3	(7)	0.03 U	0.033 U	0.037 U	0.054 U	0.045 U
Selenium	2	(4)	39	(7)	0.21 J	0.11 J	0.11 J	0.14 J	0.083 J
Silver	0.5	(3)	39	(7)	0.025 J	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ
MISCELLANEOUS PARAMETERS (%)									
Percent Moisture	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mg/kg)									
Total Organic Carbon	NA	NA	NA	NA	11000	1200	2900	13000	31000
MISCELLANEOUS PARAMETERS									
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-8

SUMMARY OF ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SEDIMENT SAMPLE
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION					22SD/SW006		22SD/SW007		22SD/SW008	
SAMPLE ID SAMPLE DATE MATRIX SUBMATRIX	ECO (1)	ECO REF	HH (2)	HH REF	22SD0060006 01/18/2011 SD SD	22SD0060624 01/18/2011 SD SD	22SD0070006 01/18/2011 SD SD	22SD0070624 01/18/2011 SD SD	22SD0080006 01/18/2011 SD SD	22SD0080624 01/18/2011 SD SD
EXPLOSIVES (MG/KG)										
1,3,5-Trinitrobenzene	8	(5)	220	(7)	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
2,4,6-Trinitrotoluene	4	(5)	3.6	(7)	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-Dinitrotoluene	0.0144	(3)	1.6	(7)	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
4-Amino-2,6-Dinitrotoluene	NA	NA	15	(7)	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
METALS (MG/KG)										
Arsenic	9.79	(3)	0.39	(7)	**1.7 J**	**1.6 J**	**2.7 J**	**1.6 J**	**5.6 J**	**5.1 J**
Barium	48	(6)	1500	(7)	25 J	17.9 J	23.2 J	19.6 J	41.1 J	46.1 J
Cadmium	0.99	(3)	7	(7)	0.88 J	0.071 J	0.15 J	0.51 J	0.24 J	0.13 J
Chromium	43.4	(3)	0.29	(7)	**4.7 J**	**4 J**	**3.7 J**	**2.9 J**	**10.4 J**	**11.4 J**
Lead	35.8	(3)	400	(7)	11.3 J	4 J	8.8 J	8.3 J	14.8 J	20 J
Mercury	0.174	(3)	2.3	(7)	0.041 U	0.04 U	0.034 U	0.039 U	0.045 U	0.056 U
Selenium	2	(4)	39	(7)	0.1 J	0.061 J	0.11 J	0.12 J	0.22 J	0.19 J
Silver	0.5	(3)	39	(7)	0.02 J	0.04 UJ	0.04 UJ	0.04 UJ	0.02 J	0.04 UJ
MISCELLANEOUS PARAMETERS (%)										
Percent Moisture	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mg/kg)										
Total Organic Carbon	NA	NA	NA	NA	10000	2000	8300	5500	18000	2100
MISCELLANEOUS PARAMETERS										
pH	NA	NA	NA	NA	6.6	7.3	NA	NA	NA	NA

TABLE 5-8

SUMMARY OF ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SEDIMENT SAMPLE
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION					22SD/SW009	22SD/SW010		22SD/SW011	22SD/SW017	
SAMPLE ID					22SD0090006	22SD0100006	22SD0100006_201205	22SD0110006	22SD0170006	22SD0170006_20130123
SAMPLE DATE	ECO [1]	ECO REF	HH [2]	HH REF	01/20/2011	01/20/2011	05/12/2012	01/20/2011	05/11/2012	01/23/2013
MATRIX					SD	SD	SD	SD	SD	SD
SUBMATRIX					SD	SD	SD	UPSTREAM SD	SD	SD
EXPLOSIVES (MG/KG)										
1,3,5-Trinitrobenzene	8	(5)	220	(7)	0.158 U	0.158 U	NA	0.158 U	NA	NA
2,4,6-Trinitrotoluene	4	(5)	3.6	(7)	0.166 U	0.166 U	NA	0.166 U	NA	0.2 U
2,4-Dinitrotoluene	0.0144	(3)	1.6	(7)	0.166 U	0.166 U	NA	0.166 U	NA	NA
4-Amino-2,6-Dinitrotoluene	NA	NA	15	(7)	0.15 U	0.15 U	NA	0.15 U	NA	NA
METALS (MG/KG)										
Arsenic	9.79	(3)	0.39	(7)	2.2 J	2 J	NA	12.3 J	5.5	NA
Barium	48	(6)	1500	(7)	16.7 J	8.6 J	NA	38.3 J	42.1	NA
Cadmium	0.99	(3)	7	(7)	0.24 J	0.37 J	NA	0.26 J	0.28	NA
Chromium	43.4	(3)	0.29	(7)	3.8 J	2.5 J	NA	16.2 J	10	NA
Lead	35.8	(3)	400	(7)	7.2 J	7.9 J	NA	11.3 J	11.3	NA
Mercury	0.174	(3)	2.3	(7)	0.26	0.051 U	NA	0.049 U	0.086 J	NA
Selenium	2	(4)	39	(7)	0.1 J	0.044 J	NA	0.19 J	0.42	NA
Silver	0.5	(3)	39	(7)	0.04 UJ	0.04 UJ	NA	0.04 UJ	0.04 U	NA
MISCELLANEOUS PARAMETERS (%)										
Percent Moisture	NA	NA	NA	NA	NA	NA	44.1	NA	31.1	NA
MISCELLANEOUS PARAMETERS (mg/kg)										
Total Organic Carbon	NA	NA	NA	NA	18000	8800	29000	2800	670	NA
MISCELLANEOUS PARAMETERS										
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-8

SUMMARY OF ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SEDIMENT SAMPLE
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	ECO (1)	ECO REF	HH (2)	HH REF	22SD/SW018		22SD/SW023	22SD/SW024	22SD/SW026
SAMPLE ID					22SD0180006	22SD0180006_201205	22SD0230006	22SD0240006	22SD0260006
SAMPLE DATE					04/09/2011	05/12/2012	05/11/2012	05/11/2012	05/11/2012
MATRIX					SD	SD	SD	SD	SD
SUBMATRIX					SD	SD	SD	SD	SETTLING BASIN
EXPLOSIVES (MG/KG)									
1,3,5-Trinitrobenzene	8	(5)	220	(7)	0.158 U	NA	0.158 U	0.158 U	0.88
2,4,6-Trinitrotoluene	4	(5)	3.6	(7)	0.166 U	NA	0.166 U	0.166 U	**2100**
2,4-Dinitrotoluene	0.0144	(3)	1.6	(7)	0.166 U	NA	0.166 U	0.166 U	0.27 J
4-Amino-2,6-Dinitrotoluene	NA	NA	15	(7)	0.15 U	NA	0.15 U	0.15 U	**46 J**
METALS (MG/KG)									
Arsenic	9.79	(3)	0.39	(7)	**1.2 J**	NA	**14.7**	**5.9**	**5.6**
Barium	48	(6)	1500	(7)	12.8 J	NA	**67.4**	43.2	515
Cadmium	0.99	(3)	7	(7)	0.24 J	NA	0.36	0.22	0.43
Chromium	43.4	(3)	0.29	(7)	**2.8 J**	NA	**11.3**	**11.9**	**16.5**
Lead	35.8	(3)	400	(7)	12.1 J	NA	16.3	9.4	181
Mercury	0.174	(3)	2.3	(7)	0.038 J	NA	0.073 J	0.047 J	0.99
Selenium	2	(4)	39	(7)	0.17 J	NA	0.61	0.33	0.4
Silver	0.5	(3)	39	(7)	0.04 UJ	NA	0.04 U	0.04 U	0.025 J
MISCELLANEOUS PARAMETERS (%)									
Percent Moisture	NA	NA	NA	NA	NA	21.4	25.7	21.6	19.3
MISCELLANEOUS PARAMETERS (mg/kg)									
Total Organic Carbon	NA	NA	NA	NA	6900 J	39000	14000	6400	NA
MISCELLANEOUS PARAMETERS									
pH	NA	NA	NA	NA	NA	NA	6.1	NA	NA

NOTES:
Only analytes with at least one detection are shown on this table.
(1) Minimum Ecological Risk Criteria
(2) Minimum Human Health Risk Criteria
(3) Region 5 (USEPA, 2003a)
(4) Region 3, freshwater (USEPA, 2006b)
(5) Sunahara (Sunahara, et al., 2009)
(6) NOAA sediment screening value (Buchman, 2008)
(7) Adjusted USEPA Regional Screening Level Direct Contact Residential (USEPA, 2012b)
mg/kg - Milligrams per kilogram
NA - Not Available / Not Analyzed
Light gray shading indicates detection.
Dark shading indicates exceedance of at least one criterion.

DATA QUALIFIERS:
U - Indicates that parameter was not detected at the numerical detection limit.
J - Indicates that the parameter was detected but the concentration is considered an estimate due to imprecision.
UJ - Indicates that the parameter was not detected and the result is estimated.

TABLE 5-9

SUMMARY STATISTICS FOR SURFACE WATER ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-detect	Maximum Non-detect	Average of Detections	Overal Average	Standard Deviation
EXPLOSIVES (µg/L)										
1,3,5-Trinitrobenzene	0/11					0.260	0.520		0.154	0.0526
1,3-Dinitrobenzene	0/11					0.262	0.520		0.154	0.0522
2,4,6-Trinitrotoluene	0/11					0.266	0.520		0.156	0.0514
2,4-Dinitrotoluene	0/11					0.250	0.520		0.150	0.0546
2,6-Dinitrotoluene	0/11					0.250	0.520		0.150	0.0546
2-Amino-4,6-Dinitrotoluene	0/11					0.250	0.520		0.150	0.0546
2-Nitrotoluene	0/11					0.252	0.520		0.150	0.0542
3-Nitrotoluene	0/11					0.266	0.520		0.156	0.0514
4-Amino-2,6-Dinitrotoluene	0/11					0.200	0.400		0.118	0.0405
4-Nitrotoluene	0/11					0.266	0.520		0.156	0.0514
HMX	7/15	0.15 J	0.87	22SD/SW003	22SW003	0.230	0.480	0.586	0.351	0.298
Nitrobenzene	0/11					0.252	0.520		0.150	0.0542
Nitroglycerin	0/4					0.260	0.260		0.130	0.000
PETN	0/4					1.21	1.21		0.607	0.000
RDX	7/15	0.39 J	2.5	22SD/SW017	22SW017	0.246	0.480	1.04	0.567	0.664
Tetryl	0/11					0.266	0.520		0.156	0.0514
TOTAL METALS (µg/L)										
Arsenic	8/12	0.18 J	1.5	22SD/SW004	22SW004	0.180	0.180	0.58	0.417	0.406
Barium	12/12	26.4	74.8	22SD/SW003	22SW003			55.1	55.1	15.6
Cadmium	6/12	0.23 J	1.7 J	22SD/SW024	22SW024	0.0400	0.0830	0.535	0.281	0.473
Chromium	11/11	0.4 J	3	22SD/SW004	22SW004			0.924	0.924	0.772
Lead	7/11	0.86 J	9.6	22SD/SW006	22SW006	0.220	0.220	4.25	2.75	3.27
Mercury	5/12	0.065 J	0.1 J	22SD/SW017	22SW017_20120511	0.120	0.120	0.0838	0.0699	0.0157
Selenium	5/12	0.1 J	0.56 J	22SD/SW024	22SW024	0.200	0.200	0.212	0.147	0.132
Silver	1/12	0.032 J	0.032 J	22SD/SW009	22SW009	0.0600	0.190	0.0320	0.036	0.019
DISSOLVED METALS (µg/L)										
Arsenic	5/9	0.19 J	0.35	22SD/SW018	22SW018	0.180	0.180	0.240	0.173	0.0911
Barium	9/9	26	73.9	22SD/SW003	22SW003			46.9	46.9	19.2
Cadmium	3/9	0.066 J	0.26 J	22SD/SW007	22SW007	0.0400	0.0430	0.189	0.0764	0.0997
Chromium	8/8	0.27 J	0.75	22SD/SW004	22SW004			0.395	0.395	0.162
Lead	3/8	0.11 J	0.69 J	22SD/SW007	22SW007	0.22	0.22	0.390	0.215	0.212
Mercury	2/9	0.067 J	0.068 J	22SD/SW004	22SW004	0.12	0.12	0.0675	0.0617	0.00332
Selenium	0/9					0.2	0.2		0.100	0.000
Silver	2/9	0.057 J	0.067 J	22SD/SW006	22SW006	0.06	0.06	0.0620	0.0371	0.0143

TABLE 5-9

SUMMARY STATISTICS FOR SURFACE WATER ANALYTICAL RESULTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Result		Maximum Result		Location of Maximum Detection	Sample of Maximum Detection	Minimum Non-detect	Maximum Non-detect	Average of Detections	Overal Average	Standard Deviation
MISCELLANEOUS PARAMETERS												
Perchlorate (ug/L)	1/8	0.4	J	0.4	J	22SD/SW002	22SW002	0.4	0.4	0.400	0.225	0.0707
pH	1/1	6.3		6.3		22SD/SW023	22SW023			6.30	6.30	

Associated Samples:
22SW001
22SW002
22SW003
22SW004
22SW006
22SW007
22SW009
22SW010
22SW010_20120512
22SW017
22SW017_20120511
22SW018
22SW019
22SW020
22SW021
22SW023
22SW024

J - Indicates that the parameter was detected but the concentration is considered an estimate due to imprecision.
ug/kg = Micrograms per kilogram.

TABLE 5-10

SUMMARY OF SURFACE WATER ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SURFACE WATER SAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION SAMPLE ID SAMPLE DATE MATRIX SAMPLE TYPE SUBMATRIX	ECO (1)	ECO REF	HH (2)	HH REF	22SD/SW001 22SW001 01/20/2011 SW NORMAL NA	22SD/SW002 22SW002 01/20/2011 SW NORMAL NA	22SD/SW003 22SW003 01/20/2011 SW NORMAL NA	22SD/SW004 22SW004 01/20/2011 SW NORMAL NA	22SD/SW006 22SW006 01/18/2011 SW NORMAL NA	22SD/SW007 22SW007 01/18/2011 SW NORMAL NA	22SD/SW009 22SW009 01/20/2011 SW NORMAL NA
DISSOLVED METALS (µg/L)											
Arsenic	150	(3)	0.045	(7)	0.18 U	0.18 U	0.18 U	0.18 U	**0.19 J**	**0.23 J**	**0.23 J**
Barium	220	(4)	290	(7)	**68**	**68.4**	**73.9**	**26**	**36 J**	**53.8 J**	**34.5 J**
Cadmium	0.25	(3)	0.69	(7)	0.04 U	0.04 U	0.04 U	0.04 U	**0.24 J**	**0.26 J**	0.04 U
Chromium	11	(3)	0.031	(7)	**0.5**	**0.39 J**	0.92 R	**0.75**	**0.29 J**	**0.28 J**	**0.31 J**
Lead	2.5	(3)	15	(7)	0.22 U	0.22 U	2.2 R	0.22 U	**0.37 J**	**0.69 J**	**0.11 J**
Mercury	0.77	(3)	0.43	(7)	0.12 U	0.12 U	0.12 U	**0.068 J**	0.12 U	**0.067 J**	0.12 U
Selenium	5	(3)	7.8	(7)	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 UJ	0.2 UJ
Silver	3.2	(3)	7.1	(7)	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	**0.067 J**	**0.057 J**	0.06 UJ
EXPLOSIVES (µg/L)											
HMX	150	(5)	78	(7)	**0.82**	**0.79**	**0.87**	0.23 U	0.48 U	0.48 U	**0.15 J**
RDX	360	(5)	0.61	(7)	**0.78**	**0.75**	**0.82**	0.246 U	0.48 U	0.48 U	**0.39 J**
METALS (µg/L)											
Arsenic	150	(3)	0.045	(7)	0.18 U	0.18 U	0.18 U	**1.5**	**0.38**	0.18 U	**0.46 J**
Barium	220	(4)	290	(7)	**69**	**69.2**	**74.8**	**57.7**	**45.9**	**54.3**	**36.9 J**
Cadmium	0.25	(3)	0.69	(7)	0.04 U	0.04 U	0.04 U	0.04 U	**0.5**	**0.24**	0.073 U
Chromium	11	(3)	0.031	(7)	**0.55**	**0.48 J**	0.43 R	**3**	**1.5**	**0.47 J**	**0.4 J**
Lead	2.5	(3)	15	(7)	0.22 U	0.22 U	0.11 R	**6.1**	**9.6**	**1.8**	**1 J**
Mercury	0.77	(3)	0.43	(7)	0.12 U	0.12 U	0.12 U	0.12 U	**0.065 J**	0.12 U	**0.089 J**
Selenium	5	(3)	7.8	(7)	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	**0.1 J**
Silver	3.2	(3)	7.1	(7)	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	**0.032 J**
MISCELLANEOUS PARAMETERS											
PH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Perchlorate (µg/L)	9300	(6)	1.1	(7)	0.4 U	**0.4 J**	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U

TABLE 5-10

SUMMARY OF SURFACE WATER ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SURFACE WATER SAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	ECO [1]	ECO REF	HH [2]	HH REF	22SD/SW010		22SD/SW011	22SD/SW012	22SD/SW013	22SD/SW014
SAMPLE ID					22SW010	22SW010_20120512	22SW011	22SW012	22SW013	22SW014
SAMPLE DATE					01/20/2011	5/12/2012	01/20/2011	04/09/2011	04/09/2011	04/09/2011
MATRIX					SW	SW	SW	SW	SW	SW
SAMPLE TYPE					NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX					NA	NA	UPSTREAM SW	UPSTREAM SW	UPSTREAM SW	UPSTREAM SW
DISSOLVED METALS (µg/L)										
Arsenic	150	(3)	0.045	(7)	**0.2 J**	NA	**0.44 J**	NA	NA	NA
Barium	220	(4)	290	(7)	**34.4 J**	NA	**77.4 J**	NA	NA	NA
Cadmium	0.25	(3)	0.69	(7)	0.043 U	NA	0.04 UJ	NA	NA	NA
Chromium	11	(3)	0.031	(7)	**0.27 J**	NA	**0.46 J**	NA	NA	NA
Lead	2.5	(3)	15	(7)	0.22 UJ	NA	**0.12 J**	NA	NA	NA
Mercury	0.77	(3)	0.43	(7)	0.12 U	NA	**0.084 J**	NA	NA	NA
Selenium	5	(3)	7.8	(7)	0.2 UJ	NA	**0.28 J**	NA	NA	NA
Silver	3.2	(3)	7.1	(7)	0.06 UJ	NA	0.06 UJ	NA	NA	NA
EXPLOSIVES (µg/L)										
HMX	150	(5)	78	(7)	**0.23 J**	NA	**0.88**	0.23 U	**11**	0.23 U
RDX	360	(5)	0.61	(7)	**0.55**	NA	**0.79**	0.246 U	**0.98**	0.246 U
METALS (µg/L)										
Arsenic	150	(3)	0.045	(7)	**0.49 J**	NA	**0.41**	NA	NA	NA
Barium	220	(4)	290	(7)	**36.1 J**	NA	**76.5**	NA	NA	NA
Cadmium	0.25	(3)	0.69	(7)	0.083 U	NA	0.04 U	NA	NA	NA
Chromium	11	(3)	0.031	(7)	**0.43 J**	NA	**0.45 J**	NA	NA	NA
Lead	2.5	(3)	15	(7)	**0.86 J**	NA	0.22 U	NA	NA	NA
Mercury	0.77	(3)	0.43	(7)	0.12 U	NA	0.12 U	NA	NA	NA
Selenium	5	(3)	7.8	(7)	0.2 UJ	NA	**0.24 J**	NA	NA	NA
Silver	3.2	(3)	7.1	(7)	0.06 UJ	NA	0.06 UJ	NA	NA	NA
MISCELLANEOUS PARAMETERS										
PH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Perchlorate (µg/L)	9300	(6)	1.1	(7)	0.4 U	NA	0.4 U	NA	NA	NA

TABLE 5-10

SUMMARY OF SURFACE WATER ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SURFACE WATER SAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	ECO [1]	ECO REF	HH [2]	HH REF	22SD/SW015	22SD/SW016	22SD/SW017		22SD/SW018	22SD/SW019
SAMPLE ID					22SW015	22SW016	22SW017	22SW017_20120511	22SW018	22SW019
SAMPLE DATE					04/09/2011	04/09/2011	04/09/2011	05/11/2012	04/09/2011	04/09/2011
MATRIX					SW	SW	SW	SW	SW	SW
SAMPLE TYPE					NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX					UPSTREAM SW	UPSTREAM SW	NA	NA	NA	NA
DISSOLVED METALS (µg/L)										
Arsenic	150	(3)	0.045	(7)	NA	NA	NA	NA	**0.35**	NA
Barium	220	(4)	290	(7)	NA	NA	NA	NA	**27.1 J**	NA
Cadmium	0.25	(3)	0.69	(7)	NA	NA	NA	NA	**0.066 J**	NA
Chromium	11	(3)	0.031	(7)	NA	NA	NA	NA	**0.37 J**	NA
Lead	2.5	(3)	15	(7)	NA	NA	NA	NA	0.22 U	NA
Mercury	0.77	(3)	0.43	(7)	NA	NA	NA	NA	0.12 U	NA
Selenium	5	(3)	7.8	(7)	NA	NA	NA	NA	0.2 UJ	NA
Silver	3.2	(3)	7.1	(7)	NA	NA	NA	NA	0.06 U	NA
EXPLOSIVES (µg/L)										
HMX	150	(5)	78	(7)	0.23 U	0.23 U	**0.61**	NA	**0.63**	0.23 U
RDX	360	(5)	0.61	(7)	0.246 U	0.246 U	**2.5**	NA	**1.5**	0.246 U
METALS (µg/L)										
Arsenic	150	(3)	0.045	(7)	NA	NA	NA	**0.18 J**	**0.72**	NA
Barium	220	(4)	290	(7)	NA	NA	NA	**67.1**	**26.4**	NA
Cadmium	0.25	(3)	0.69	(7)	NA	NA	NA	**0.29 J**	**0.25**	NA
Chromium	11	(3)	0.031	(7)	NA	NA	NA	**0.51**	**1**	NA
Lead	2.5	(3)	15	(7)	NA	NA	NA	0.22 U	**6 J**	NA
Mercury	0.77	(3)	0.43	(7)	NA	NA	NA	**0.1 J**	0.12 U	NA
Selenium	5	(3)	7.8	(7)	NA	NA	NA	**0.12 J**	**0.17 J**	NA
Silver	3.2	(3)	7.1	(7)	NA	NA	NA	0.06 U	0.06 U	NA
MISCELLANEOUS PARAMETERS										
PH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Perchlorate (µg/L)	9300	(6)	1.1	(7)	NA	NA	NA	NA	NA	NA

TABLE 5-10

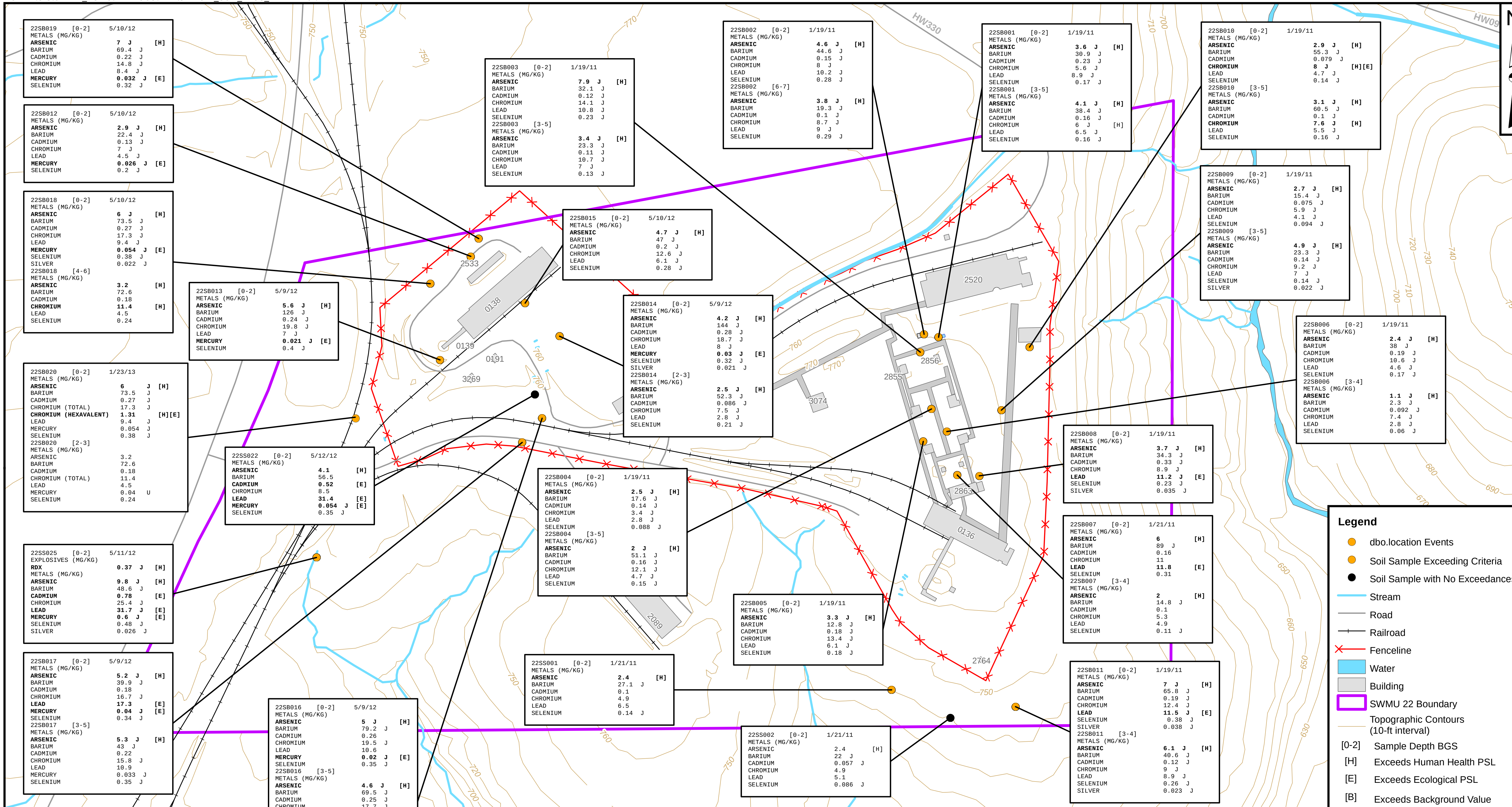
SUMMARY OF SURFACE WATER ANALYSIS RESULTS FOR CHEMICALS DETECTED IN AT LEAST ONE SURFACE WATER SAMPLE
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION SAMPLE ID SAMPLE DATE MATRIX SAMPLE TYPE SUBMATRIX	ECO (1)	ECO REF	HH (2)	HH REF	22SD/SW020 22SW020 04/09/2011 SW NORMAL NA	22SD/SW021 22SW021 04/09/2011 SW NORMAL NA	22SD/SW023 22SW023 05/11/2012 SW NORMAL NA	22SD/SW024 22SW024 05/11/2012 SW NORMAL NA
DISSOLVED METALS (µg/L)								
Arsenic	150	(3)	0.045	(7)	NA	NA	NA	NA
Barium	220	(4)	290	(7)	NA	NA	NA	NA
Cadmium	0.25	(3)	0.69	(7)	NA	NA	NA	NA
Chromium	11	(3)	0.031	(7)	NA	NA	NA	NA
Lead	2.5	(3)	15	(7)	NA	NA	NA	NA
Mercury	0.77	(3)	0.43	(7)	NA	NA	NA	NA
Selenium	5	(3)	7.8	(7)	NA	NA	NA	NA
Silver	3.2	(3)	7.1	(7)	NA	NA	NA	NA
EXPLOSIVES (µg/L)								
HMX	150	(5)	78	(7)	0.23 U	0.23 U	0.23 U	0.23 U
RDX	360	(5)	0.61	(7)	0.246 U	0.246 U	0.246 U	0.246 U
METALS (µg/L)								
Arsenic	150	(3)	0.045	(7)	NA	NA	**0.29**	**0.62**
Barium	220	(4)	290	(7)	NA	NA	**57.5**	**66.6**
Cadmium	0.25	(3)	0.69	(7)	NA	NA	**0.23 J**	**1.7 J**
Chromium	11	(3)	0.031	(7)	NA	NA	**0.72**	**1.1**
Lead	2.5	(3)	15	(7)	NA	NA	0.22 U	**4.4**
Mercury	0.77	(3)	0.43	(7)	NA	NA	**0.068 J**	**0.097 J**
Selenium	5	(3)	7.8	(7)	NA	NA	**0.11 J**	**0.56 J**
Silver	3.2	(3)	7.1	(7)	NA	NA	0.19 U	0.06 U
MISCELLANEOUS PARAMETERS								
PH	NA	NA	NA	NA	NA	NA	**6.3**	NA
Perchlorate (µg/L)	9300	(6)	1.1	(7)	NA	NA	NA	NA

NOTES:
Only analytes with at least one detection are shown on this table.
(1) Minimum Ecological Risk Criteria
(2) Minimum Human Health Risk Criteria
(3) Ambient Water Quality Criteria (AWQC) (USEPA, 2009a)
(4) Region 5 (USEPA, 2003a)
(5) Region 3, freshwater (USEPA, 2006b)
(6) Dean (Dean, et al., 2004)
(7) Adjusted USEPA Regional Screening Level Tap Water (USEPA, 2012b)
µg/L - Micrograms per liter
NA - Not Available / Not Analyzed
Light gray shading indicates detection.
Dark shading indicates exceedance of at least one criterion.

DATA QUALIFIERS:
U - Indicates that parameter was not detected at the numerical detection limit.
J - Indicates that the parameter was detected but the concentration is considered an estimate due to imprecision.
UJ - Indicates that the parameter was not detected and the result is estimated.

PGH P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_SOIL_TAGS_ALT.MXD 01/22/14 JEE



200 0 200 Feet

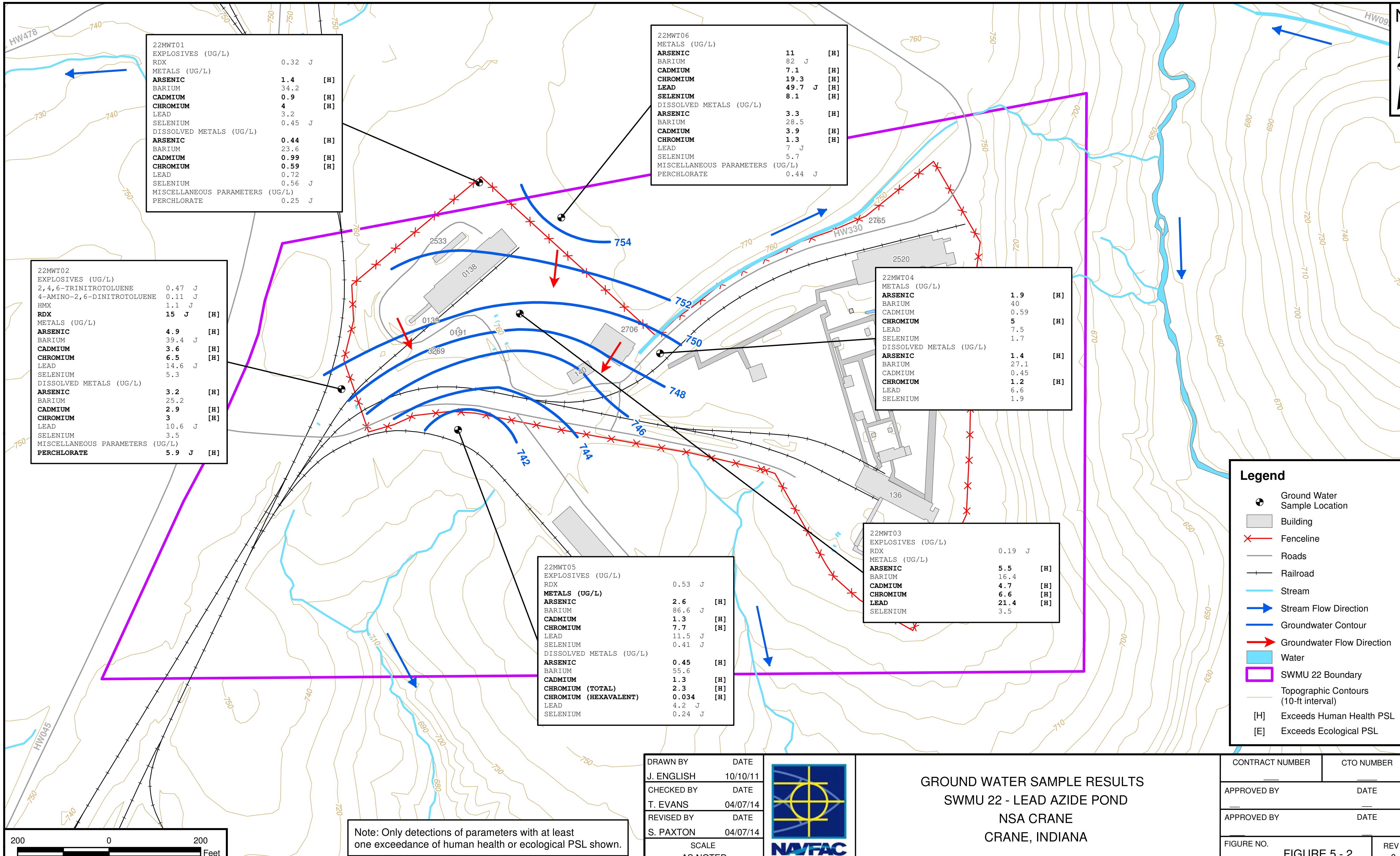
DRAWN BY	DATE
J. ENGLISH	10/10/11
CHECKED BY	DATE
T. EVANS	01/22/14
REVISED BY	DATE
J. ENGLISH	01/22/14
SCALE	
AS NOTED	

NAVFAC

SOIL SAMPLE RESULTS
JANUARY 2011 AND MAY 2012
SWMU 22 - LEAD AZIDE POND
NAVAL SUPPORT ACTIVITY
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
02362	F279
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 5 - 1	REV 0

PGH P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_GW_TAGS_ALT.MXD 04/07/14 SP



Note: Only detections of parameters with at least one exceedance of human health or ecological PSL shown.

DRAWN BY J. ENGLISH	DATE 10/10/11		CONTRACT NUMBER
CHECKED BY T. EVANS	DATE 04/07/14		CTO NUMBER
REVISED BY S. PAXTON	DATE 04/07/14		APPROVED BY / DATE
SCALE AS NOTED			APPROVED BY / DATE

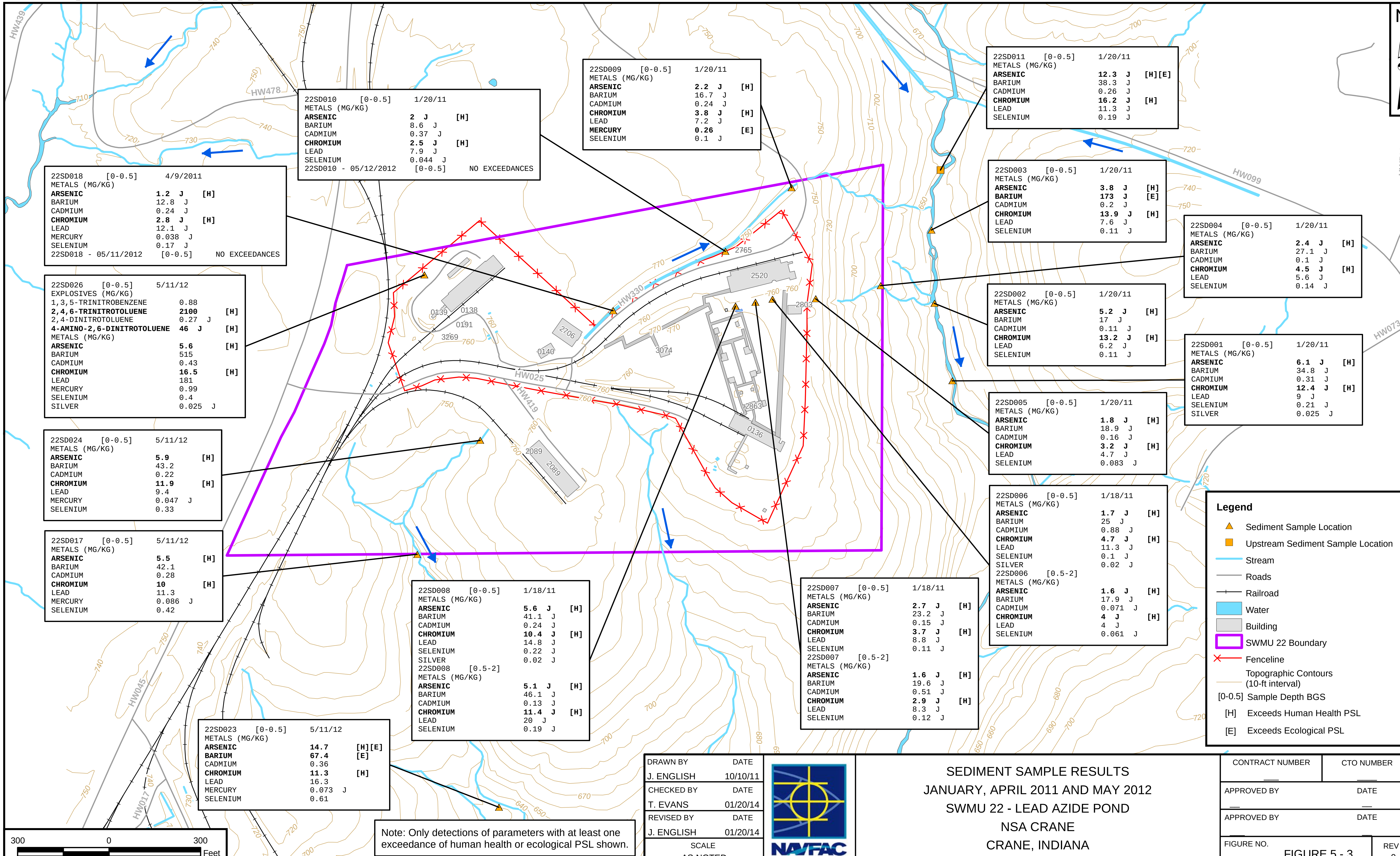
NAVFAC

GROUND WATER SAMPLE RESULTS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

FIGURE NO. FIGURE 5 - 2

REV 0

PGH P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_SD_TAGS_ALT.MXD 01/20/14 JEE



Note: Only detections of parameters with at least one exceedance of human health or ecological PSL shown.

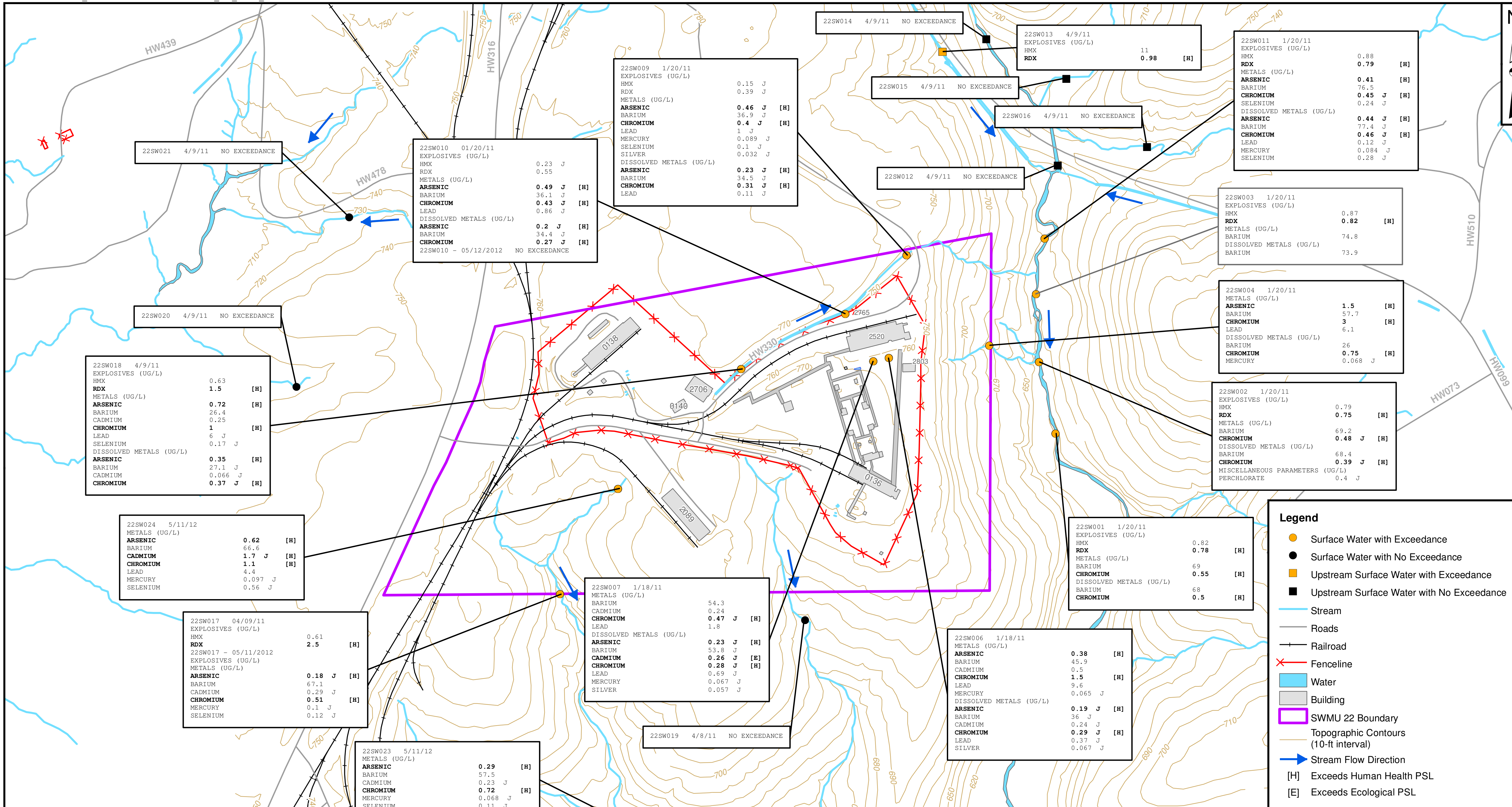
DRAWN BY	DATE
J. ENGLISH	10/10/11
CHECKED BY	DATE
T. EVANS	01/20/14
REVISED BY	DATE
J. ENGLISH	01/20/14
SCALE AS NOTED	

NAVFAC

SEDIMENT SAMPLE RESULTS
JANUARY, APRIL 2011 AND MAY 2012
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 5 - 3	REV 0

PGH:P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_SW_TAGS_ALT.MXD 9/20/2012 SP



350 0 350 Feet

Notes:
1) Only detections of parameters with at least one exceedance of human health or ecological PSL shown.
2) Because dissolved metal concentrations more closely approximate the bioavailable fraction of metal in the water column than total metal, the ecological screening values were only compared to dissolved metal concentrations.

DRAWN BY	DATE
J. ENGLISH	10/10/11
CHECKED BY	DATE
T. JOHNSTON	9/20/12
REVISED BY	DATE
S. PAXTON	9/20/12
SCALE AS NOTED	

NAVFAC

SURFACE WATER SAMPLE RESULTS - JANUARY, APRIL 2011 AND MAY 2012
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 5 - 4	REV 0

6.0 CONTAMINANT FATE AND TRANSPORT AND CONCEPTUAL SITE MODEL

Described in this section are factors that affect the fate and transport of contaminants and the conceptual site model (CSM) that summarizes how the identified contaminants move in the environment, representative receptors that are potentially exposed to the contaminants, and their exposure pathways.

6.1 CONTAMINANT FATE AND TRANSPORT

The following contaminants and contaminant groups were identified in Section 4.0 as exceeding screening levels and background concentrations (metals only) or upgradient/upstream concentrations:

- Metals
- Perchlorate
- Energetic compounds (nitramines and nitroaromatic compounds)

Persistence of these classes of contaminants and their chemical and physical properties in soil-water environments are discussed in this section. Multiple chemical transformation mechanisms or combinations thereof, including hydrolysis, biodegradation, photolysis, and oxidation/reduction reactions, affect contaminant persistence and are described according to the chemical groups affected by them.

6.1.1 Metals

The fate and transport of metals are controlled mainly by the mobility of soil particles and dissolution into water in the immediate environment. Metals do not undergo degradation reactions that organic chemicals do; therefore, they are considered to be persistent in the environment. The major fate mechanisms for metals are adsorption to the soil matrix and bioaccumulation. The mobilities of metals are influenced primarily by their physical and chemical properties, in combination with the physical and chemical characteristics of the environmental matrices containing them. Factors that assist in predicting the mobility of inorganic species are soil/pore water pH, soil/pore water ORP (Eh), and cation exchange capacity (CEC). The mobility of a metal generally increases with decreasing soil pH and CEC. Sediments are generally finer grained than soil and typically exhibit greater CECs than soil. Over time, metals are assimilated into the geologic matrices of soil and bedrock.

For metals that occur in different chemical oxidation states, one or two oxidation states are typically more soluble than the other oxidation states. When in the more mobile oxidation state, it is more likely that the metal will migrate as a dissolved species in water, especially when Eh conditions favor this oxidation state. This can be particularly important for metals that move vertically downward in soil under the influence of precipitation and for metals that move with groundwater as it migrates from high to low elevations. Comparisons of total metal concentrations to dissolved metal concentrations allow evaluation of how metals are partitioned between solid and aqueous phases of the environment.

Groundwater at SWMU 22 is fairly acidic, with pH values ranging from about 3.7 to 5.1. The most upgradient well, 22MWT006, had the lowest pH (3.7). Such low pH values favor dissolution of metals into the groundwater matrix and could be a contributor to the elevated metals concentrations detected in that well. ORP values (approximately 160 to 350 millivolts as measured against a silver-silver chloride electrode and DO concentrations (ranging from about 2.9 to 9.1 mg/L) do not indicate a particularly reducing environment for metals.

6.1.2 Perchlorate

Perchlorate (ClO^-) is an inorganic ion that is very water soluble. It forms solid salts with various cations including ammonium, potassium, sodium, lithium, and magnesium and is persistent in the environment. Perchlorate may be present in propellant particles and can leach from these particles into environmental media. It resists degradation in the subsurface and does not readily adsorb to mineral surfaces (DoD, 2007). It is not retained for long periods in sediment because water that percolates into the sediment dissolves and leaches out the perchlorate. Similarly, perchlorate is likely to be leached from soil over time as precipitation passes through the soil. This recharging precipitation carries the perchlorate into groundwater where it migrates as a dissolved ion at approximately the same rate as the groundwater. Aqueous perchlorate ion is essentially non-volatile and not subject to photolysis.

6.1.3 Organic Energetic Compounds

Energetic organic contaminants detected at SWMU 22 were HMX, RDX, and nitrotoluenes including TNT and 4ADNT. These nitroaromatic compounds (the nitrotoluenes) and the nitramines (HMX and RDX), are subject to biotic and abiotic degradation under a fairly wide range of pH and oxidation-reduction (Eh) conditions (Price et al., 1997; Brannon et al., 1998; Talmage et al., 1999). The presence of 4ADNT (a monoaminonitrotoluene) is evidence of biotic TNT degradation.

RDX is one of the most widely used military high explosives. It is soluble in water but has a relatively low solubility of approximately 40 to 60 mg/L at 25 degrees Celsius (°C). RDX chemical stability is similar to that of TNT, although TNT solubility is approximately two times the solubility of RDX. HMX solubility is about an order of magnitude less than that of RDX. The other nitroaromatic compounds, which did not exceed screening levels, are not discussed here.

The rate of subsurface nitroaromatic or nitramine biodegradation in soil and groundwater is influenced by temperature, pH, Eh, and the presence and composition of microbial populations. Abiotic degradation rates are affected by the same factors except for microbial populations. The fate and distribution of RDX are primarily affected by microbiological and photochemical transformations (Wilkie and Stenstrom, 1996). Wilkie and Stenstrom report that aerobic degradation of RDX is not a significant transformation pathway nor is volatilization (because of low volatility) and that RDX adsorption to soil is low. Photochemical transformations are only possible in surface soil or other media exposed to light. However, the extent of RDX photodegradation is minimal because RDX does not readily absorb the light wavelengths dominating the Earth's surface. Base-catalyzed abiotic degradation of RDX is possible, but groundwater and surface water conditions at SWMU 22 are too low in pH to support this transformation pathway. In general, the most favorable biotransformation conditions for HMX and RDX appear to be anaerobic biodegradation (Wilkie and Stenstrom, 1996). Nitroaromatic compounds are subject to similar biodegradation pathways, and as stated above, the presence of the TNT degradation product 4ADNT indicates that such transformations are occurring at SWMU 22.

Wilkie and Stenstrom also report that accumulation of RDX in edible tissues of select plants suggests a possible impact on the food chain. HMX would be less likely to be incorporated into the food chain because of a lower solubility. TNT however may be more likely to be taken up by plants, making the TNT available to higher trophic levels.

6.2 CONCEPTUAL SITE MODEL

The SAP presented a CSM for SWMU 22 that assumed that contamination at the site was related to the "Backline" (i.e., Building 136 and the associated process buildings and features) and the potential migration pathways from it. Based on contaminant concentrations and their distributions identified to date, the area of Building 138 appears to be a more significant source of SWMU 22 contamination than the Backline area (Building 136/Building 2520). The potential contaminants were identified to be explosives, perchlorate, and RCRA metals that may have been released from processes at the site. The SAP CSM identified that potential releases of these chemicals may present complete exposure pathways to human and ecological receptors and/or serve as sources of contamination to groundwater and surface water and present complete exposure pathways to human and ecological receptors through those routes.

The geology in this portion of NSA Crane is typified by a thin mantle of overburden (10 feet thick or less) overlying bedrock (Pennsylvanian-age shale with interbedded sandstones and siltstones). Groundwater was not encountered in the overburden during the initial soil investigation at SWMU 22. Groundwater in the shallow bedrock in this area of NSA Crane typically occurs at 25 to 30 feet bgs. The groundwater and surface water flow directions are indicated on figures in Section 4.0.

6.2.1 Potential Sources of SWMU 22 Contamination

The potential source of contamination associated with the Building 138 area is related to its history of booster pressing and manufacturing, as well as repair of other munitions components. Based on contaminant concentrations and their distributions identified to date, the area of Building 138 appears to be a more significant source of SWMU 22 contamination than the Backline area (Building 136/Building 2520). Groundwater explosives contamination was detected downgradient of this building and indicates that soil contamination is migrating to groundwater. Groundwater wells were not installed downgradient of Building 136/Building 2520.

Lead azide and lead styphnate are shock-sensitive. Lead azide is at least as shock-sensitive as nitroglycerine, but lead styphnate is especially sensitive to heat and static electricity. The Lead Azide Pond, a likely potential lead contaminant source, is a location where elevated levels of lead were detected, although the detected soil concentrations did not exceed applicable screening values.

Metal concentrations in surface water and sediment on the eastern side of SWMU 22 are evidence of possible site-related contamination, but the data are inconclusive. The data indicate a potential upgradient surface water and sediment source of metals contamination. Metal and perchlorate target analytes were detected in the upgradient well 22MWT006. When viewed with surface water and sediment data that also indicate the presence of contaminants in the most upgradient locations sampled, it is evident that a source of contamination upgradient of SWMU 22 may exist, but the upgradient area has not been investigated.

6.2.2 Contaminant Migration Pathways

The principal potential contaminant release pathways to soil include the following:

- Spills from material handling or accidents.
- Leaks from underground piping.
- Aerial deposition from exhaust fans, roof vents, or ventilators directly or indirectly to the soil via deposition to building roofs or road surfaces and subsequent transport via downspouts or runoff.

Releases may have also occurred through direct discharge of contaminants from spills to surface water drainage pathways. After release, contamination may: (1) present a complete exposure pathway to human or ecological receptors and/or (2) serve as a secondary source of contamination to surface water drainage pathways, surface water bodies, or groundwater. Contaminants may leach from soil or infiltrate and migrate through the vadose zone to groundwater. Further transport of contaminants may occur in groundwater through diffuse discharge to surface water or as seeps.

The presence of a TNT degradation product in groundwater indicates that degradation is occurring for TNT. Reducing conditions are also favorable for RDX and HMX degradation, but SWMU 22 groundwater conditions are not particularly reducing. Biochemical degradation of HMX, RDX, and TNT is expected to continue and eventually reduce concentrations of these contaminants to environmentally insignificant concentrations as they migrate in groundwater. There does not appear to be a significant reservoir of these contaminants in soil that could continue to contaminate groundwater over the long term. The greatest levels of explosives contamination were found in the settling basin. This basin represents a groundwater contamination risk if it leaks and the contaminants inside it migrate to surrounding soil and eventually to groundwater.

6.2.3 Receptors and Exposure Pathways

Receptors and exposure pathways remain the same as those presented in the SAP and Section 4.0. Human receptors include persons who currently, or could in the future, interact with contaminated media. Persons currently using the site include industrial or construction workers and trespassers. However, given that future land use is unknown, it is customary to evaluate future use of a property as residential and recreational. Therefore, potential future receptors include residents and people recreating at the site. Human receptors may be exposed to different media based on their specific activities. These media include surface and subsurface soil, groundwater, surface water, and sediment. Potential exposure pathways may include dermal contact with, inhalation of, or ingestion of contaminated media including soil, groundwater, surface water, or sediment. Currently, groundwater from this site is not used for potable or agricultural purposes.

Ecological receptors include animal and plant species that could be affected by the contaminants present at a site. Typically, ecological receptors can be exposed only to surface media – surface soil, surface water, and upper layers of wetland sediments. Exposure of ecological receptors to groundwater and subsurface soil is not anticipated; however, contamination in subsurface soil or groundwater may serve as sources of contamination to sediments or surface water through subsurface transport or diffuse flow to streams located near Building 138. The exposure media for ecological receptors are surface soil, sediment, and surface water.

Terrestrial plants, invertebrates, and vertebrates are exposed to surface soil by direct contact with and ingestion of soil and other food items. Aquatic and semi-aquatic vegetation, benthic invertebrates, and aquatic organisms may be exposed to surface water and sediment by direct contact with and ingestion of sediment and surface water and other food items. The benthic invertebrates or other aquatic organisms may be consumed by wildlife; therefore, contamination may be continued through the food chain. Although terrestrial vertebrates may be exposed to chemicals found in the air via inhalation, this is not considered a significant pathway.

The risks posed to these receptors by site-related contaminants are evaluated in detail in Sections 7.0 and 8.0. Diagrams showing SWMU 22 contaminant migration pathways, receptors, and exposure routes are provided in those sections.

7.0 HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

7.1 INTRODUCTION

This section presents the HHRA for the SWMU 22 – Lead Azide Pond at NSA Crane. The objective of the HHRA is to determine whether detected concentrations of chemicals within the study area pose a significant threat to potential human receptors under current and/or future land use. The potential risks to human receptors were estimated based on the assumption that no actions were taken to control contaminant releases.

The following current United States Environmental Protection Agency (USEPA) and IDEM guidance documents were used to develop the framework for the baseline HHRA:

- Conducting Human Health Risk Assessments Under the Environmental Restoration Program (Navy, 2001).
- Navy Policy on the Use of Background Chemical Levels (Navy, 2004).
- Navy Human Health Risk Assessment Guidance (Navy, 2008)
- Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A) (USEPA, 1989).
- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (USEPA, 1991).
- Distribution of Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure (USEPA, 1993a).
- Exposure Factors Handbook. (USEPA, 1997b).
- Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002a).

- Guidance for Characterizing Background and Chemical Concentrations in Soil for CERCLA Sites (USEPA, 2002b).

- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (USEPA, 2004).

- Guidelines for Carcinogen Risk Assessment (USEPA, 2005e).

- Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005f).

- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (USEPA, 2009b).

- Remediation Closure Guide (IDEM, 2013).

The HHRA is structured and reported according to the guidelines of the Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluation Manual, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments (RAGS Part D) (USEPA, 2001).

An HHRA provides the framework for developing risk information necessary to assist in developing potential remedial alternatives for a site. An HHRA consists of five components: data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis.

Three major aspects of chemical contamination and environmental fate and transport must be considered to evaluate potential risks: (1) contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action; (2) potential exposure points must exist; and (3) human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of these factors is absent for a site, the exposure pathway is incomplete, and no potential risks are considered to exist for human receptors.

7.2 DATA EVALUATION

Data evaluation, the first component of a baseline HHRA, is a medium-specific task involving compilation of analytical data as the first step. The second step and main objective of data evaluation is to develop a medium-specific list of COPCs that will be used to quantitatively and/or qualitatively determine potential human health risks for site media. COPCs are selected based on a toxicity screen (i.e., a comparison of site contaminant concentrations to conservative toxicity screening values) and a background screen (i.e., a comparison of site concentrations to background concentrations).

7.2.1 Data Usability

Section 3.0 presents a discussion of the data usability evaluation. Soil, surface water, and sediment samples collected in 2011 and 2012 and groundwater samples collected in 2012 and 2013 were used in this HHRA. Both total (unfiltered) and dissolved (filtered) groundwater sampling results are presented in the COPC selection tables, although only the total results were used to quantify risks. Field measurements and data regarded as unreliable (e.g., qualified as "R" during the data validation process) were not used in the quantitative HHRA. The sediment sample collected from within the settling basin was not used in this HHRA because it is unlikely that receptors would have significant exposure to this material. Risks from potential exposures to the material in the settling basin are discussed in Section 7.5.3.5. Samples used in this HHRA are listed on the COPC selection Tables 7-5 through 7-12 and in Appendix E.1.

7.2.2 Derivation of Screening Criteria

The primary criteria used to identify COPCs are based on USEPA Regional Screening Levels (RSLs) (2012a) and IDEM screening levels (2013). The RSLs are based on exposure pathways for which generally accepted methods, models, and assumptions have been developed (i.e., ingestion, dermal contact, and inhalation) for specific land use conditions and do not consider ecological receptors. The screening concentrations based on the RSLs correspond to a systemic hazard quotient (HQ) of 0.1 for non-carcinogens or an incremental lifetime cancer risk (ILCR) of $1x10^{-6}$ for carcinogens. The RSLs for non-carcinogens are based on an HQ of 1, whereas the screening concentrations used in the selection of COPCs were based on an HQ of 0.1 to account for the potential cumulative effects of several chemicals affecting the same target organ or producing the same adverse non-carcinogenic effect.

The IDEM screening levels for soil are based on the USEPA RSLs; however the IDEM screening levels are not necessarily the same as the RSLs. The IDEM screening levels for direct contact correspond to systemic HQs of 1 (for noncarcinogens) or ILCRs of $1x10^{-5}$ (for carcinogens). The USEPA RSLs for carcinogens corresponds to an ILCR of $1x10^{-6}$. The IDEM screening levels for soil can also be based on the soil saturation limit or capped at 100,000 mg/kg (direct contact) or 1,000,000 mg/kg (migration from soil to groundwater).

Screening Levels for Soil

Screening concentrations based on USEPA residential RSLs and IDEM residential soil screening levels were used to select COPCs for surface and subsurface soil. Maximum chemical concentrations in soil were also compared to USEPA risk-based soil screening levels (SSLs) for groundwater protection and to IDEM screening levels for migration from soil to groundwater. The SSLs and IDEM screening levels for migration from soil to groundwater were not used for the selection of COPCs for direct contact exposure; however, they do allow qualitative evaluation of the potential for chemical migration from soil to groundwater. Chemicals with concentrations exceeding the SSLs/IDEM default closure levels may potentially migrate from the soil to groundwater in sufficient quantities to pose groundwater quality problems.

The risk-based screening levels used in the COPC selection for soil are presented in Table 7-1.

Screening Levels for Groundwater

Screening levels based on the following criteria were used to select COPCs for groundwater:

- USEPA RSLs for tap water (2012a)
- USEPA Maximum Contaminant Levels (MCLs) (2012b)
- IDEM tap water screening levels for groundwater (2013)

Table 7-2 presents the screening criteria used for groundwater.

Screening Levels for Surface Water

Screening levels based on the following criteria were used to select COPCs for surface water:

- USEPA RSLs for tap water (2012a)
- USEPA MCLs (USEPA, 2012b)
- IDEM tap water screening levels for groundwater (2013)

In general, the use of tap water screening levels is regarded as a highly conservative approach to COPC selection at SWMU 22 because surface water is not used as a potable water source.

Table 7-3 presents the screening criteria used for surface water.

Screening Levels for Sediment

Screening concentrations based on USEPA residential RSLs and IDEM residential soil screening levels were used to select COPCs for sediment. The use of residential soil screening levels to select COPCs for sediments is highly conservative because residential screening criteria assume that receptors are exposed to soil 350 days of the year, whereas exposures to sediments will likely occur on a much less frequent basis.

Table 7-4 presents the screening criteria used for sediment.

Screening Levels for Chromium

Chromium speciation was only performed on one surface soil sample, collected at location 22SB020, and two groundwater samples collected from monitoring well 22MWT05. Hexavalent chromium was detected at a concentration of 1.31 mg/kg in the surface soil sample. The concentration of total chromium in this same sample was 16.5 mg/kg. Hexavalent chromium was not detected in the groundwater sample collected at monitoring well 22MWT05 in January 2013. The detection limit of 10 µg/L was greater than USEPA and IDEM screening levels; therefore, this monitoring well was resampled in April 2013. Hexavalent chromium was detected at an estimated concentration of 0.046 µg/L in the sampled collected in April 2013; total chromium was not detected above the detection limit of 10 µg/L. Based on available information, hexavalent chromium was not known to have been used at SWMU 22. Because chromium was detected at a low concentration in soil and in groundwater and because there is no evidence to support the conclusion that hexavalent chromium was used at the site, total chromium was treated as trivalent chromium in this HHRA. The uncertainty associated with this is discussed in the uncertainty analysis in Section 7.6.1.

Update to RSLs

The HHRA was prepared using the November 2012 RSLs. The RSLs were updated in November 2013. Arsenic is the only chemical for which the RSLs have changed. The RSL for residential soil changed from 0.39 mg/kg to 0.61 mg/kg. The changes in the RSL for arsenic do not affect the conclusions of the HHRA. Concentrations of arsenic were within background levels in surface soil and subsurface soil. Arsenic was retained as a COPC in sediment and would still be a COPC using the November 2013 RSLs.

Background Evaluation

In accordance with Navy policy (2004), chemicals present at background concentrations were not retained as COPCs in this HHRA. Background data are only available for soils at NSA Crane; consequently, a background comparison was not performed for groundwater, surface water, or sediment. The background evaluation was conducted in accordance with the Navy guidance titled Guidance for Environmental Background Analysis, Volume I: Soil (NFEC, 2002).

In the COPC selection process, if the results of the background evaluation indicated that concentrations of a chemical detected in site soils did not exceed background concentrations, that chemical was not selected as a COPC and was not carried through the quantitative risk assessment. However, chemicals present at concentrations exceeding risk-based screening criteria but not selected as COPCs on the basis of background evaluations are further discussed in the risk characterization section. The results of the background comparison analysis for surface soil and subsurface soil are presented in Section 5.

The elimination of chemicals as site-related COPCs on the basis of background follows Navy Policy on the Use of Background Chemical Levels (2004). This document also presents the Navy's interpretation of USEPA guidance provided in the document titled Role of Background in the CERCLA Cleanup Program (2002c) and details the methodology to be used in evaluating background under the Navy's Environmental Restoration and Base Realignment and Closure (BRAC) programs. Navy policy has been accepted by the USEPA as not contradicting the USEPA guidance (2002c). Navy policy applies to both the screening-level and baseline risk assessments and requires the following:

1. A clear and concise understanding of chemicals released from a site thus ensuring that the Navy is focusing on remediating the release.

2. The use of background data in the screening-level risk assessment.

   a. The comparison of site chemical levels to risk-based screening criteria.
   b. The comparison of site chemical levels to background concentrations.
   c. The identification of site-related COPCs based on screening criteria comparisons AND background comparisons. Site-related COPCs are those chemicals with concentrations exceeding risk-based screening criteria AND background concentrations. To the extent possible, site-related COPCs are further evaluated quantitatively in the baseline risk assessment (non-site-related COPCs are further discussed in the risk characterization sections of the baseline risk assessment).

3. The consideration of background in the baseline risk assessment.

   a. The calculation of risk estimates for site-related COPCs only.
   b. The further evaluation of non-site-related COPCs in the risk characterization section only (e.g., the evaluation of chemicals detected at concentrations exceeding screening criteria but less than background concentrations). The Navy considers this evaluation to be consistent with USEPA's Role of Background in the CERCLA Cleanup Program (2002c).

4. The selection of site cleanup remedial goals at levels not less than background levels. Additionally, cleanup levels should not be developed for chemicals not identified as chemicals of concern (COCs). As defined in the Navy guidance, COCs are site-related COPCs found to be the risk drivers in the baseline risk assessment and that may pose unacceptable human or ecological risks.

7.2.3 Decision Rules for Establishing COPCs

The following decision rules were used to select initial lists of COPCs for SWMU 22:

- A chemical detected in soil was selected as a COPC for soil if any detected chemical concentration exceeded the USEPA or IDEM direct contact screening levels for soil and, for inorganics, if the background comparison indicated that site concentrations are statistically greater than corresponding background concentrations.

- A chemical detected in groundwater was selected as a COPC for groundwater if the maximum detected concentration in any on-site monitoring well exceeded the USEPA or IDEM direct contact screening level for domestic use of a water supply (e.g., the tap water RSLs).

- A chemical detected in surface water was selected as a COPC for surface water if the maximum detected concentration in a potentially impacted surface water body exceeded the USEPA or IDEM direct contact screening level for domestic use of a water supply (e.g., the tap water RSLs).

- A chemical detected in sediment was selected as a COPC for sediment if any detected concentration exceeded the USEPA or IDEM direct contact screening level for residential exposures to soil.

Chemicals detected in any sample at concentrations greater than screening levels but eliminated as COPCs on the basis of background comparisons are further discussed in Section 7.4.3.4.

7.2.4 COPCs Selected for HHRA

COPCs were selected for surface soil, subsurface soil, groundwater, surface water, and sediment using the risk-based COPC screening levels described in Section 7.1.2. A discussion of the chemicals identified as COPCs and the rationale for COPC selection is provided in the following subsections. A discussion of the nature and extent of the chemicals detected in site media is presented in Section 5.0. COPC selection information for each medium is presented in Tables 7-5 through 7-11, and chemicals retained as COPCs are presented in Table 7-12. RAGS Part D tables for COPC selection are included in Appendix E.2.

7.2.4.1 Surface Soil

A comparison of maximum detected surface soil concentrations to screening levels based on RSLs and IDEM screening levels for residential exposures to soil is presented in Table 7-5. Concentrations of arsenic exceeded the screening levels but were within the site background level and are not considered to be site related. Concentrations of hexavalent chromium also exceeded the screening levels. No background data are available for hexavalent chromium. Concentrations of total chromium were within background levels; consequently, concentrations of hexavalent chromium are also considered to be within background levels. Therefore, no chemicals were retained as COPCs for direct contact exposures to surface soil at SWMU 22.

A comparison of maximum detected surface soil concentrations to USEPA SSLs and IDEM screening levels for chemical migration from soil to groundwater is presented in Table 7-6. RDX was detected in surface soil at a maximum concentration exceeding the screening level for migration from soil to groundwater and was retained as a COPC for direct contact exposures to surface soil at SWMU 22.

Concentrations of arsenic and hexavalent chromium also exceeded the screening levels but were within site background levels and are not considered to be site related; therefore, arsenic and hexavalent chromium were not retained as COPCs for migration from surface soil to groundwater at SWMU 22.

7.2.4.2 Subsurface Soil

A comparison of maximum detected subsurface soil concentrations to screening levels based on RSLs and IDEM screening levels for residential exposures to soil is presented in Table 7-7. Concentrations of arsenic exceeded the screening levels but were within the site background level and are not considered to be site related. Therefore, no chemicals were retained as COPCs for direct contact exposures to subsurface soil at SWMU 22.

A comparison of maximum detected subsurface soil concentrations to USEPA SSLs and IDEM screening levels for chemical migration from soil to groundwater is presented in Table 7-8. Concentrations of arsenic exceeded the screening levels but were within the site background level and are not considered to be site related; therefore, no chemicals were retained as COPCs for migration from surface soil to groundwater at SWMU 22.

7.2.4.3 Groundwater

A comparison of maximum detected groundwater concentrations in on-site monitoring wells to screening levels based on RSLs, IDEM screening levels for tap water, and MCLs is presented in Table 7-9. The following chemicals were detected at maximum concentrations exceeding COPC screening levels and were retained as COPCs for direct contact exposures to groundwater at SWMU 22:

- RDX
- Total arsenic, cadmium, hexavalent chromium, and lead
- Dissolved arsenic and cadmium
- Perchlorate

7.2.4.4 Surface Water

A comparison of maximum detected surface water concentrations to screening levels based on RSLs, IDEM screening levels for tap water, and MCLs is presented in Table 7-10. The following chemicals were detected at maximum concentrations exceeding COPC screening levels and were retained as COPCs for direct contact exposures to surface water at SWMU 22:

- RDX
- Total arsenic and cadmium
- Dissolved arsenic

Concentrations of all chemicals were less than the IDEM screening levels for tap water and USEPA MCLs.

7.2.4.5 Sediment

A comparison of maximum detected sediment concentrations to screening levels based on RSLs and IDEM screening levels for residential exposures to soil is presented in Table 7-11. Arsenic was detected in sediment at a maximum concentration exceeding direct contact risk-based COPC screening levels for residential land use and was retained as a COPC for direct contact exposures to sediment at SWMU 22:

7.2.4.6 Summary

Table 7-12 summarizes the chemicals retained as COPCs for surface soil, subsurface soil, groundwater, surface water, and sediment at SWMU 22. RAGS Part D tables for COPC selection are included in Appendix E.2.

7.3 EXPOSURE ASSESSMENT

The exposure assessment component of the risk assessment defines and evaluates, quantitatively or qualitatively, the type and magnitude of human exposure to the chemicals present at or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, to identify potentially exposed populations and applicable exposure pathways, to calculate concentrations of COPCs to which receptors might be exposed, and to estimate chemical intakes under the identified exposure scenarios.

Actual or potential exposures at SWMU 22 were determined based on the most likely pathways of contaminant release and transport and on human activity patterns. A complete exposure pathway has three components: a source of chemicals that can be released to the environment, a route of contaminant transport through an environmental medium, and an exposure or contact point for a human receptor.

7.3.1 Conceptual Site Model

A CSM facilitates consistent and comprehensive evaluation of potential risks to human health by creating a framework for identifying the pathways by which human receptors may come in contact with environmental media contaminated by site activities. A CSM depicts the relationships among the following elements, which are necessary for defining complete exposure pathways:

- Site sources of contamination
- Contaminant release mechanisms and transport/migration pathways
- Exposure routes
- Potential receptors

These elements of the CSM establish the manner and degree to which a potential receptor may be exposed to chemicals present at the site. The degree of risk incurred by a potential receptor varies according to the means of exposure, duration of exposure, and specific chemical(s) to which the receptor is exposed.

The CSM for SWMU 22 is presented in the Section 6. Section 6 also discusses contaminant fate and transport at SWMU 22. Table 7-13 provides a site-specific summary of the potential receptors evaluated for SWMU 22. A summary of the exposure routes addressed quantitatively in the HHRA for each human receptor is provided in Table 7-14. Figure 7-1 illustrates the CSM for SWMU 22.

Potential Current and Future Receptors of Concern and Exposure Pathways

NSA Crane is an active naval base and will remain active for the foreseeable future. Current site receptors include industrial and construction workers and adolescent trespasses. However, for purposes of completeness, the baseline risk assessment also considered receptor exposure under residential and recreational land use scenarios. As discussed in Sections 7.2.4.1 and 7.2.4.2, no COPCs were identified for surface soil or subsurface soil; consequently, there are no complete exposures pathways for surface soil and subsurface soil at SWMU 22. Based on current and potential future land use, the following potential receptors may be exposed to contaminated environmental media within the study area:

- **Construction Workers** – A plausible receptor under current or future land use. No construction activities are currently planned for the study area. However, this receptor could be exposed to shallow groundwater (dermal contact) and airborne contaminants emanating from groundwater (inhalation). Significant exposures by a construction worker to groundwater is unlikely because if a construction worker were to have prolonged contact with groundwater, he/she would most likely wear protective clothing such as rubber boots and/or hip waders, which would limit exposure. In addition, most excavation activities would use construction equipment such as a backhoe, which would limit worker exposure. Also, if significant groundwater were encountered during excavation of a trench or foundation, the groundwater would most likely be pumped out of the excavation so that the construction activities could be completed.

- **Industrial Worker** – A plausible receptor under current and future land use. This includes adult military or civilian personnel assigned to routine daily work tasks in the SWMU 22 area. If this receptor were to work in an on-site structure, this receptor could be exposed to VOCs migrating to the indoor air of a building from contaminated groundwater via vapor intrusion. However, no VOCs were detected in groundwater; therefore, there are no complete exposure pathways for current or future industrial workers.

- **Adolescent Trespassers** – A plausible receptor under current or future land use. Although access to the base is controlled, once inside the base, access to the site is not limited by any physical constraints. This receptor may be exposed to potentially contaminated surface water (via incidental ingestion and dermal contact) and sediments (via incidental ingestion and dermal contact) in the drainage ditches and intermittent streams. However, exposure to surface water is likely to be limited in some areas because of the intermittent nature of the surface water in the streams at the site. Also, potential exposures to surface water would be limited to wading because the streams at the sites are not deep enough for swimming. Direct contact with groundwater is not anticipated for this receptor.

- **Recreational Users (Child and Adult)** – A plausible receptor under future land use. If NSA Crane were to close, the property could be converted to a park. A recreational user may be exposed to potentially contaminated surface water (via incidental ingestion and dermal contact) and sediments (via incidental ingestion and dermal contact). Exposures to surface water would be limited to wading because the streams at the sites are not deep enough for swimming. NSA Crane is not expected to close because principal base operations, the demilitarization of munitions, are critical to the support of the United States Naval fleet.

- **Residents (Child and Adult)** – Given the anticipated future land use for much of SWMU 22 (commercial/industrial), residents are very unlikely future receptors. However, the hypothetical future residential scenario is typically evaluated in a risk assessment for decision-making purposes. For example, the need for deed restrictions at a site may be eliminated prior to site closure if minimal risks are estimated for residential receptors. It is assumed that a hypothetical resident may be exposed to groundwater (via ingestion and dermal contact), surface water (via ingestion and dermal contact), and sediment (via incidental ingestion and dermal contact). Potential exposures to surface water would be limited to wading because the streams at the sites are not deep enough for swimming. Also, hypothetical residents could be exposed to VOCs migrating from contaminated groundwater to the indoor air of a home; however, no VOCs were detected in groundwater.

7.3.2 Central Tendency Exposure and Reasonable Maximum Exposure

Traditionally, exposures evaluated in the HHRA were based on the concept of a reasonable maximum exposure (RME) only, which is defined as "the maximum exposure that is reasonably expected to occur at a site" (USEPA, 1989). However, subsequent risk assessment guidance (USEPA, 1992) indicates the need to address an average case or central tendency exposure (CTE).

To provide a full characterization of potential exposure, both RME and CTE scenarios were evaluated in the HHRA for SWMU 22. The available guidance (USEPA, 1993a) concerning the evaluation of CTE is limited. Therefore, professional judgment was exercised when defining CTE conditions for a particular receptor at a site.

7.3.3 Exposure Point Concentrations

The exposure point concentration (EPC), which is calculated for COPCs only, is an estimate of the chemical concentration within an exposure unit (EU). The EPC is assumed to be the concentration to which the receptor is exposed and is used to estimate exposure intakes. An EU is the area over which receptor activity is expected to occur. The entire site was used as the EU for SWMU 22. As discussed in Section 7.1.3, no COPCs were identified for surface soil and subsurface soil; therefore, EPCs were not calculated for these media.

The following guidelines were used to calculate EPCs:

- For surface water and sediment, the 95-percent upper confidence limit (UCL) on the arithmetic mean, which was based on the distribution of the data set, was selected as the EPC. EPCs were calculated following USEPA's Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (2002a) and using USEPA's ProUCL software Version 4.1.01. If ProUCL was unable to calculate an UCL, the maximum detected concentration was used as the EPC.

- There were only four groundwater samples, so the maximum detected concentration was used as the EPC for groundwater.

- As stated in the guidance manual for the Integrated Exposure Uptake Biokinetic (IEUBK) model (USEPA, 1994), the arithmetic mean concentration was used as the EPC for lead.

- Non-detected values were evaluated in accordance with the ProUCL guidance (USEPA, 2010a).

- The same EPCs were used to evaluate both RME and CTE scenarios.

Table 7-15 summarizes the EPCs used in this HHRA. ProUCL Outputs are included in Appendix E.3, and RAGS Part D Tables for the EPCs are presented in Appendix E.2.

7.3.4 Chemical Intake Estimation

The methodologies and techniques used to estimate exposure intakes are presented in this section. Intakes for the identified potential receptor groups were calculated using current USEPA risk assessment guidance and are presented in the risk assessment spreadsheets. Risk assessment results are presented using USEPA RAGS Part D table format. Assumptions regarding exposure are presented in Tables 7-16 and 7-17 for the RME and CTE scenarios, respectively. The exposure assumptions presented in Table 7-16 and 7-17 are based on current USEPA risk assessment guidance.

Non-carcinogenic intakes were estimated using the concept of an average annual exposure. Carcinogenic intakes were calculated as incremental lifetime exposures, which assume a life expectancy of 70 years. The exposure assumptions reflect current USEPA guidance. The majority of the exposure assumptions used to estimate chemical intakes were based on default assumptions described in several USEPA guidance documents (e.g., USEPA December 1989, 1991, 1997b, and 2004). The following paragraphs discuss the non-default receptor-specific exposure assumptions used in the risk assessment.

7.3.4.1 Incidental Ingestion of Sediment

Direct physical contact with sediment may result in the incidental ingestion of chemicals. Chemical intake for the incidental ingestion of sediment was estimated in the following manner (USEPA, 1989):

$$\text{Intake} = \frac{(C_s)(IR)(FI)(EF)(ED)(CF)}{(BW)(AT)}$$

where:

Intake	=	intake of chemical from sediment (mg/kg/day)
C_s	=	concentration of chemical in sediment (mg/kg)
IR	=	ingestion rate (mg/day)
FI	=	fraction ingested from contaminated source (dimensionless)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (year)
CF	=	conversion factor (1 x 10^{-6} kg/mg)
BW	=	body weight (kg)

AT = averaging time (days);
for non-carcinogens, AT = ED x 365 days per year
for carcinogens, AT = 70 years x 365 days per year

Most of the exposure assumptions used to estimate chemical intakes from incidental ingestion of sediment were based on default assumptions for exposures to soil described in standard USEPA guidance and are summarized in Tables 7-16 and 7-17. The following paragraphs briefly discuss the non-default receptor-specific exposure assumptions for incidental ingestion of sediment that were used in the HHRA.

Child and adult recreational users are assumed to be exposed to sediment for 2 days a week during the warmer weather months (52 days per year) under the RME scenario and for 1 day a week (26 days per year) under the CTE scenario. The adolescent trespasser is assumed to be exposed to sediment on a somewhat less frequent basis (26 and 13 days per year for the RME and CTE cases, respectively).

7.3.4.2 Dermal Contact with Sediment

Direct physical contact with sediment may result in the dermal absorption of chemicals. Exposure associated with dermal contact with sediment was estimated in the following manner (USEPA, 1989):

$$\text{Intake} = \frac{(C_s)(SA)(AF)(ABS)(CF)(EF)(ED)}{(BW)(AT)}$$

where:

Intake = amount of chemical absorbed during contact with sediment (mg/kg/day)
C_s = concentration of chemical in sediment (mg/kg)
SA = skin surface area available for contact (cm^2/day)
AF = skin adherence factor (mg/cm^2)
ABS = absorption factor (dimensionless)
CF = conversion factor (1×10^{-6} kg/mg)
EF = exposure frequency (days/year)
ED = exposure duration (year)
BW = body weight (kg)
AT = averaging time (days);
for non-carcinogens, AT = ED x 365 days per year
for carcinogens, AT = 70 years x 365 days per year

Most of the exposure assumptions used to estimate chemical intakes from dermal contact with sediment were based on the default assumptions for exposures to soil described in standard USEPA guidance and are summarized in Tables 7-16 and 7-17. The following paragraphs briefly discuss non-default receptor-specific exposure assumptions for dermal contact with sediment that were used in the HHRA.

The exposed skin surface areas of the body available for dermal contact with sediment were determined on a receptor-specific basis because they correspond with assumed human activities and clothing worn during exposure events. With the exception of the skin surface area recommended for adolescent trespassers, all of the skin surface areas presented in Tables 7-16 and 7-17 are based on USEPA default values. For an adolescent trespasser (7 to 16 years old), it was assumed that 25 percent of the body surface area was exposed to sediment (i.e., 3,280 cm^2). This value represents the 50^{th}-percentile areas presented in Table 4-6 of the Exposure Factors Handbook (USEPA, 1997b).

The same exposure frequencies and durations recommended for the evaluation of incidental ingestion of sediment were used to estimate chemical intakes for dermal contact with sediment. The soil adherence factors presented in Exhibits 3.3 and 3.5 of RAGS Part E were used to evaluate dermal contact with sediment. Table 7-18 presents the absorption factor values used in this HHRA.

7.3.4.3 Direct and Incidental Ingestion of Groundwater and Incidental Ingestion of Surface Water

Direct ingestion of groundwater is expected to be limited to exposure that would occur under a future hypothetical residential scenario. Incidental ingestion of groundwater by construction workers may occur during excavation activities. In addition, hypothetical residents, recreational users, and trespassers may incidentally ingest surface water while at SWMU 22. Intakes associated with ingestion of groundwater and surface water were evaluated using the following equation (USEPA, 1989):

$$\text{Intake} = \frac{(C_W)(CF)(IR_W)(EF)(ED)}{(BW)(AT)}$$

where:

Intake	=	intake of chemical from groundwater/surface water (mg/kg/day)
C_w	=	concentration of chemical in groundwater/surface water (mg/L)
CF	=	conversion factor (0.001 mg/µg)
IR_w	=	ingestion rate for groundwater (L/day)

IR_w	=	surface water ingestion rate (L/day) = (CR)(ET)
CR	=	contact rate (L/hr)
ET	=	exposure time (hours/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (year)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for non-carcinogens, AT = ED x 365 days per year
		for carcinogens, AT = 70 years x 365 days per year

USEPA standard default exposure assumptions were used to evaluate residential exposures to groundwater. The following paragraphs briefly discuss non-default receptor-specific exposure assumptions for ingestion of groundwater and surface water that were used in the HHRA.

There are no USEPA or IDEM default exposure assumptions for exposures to groundwater by construction workers; consequently, values were derived based on site-specific information and professional judgment. It was assumed that a construction worker would be exposed to groundwater for 4 hours per day for 30 days per year under the RME scenario and for 2 hours per day for 15 days per year under the CTE scenario. A shorter exposure frequency is recommended for a construction worker exposed to groundwater than is recommended for exposure to soil because it is unlikely that a construction worker will have direct contact with groundwater on a daily basis during a construction project. Trespassers, recreational users, and residents were assumed to be exposed to surface water for 4 hours per day under the RME scenario and for 2 hours per day under the CTE scenario. It was assumed that trespassers, recreational users, and hypothetical residents would incidentally ingest 0.01 liters per hour of surface water under the RME and CTE scenarios (USEPA, 2011).

A summary of the receptor-specific input values used to estimate chemical intakes from ingestion of groundwater are presented in Tables 7-16 and 7-17.

7.3.4.4 Dermal Contact with Groundwater and Surface Water

The same equation was used to estimate intakes for dermal contact with both groundwater and surface water. Hypothetical residential receptors were assumed to use groundwater for domestic purposes (e.g., bathing, showering, and dish washing) that can result in dermal exposure. Construction workers could contact groundwater during excavation activities. Trespassers, recreational users, and hypothetical residents may have dermal contact with surface water while wading in the streams at site. The following equation was used to assess exposures resulting from dermal contact with groundwater and surface water (USEPA, 2004):

$$DAD = \frac{(DA_{event})(EV)(ED)(EF)(SA)}{(BW)(AT)}$$

where:

DAD	=	dermally absorbed dose of chemical from water (mg/kg/day)
DA_{event}	=	dermally absorbed dose per event (mg/cm^2-event)
EV	=	event frequency (events/day)
ED	=	exposure duration (year)
EF	=	exposure frequency (days/year)
SA	=	skin surface area available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for non-carcinogens, AT = ED x 365 days per year
		for carcinogens, AT = 70 years x 365 days per year

Most of the exposure assumptions used to estimate chemical intakes from dermal contact with groundwater were based on default assumptions described in standard USEPA guidance and are summarized in Tables 7-16 and 7-17.

Dermal intakes for residents exposed to groundwater assumed total body exposure on a daily basis. For construction workers exposed to groundwater and trespassers, recreational users, and residents exposed to surface water, the exposed surface area of the body available for contact was based on assumed activities and was similar to the assumptions outlined for dermal contact with soil and sediment.

The absorbed dose per event (DA_{event}) was estimated using a non-steady-state approach for organic compounds and a traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{event} < t^{*}, \text{ then: } DA_{event} = (2)(K_p)(FA)(C_w)(CF)\left(\sqrt{\frac{6\,\tau\,t_{event}}{\pi}}\right)$$

$$\text{If } t_{event} > t^{*}, \text{ then: } DA_{event} = (K_p)(FA)(C_w)(CF)\left(\frac{t_{event}}{1+B} + 2\,\tau\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right)$$

where:

t_{event}	=	duration of event (hour/event)
t^*	=	time to reach steady-state conditions (hour)
K_p	=	permeability coefficient from water through skin (cm/hour)
FA	=	chemical-specific fraction absorbed (dimensionless)
C_w	=	concentration of chemical in water (mg/L)
τ	=	lag time (hour)
π	=	Pi (dimensionless; equal to 3.1416)
CF	=	conversion factor (0.001 L/cm^3)
B	=	Dimensionless ratio of the permeability of the stratum corneum relative to the permeability across the viable epidermis (dimensionless)

Values for the chemical-specific parameters (t^*, K_p, FA, τ, and B) were obtained from the current dermal guidance (USEPA, 2004, Exhibit B-3) and are presented in Table 7-18. If published values were not available for a particular compound, they were calculated using equations provided in the USEPA dermal guidance.

The following steady-state equation was used to estimate DA_{event} for inorganics:

$$DA_{event} = (K_p)(C_W)(t_{event})$$

The dermal permeability coefficient (K_p) values recommended in the USEPA dermal guidance (USEPA, 2004) were used to calculate DA_{event} for inorganic COPCs.

7.3.4.5 Assessing Cancer Risks from Early Life Exposures

USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005f) recommends making adjustments to the toxicity values of carcinogenic chemicals that act via the mutagenic mode of action when evaluating early-life exposures. The guidance recommends using age-dependent adjustment factors (ADAFs) combined with age-specific exposure estimates when assessing cancer risks. In the absence of chemical-specific data, the supplement guidance recommends the following default adjustments, which reflect the fact that cancer risks are generally higher from early-life exposures than from similar exposures later in life:

- For exposures before 2 years of age (i.e., spanning a 2-year interval from the first day of birth until a child's second birthday), a 10-fold adjustment.

- For exposures between 2 and 16 years of age (i.e., spanning a 14-year time interval from a child's second birthday until their sixteenth birthday), a three-fold adjustment.

- For exposures after turning 16 years of age, no adjustment.

The adjustments were applied using the same method as that used by Oak Ridge National Laboratory (ORNL) in the development of RSLs. Children were evaluated as two age groups, ages 0 to 2 years and 2 to 6 years, and adults were evaluated as two age groups, ages 6 to 16 and greater than 16 years old. Using this approach, the intakes for hypothetical residents were calculated as follows:

$$\text{Intake}_{\text{Child}} = \text{Intake}_{(\text{ages } 0-2 \text{ years})} \times 10 + \text{Intake}_{(\text{ages } 2-6 \text{ years})} \times 3$$

$$\text{Intake}_{\text{Adult}} = \text{Intake}_{(\text{ages } 6-16 \text{ years})} \times 3 + \text{Intake}_{(\text{ages} > 16 \text{ years})}$$

The above approach was used only for those chemicals identified as mutagenic in the ORNL screening table (e.g., hexavalent chromium). Sample calculations showing how this approach was applied are included in Appendix E.4.

7.3.4.6 Exposure to Lead

The equations and methodology presented in the previous section cannot be used to evaluate exposure to lead because of the absence of published dose-response parameters. Exposure to lead was assessed using the latest version of USEPA's IEUBK Model for lead, Version 1.1 Build 11 (2010b). This model is typically used to evaluate lead exposure assuming a residential land use scenario.

The IEUBK Model for lead is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure. Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood-lead levels. The threshold for toxic effects from this chemical is believed to be in the range of 10 to 15 micrograms per deciliter (µg/dL). Blood-lead levels greater than 10 µg/dL are considered to be a "concern."

7.4 TOXICITY ASSESSMENT

The toxicity assessment weighs the evidence regarding the potential for exposure to chemicals to produce adverse effects in exposed receptors, and when possible, the assessment estimates the relationship between the exposure to a chemical and the increased likelihood and/or severity of adverse effects. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified constituents of concern. Quantitative toxicity values determined during this component of the risk assessment are integrated with exposure assessment outputs to characterize the potential occurrence of adverse health effects for each receptor group.

The reference dose (RfD) is the toxicity value used to evaluate non-carcinogenic health effects for ingestion and dermal exposures. The reference concentration (RfC) is used to evaluate non-carcinogenic health effects for inhalation exposures. The RfD and RfC estimate a daily exposure level for a human population that is unlikely to pose an appreciable risk during a portion or for all of a human lifetime. It is based on a review of animal and/or human toxicity data, with adjustments for various data uncertainties. Carcinogenic effects are quantified using the cancer slope factor (CSF) for ingestion and dermal exposures and using inhalation unit risks (IUR) for inhalation exposure that are plausible upper-bound estimates of the probability of the development of cancer per unit intake of the chemical over a lifetime. These are typically based on dose-response data from human and/or animal studies.

7.4.1 <u>Toxicity Criteria for Oral and Inhalation Exposures</u>

Oral RfDs and CSFs and inhalation RfCs and IURs used in this HHRA were obtained from the following primary USEPA literature sources (2003b):

- Tier 1 - Integrated Risk Information System (IRIS).

- Tier 2 - USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs) – The Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by USEPA's Superfund program.

- Tier 3 - Other Toxicity Values – These sources include but are not limited to California Environmental Protection Agency (Cal EPA) toxicity values, Agency for Toxic Substances and Disease Registry (ATSDR) values, and the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997c).

Although toxicity criteria can be found in several toxicological sources, USEPA's IRIS online database is the preferred source of toxicity values. This database is continuously updated, and the presented values have been verified by USEPA. The toxicity criteria for the constituents selected as COPCs are presented in Tables 7-19 through 7-22.

7.4.2 Toxicity Criteria for Dermal Exposure

RfDs and CSFs in the scientific literature are typically expressed as "administered" (i.e., not absorbed) doses; therefore, these values are considered inappropriate for estimating risks associated with dermal exposures. Oral dose-response parameters based on administered doses must be adjusted to absorbed doses before they can be compared to estimated dermal exposure intakes.

When oral absorption is essentially complete (i.e., 100 percent), an absorbed dose is equivalent to the administered dose, and therefore no toxicity adjustment is necessary. Conversely, when the gastrointestinal absorption of a chemical is poor (e.g., 1 percent), the absorbed dose is smaller than the administered dose; thus, toxicity factors based on absorbed dose should be adjusted to account for the difference in the absorbed dose relative to the administered dose. USEPA (2004) recommends a 50-percent absorption cutoff to reflect the intrinsic variability in analyzing absorption studies. Therefore, the adjustment from administered to absorbed dose was only performed when the chemical-specific gastrointestinal absorption efficiency was less than 50 percent. The adjustment from administered to absorbed dose was made using chemical-specific gastrointestinal absorption efficiencies published in numerous sources of guidance [e.g., 2004 (the primary reference), IRIS, ATSDR toxicological profiles, etc.] and the following equations:

$$RfD_{dermal} = (RfD_{oral})(ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) / (ABS_{GI})$$

where:

ABS_{GI}	=	absorption efficiency in the gastrointestinal tract
RfD_{dermal}	=	RfD for the dermal route of exposure
RfD_{oral}	=	RfD for the oral route of exposure
CSF_{dermal}	=	CSF for the dermal route of exposure
CSF_{oral}	=	CSF of the oral route of exposure

As noted above, the preceding adjustment of the oral toxicity criteria (e.g., RfDs, CSFs) was necessary to allow quantitative evaluation of the dermal route of exposure in the baseline risk assessment. Explanations of this procedure and the need for this procedure are presented in Appendix A of USEPA RAGS Part A.

7.4.3 Toxicity Values for Construction Workers

Under the guidelines established by the Superfund program, exposures to construction workers of 1 year or less are classified as subchronic exposures. Risks for non-carcinogenic effects associated with subchronic exposures should incorporate toxicity values for subchronic and not chronic effects. Tables 7-19 and 7-20 present the available subchronic RfDs and RfCs that were used for the construction worker. Uncertainty associated with the lack of subchronic RfCs for many chemicals is discussed in Section 7.6.3.

7.5 RISK CHARACTERIZATION

This section provides a characterization of human health risks associated with potential exposures to COPCs at the site. Potential risks (non-carcinogenic and carcinogenic) for human receptors resulting from exposures outlined in the exposure assessment were quantitatively determined and are discussed in this section. Sections 7.5.1 and 7.5.2 outline the methods used to quantitatively estimate the type and magnitude of potential risks for human receptors. Summaries of the risk characterization for SWMU 22 are provided in Section 7.5.3.

7.5.1 Quantitative Analysis for Chemicals Other Than Lead

Quantitative estimates of risk for chemicals were calculated according to risk assessment methods outlined in USEPA guidance (1989). Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as ILCRs, based on CSFs and IURs. Non-carcinogenic risk estimates are presented in the form of HQs that are determined through a comparison of intakes with published RfDs and RfCs.

ILCR estimates for ingestion and dermal exposures were generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$\text{ILCR} = (\text{Estimated Exposure Intake})(\text{CSF})$$

ILCRs estimates for inhalation exposures were generated for each COPC using estimated exposure concentrations and published IURs, as follows:

$$ILCR = (IUR)(Exposure\ Concentration)(1{,}000\ \mu g/mg)$$

An ILCR of $1x10^{-6}$ indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of 1 million people.

Non-carcinogenic risks were assessed using the concept of HQs and hazard indices (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD and is calculated for ingestion and dermal exposures as follows:

$$HQ = (Estimated\ Exposure\ Intake)/(RfD)$$

For inhalation exposures, HQ is calculated as follows:

$$HQ = (Exposure\ Concentration)/(RfC)$$

An HI was generated by summing the individual HQs for all COPCs. The HI is not a mathematical prediction of the severity of toxic effects and therefore is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of non-carcinogenic (threshold) effects.

7.5.2 Comparison of Quantitative Risk Estimates to Benchmarks

To interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates are compared to typical risk benchmarks. Calculated ILCRs for SWMU 22 were interpreted using the USEPA's "target range" of $1x10^{-6}$ to $1x10^{-4}$. Current USEPA policy regarding lead exposures is to limit the childhood risk of exceeding a 10 µg/dL blood-lead level to 5 percent.

USEPA has defined the range of $1x10^{-6}$ to $1x10^{-4}$ as the ILCR target risk range for most hazardous waste facilities addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and RCRA. IDEM has defined this same risk range. Individual or cumulative ILCRs greater than $1x10^{-4}$ will typically not be considered as protective of human health, and ILCRs less than $1x10^{-6}$ will typically be regarded as protective. Risk management decisions are necessary when the ILCR is within the $1x10^{-4}$ to $1x10^{-6}$ cancer risk range.

An HI exceeding unity (1) indicates that there may be potential non-carcinogenic health risks associated with exposure. If an HI exceeds unity, a segregation of target organ effects associated with exposure to COPCs is typically performed. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) are regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1, but no adverse health effects are anticipated if the COPCs do not affect the same target organ or exhibit the same critical effect.

7.5.3 <u>Results of the Risk Characterization</u>

This section contains a summary of the results of the risk characterization for SWMU 22. Quantitative risk estimates for potential human receptors are developed for chemicals detected in groundwater, surface water, and sediment. No COPCs were identified for soil; consequently, cancer risks and HIs were not calculated for exposures to surface soil and subsurface soil. Industrial workers were assumed to only be exposed to soil; therefore, no risks were estimated for industrial workers. Uncertainties associated with the risk estimates are discussed in Section 7.6. The methodology used to calculate the risks presented in this section is provided in Sections 7.5.1 and 7.5.2. Potential cancer risks and HIs were calculated for current and future construction workers, future child and adult recreational users, adolescent trespassers, and hypothetical future residents under the RME and CTE scenarios and are summarized in Tables 7-23 and 7-24. Sample calculations are presented in Appendix E.4, and the results of the risk assessment in RAGS Part D format are included in Appendix E.2.

7.5.3.1 Non-Carcinogenic Risks

<u>RME Scenario</u>

Table 7-23 and Figures 7-2 and 7-3 presents the HIs for the RME scenario at SWMU 22. Cumulative HIs for all receptors exposed to groundwater, surface water, and sediment were less than unity (1) with the exception of hypothetical child residents, indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

Medium-specific HIs for hypothetical child residents exposed to surface water and sediment were less than unity. The HI for hypothetical child residents exposed to groundwater was 3, although as shown below, the HIs for the individual target organs were all less than or equal to 1.

Hypothetical Child Residents	
Target Organ	**Hazard Quotient**
Cardiovascular System	1
Kidney	0.7
Skin	1
Thyroid	0.5
None Specified	0.001

<u>CTE Scenario</u>

Table 7-24 and Figures 7-4 and 7-5 presents the HIs for the CTE scenario at SWMU 22. Cumulative HIs for all receptors were less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

7.5.3.2 Carcinogenic Risks

<u>RME Scenario</u>

Table 7-23 and Figures 7-6 and 7-7 presents the ILCRs for the RME scenario at SWMU 22. ILCRs for all receptors exposed to groundwater, surface water, and sediment under the RME scenario were less than or within USEPA's and IDEM's target risk range of 10^{-4} to 10^{-6} with the exception of the lifelong resident. The ILCR of $1x10^{-4}$ for the lifelong resident exposed to groundwater was equal to the upper bound of USEPA's and IDEM's target risk range.

<u>CTE Scenario</u>

Table 7-24 and Figures 7-8 and 7-9 presents the ILCRs for the CTE scenario at SWMU 22. ILCRs for all receptors exposed to groundwater, surface water, and sediment under the CTE scenario were less than or within USEPA's and IDEM's target risk range of 10^{-4} to 10^{-6}

7.5.3.3 Risks from Lead

Lead was identified as a COPC in groundwater at SWMU 22. Concentrations of total lead in one sample (22GWT003 at 21.4 µg/L) exceeded the federal Action Level promulgated under the Safe Drinking Water Act and IDEM screening level, both 15 µg/L.

Hypothetical future residential exposures to lead in groundwater were evaluated using the most recent version of the IEUBK lead model (Version 1.1 Build 11). As recommended in the IEUBK Model documentation (USEPA, 1994), the average lead concentrations of 13.8 µg/L in groundwater and 10.1 mg/kg in surface soil were used as the EPCs. Default values were used for the remaining model input parameters. IEUBK Model outputs are included in Appendix E.5. The lead concentration of 13.8 µg/L in groundwater and 10.1 mg/kg in surface soil results in a geometric mean blood-lead level of 1.723 µg/dL and results in 0.009 percent of future on-site child residents having blood-lead levels greater than 10 µg/dL. This value is less than the USEPA goal, as described in the 1994 Office of Solid Waste and Emergency Response (OSWER) Directive, of no more than 5 percent of children exceeding a 10 µg/dL blood-lead level.

7.5.3.4 Risk Estimates Due to Chemicals Attributable to Background

COPCs for surface soil and subsurface soil at SWMU 22 were selected, in part, using available background concentrations for soil. The background comparison is presented in Section 5.0. At SWMU 22, arsenic and hexavalent chromium were within background levels in surface soil, and arsenic was within the background level in subsurface soil. Tables 7-25 and 7-26 present the cancer risks and HIs associated with these metals for the RME and CTE scenarios. RAGS Part D tables for these chemicals are presented in Appendix E.6.

HIs were less than the acceptable level of 1 and ILCRs were within USEPA's and IDEM's target risk range for all receptors at SWMU 22 under the RME and CTE scenarios, respectively.

7.5.3.5 Sediment in Settling Basin

As discussed in Section 5.1.3, concentrations of several chemicals in sediment in the settling basin at SWMU 22 exceeded human health screening levels. There are no potential exposures to the material in the sumps under current land use. Future construction workers could be exposed to the sediment in the settling basin if the settling basin were excavated, although such exposures are expected to be negligible because it is anticipated it would take 1 day at most to remove the settling basin. If the sediment in the settling basins was somehow deposited on surrounding surface soil, future receptors could potentially be exposed to the material. Risk estimates were developed for future industrial workers and hypothetical residents hypothetically exposed to those sediments using USEPA RSLs (representing the 1×10^{-6} cancer risk level or an HI of 1), the chemical concentrations detected in the sediment, and the following simple ratio technique:

$$\frac{\text{USEPA RSLs}}{\text{Chemical Concentration}} = \frac{\text{HI of 1 or Cancer Risk Estimate of } 1\text{x}10^{-6}}{\text{HI or Cancer Risk Estimate}}$$

Tables 7-27 and 7-28 presents the estimated risks for future industrial workers and hypothetical future residents exposed to sediment from the settling basin. HIs were less than the acceptable level of 1, and ILCRs were within USEPA's and IDEM's target risk range for industrial workers and hypothetical residents.

The settling basin is currently intact, but if the integrity of the settling basin were compromised in the future, chemicals present in the sediments could migrate to underlying soil and groundwater. Table 7-29 presents a comparison of chemical concentrations in settling basin sediment to screening criteria for migration from soil to groundwater. The detected concentration of arsenic exceeds both USEPA SSLs and IDEM screening levels. The impact of the risk to the groundwater resource is limited by the small volume of sediment in the settling basin.

7.6 UNCERTAINTY ANALYSIS

Uncertainty is associated with all aspects of the HHRA. This section presents a summary of these uncertainties and discusses how they might affect the final risk numbers.

Uncertainty in the selection of COPCs is related to the current status of the predictive databases, the grouping of samples, numbers, types, and distributions of samples, and procedures used to include or exclude constituents as COPCs. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route or scenario, assumptions made to determine EPCs, and predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose-response relationships and the weight-of-evidence used to determine the carcinogenicity of COPCs. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier steps of the risk assessment process.

Whereas there are various sources of uncertainty, the direction of uncertainty can be influenced by the assumptions made throughout the risk assessment, including selection of COPCs and selection of values for dose-response relationships. Throughout the entire risk assessment, assumptions are biased toward a margin of safety so that the final calculated risks are overestimated.

Generally, risk assessments include two types of uncertainty, measurement and informational uncertainty. Measurement uncertainty refers to the usual variance that accompanies scientific measurements. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used. Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, on the biological mechanism of action of a chemical, or on the behavior of a chemical in soil.

After the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions made are protective of sensitive subpopulations or the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward over predicting both carcinogenic and non-carcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point of departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are less than an acceptable risk level (i.e., $1x10^{-6}$ to $1x10^{-4}$), the interpretation of no significant risk is typically straightforward. However, when risks calculated using a high degree of uncertainty exceed an acceptable risk level (i.e., $1x10^{-4}$); a conclusion can be difficult unless uncertainty is considered.

7.6.1 Uncertainty in Data Evaluation

The most significant issues related to uncertainty in the data evaluation are the usability of the existing database, COPC screening levels used, and evaluation of total chromium as hexavalent chromium. A brief discussion of each of these issues is provided in this section.

Usability of Existing Databases

All the data used in the HHRA were validated as discussed in Section 4.0. The qualification of data during the formal data validation process is not expected to compromise the results of the baseline HHRA. Analytical data qualified as estimated were used, even though the reported concentrations or sample-specific quantitation limits may be somewhat imprecise. The use of estimated data adds to the uncertainty associated with the risk assessment; however, the associated uncertainty is expected to be negligible compared to the other uncertainties inherent in the risk evaluation process (i.e., uncertainties with land uses, exposure scenarios, toxicological criteria, etc.). Because all data have been validated, the uncertainty in the calculated risks associated with the data is minimal.

As discussed in the DQR in Appendix C, chromium and lead results in two surface water samples were rejected due to comparability issues. The rejection of these results do not affect the conclusions of the risk assessment because the rejected results fall within the middle of the observed concentration ranges for these metals or they do not exceed screening criteria.

COPC Screening Levels

The use of risk-based screening values based on conservative land use scenarios (i.e., residential land use for soil and domestic use for groundwater) corresponding to ILCRs of 10^{-6} and HIs of 0.1 ensured that all the significant contributors to risk from the site were evaluated. The elimination of chemicals present at concentrations that correspond to ILCRs less than 10^{-6} and HIs less than 0.1 should not affect the final conclusions of the risk assessment because those chemicals are not expected to cause a potential health concern at the detected concentrations.

Evaluation of Chromium

As discussed in Section 7.1.2, total chromium was evaluated as trivalent chromium in this HHRA. A qualitative evaluation of the risks associated with evaluating total chromium as hexavalent chromium is presented below.

Total chromium was detected in surface soil and subsurface soil at maximum concentrations of 25.4 and 17.7 mg/kg, respectively. The maximum concentrations of total chromium in surface soil and subsurface soil are within two orders of magnitude of the USEPA residential RSL of 0.29 mg/kg for hexavalent chromium; therefore, the cancer risks would be less than $1x10^{-4}$ if total chromium had been evaluated as hexavalent chromium in surface and subsurface soil. Consequently, risks from exposures to surface and subsurface soil would be within USEPA's and IDEM's target risk range if total chromium in soil had been evaluated as hexavalent chromium.

Unfiltered total chromium was detected at concentrations ranging from 5 to 90.8 µg/L in groundwater. All detected concentrations of unfiltered total chromium exceed the tap water RSL of 0.031 µg/L by more than two orders of magnitude. Consequently, risks from exposures to unfiltered total chromium in groundwater would exceed USEPA's and IDEM's target risk range if unfiltered total chromium had been evaluated as hexavalent chromium. The filtered total chromium concentrations were less than the corresponding unfiltered total chromium concentrations in all samples, an indication that the unfiltered total chromium concentrations are attributable to suspended solids in the groundwater. Filtered concentrations of total chromium in groundwater ranged from non-detected to 3 µg/L, within two orders of magnitude of the tap water RSL. Therefore, risks from exposures to filtered total chromium in groundwater would be within USEPA and IDEM's target risk range if filtered chromium had been evaluated as hexavalent chromium in this HHRA.

Total chromium was detected in surface water at a maximum concentration of 3 µg/L, which is within two orders of magnitude of the USEPA tap water RSL of 0.031 µg/L for hexavalent chromium. The cancer risks would be less than $1x10^{-4}$ if total chromium had been evaluated as hexavalent chromium in surface water. The tap water RSL is based on water being used as a potable water supply; consequently, recreational exposures to surface water would be less than those for using surface water as a potable water supply. Therefore, risks from exposures to surface water would be within the USEPA and IDEM target risk range if total chromium had been evaluated as hexavalent chromium.

Total chromium was detected in sediment at a maximum concentration of 12.6 mg/kg, which is within two orders of magnitude of the USEPA residential RSL of 0.29 mg/kg for hexavalent chromium. The cancer risks would be less than $1x10^{-4}$ if total chromium had been evaluated as hexavalent chromium in sediment. Receptors would not be exposed to sediments as frequently as they are exposed to soils; therefore, risks from exposures to sediment would be within the USEPA and IDEM target risk range if total chromium had been evaluated as hexavalent chromium.

7.6.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises because of the methods used to calculate EPCs, determination of land use conditions, selection of receptors and scenarios, and selection of exposure parameters. Each of these is discussed below.

Land Use

The current land use patterns at NSA Crane are well established, thereby limiting the uncertainty associated with land use assumptions. Land use at SWMU 22 is currently limited and is expected to be limited in the future as long as NSA remains open (industrial workers and construction workers are the only current and likely future receptors). To be conservative, risks to potential and future recreational users, trespassers, and hypothetical residents were estimated for the site.

Exposure Point Concentrations

Uncertainty is associated with the use of 95-percent UCLs on the mean concentration as EPCs. As a result of using 95-percent UCLs, the estimations of potential risk for the RME scenario were most likely overstated because UCLs represent the upper limit that potential receptors would be exposed to over the entire exposure period. In some cases (because the UCL was greater than the maximum concentration or there were less than five samples), the maximum concentration was used as the EPC. Use of the maximum concentration tends to overestimate potential risks because receptors are assumed to be exposed continuously to the maximum concentration for the entire exposure period.

Exposure Routes and Receptor Identification

The determination of various receptor groups and exposure routes of potential concern was based on current land use observed at the site and anticipated future land use. Therefore, the uncertainty associated with the selection of exposure routes and potential receptors is minimal because these uses are considered to be well defined.

Exposure Parameters

Each exposure factor (for RME and CTE scenarios) selected for use in the risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological parameters and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, in most cases, the USEPA guidelines (USEPA, 1991 and 1993a) for the RME receptor were used, which generally specify the use of the 95th percentile for most parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Generally, the uncertainty can be assessed quantitatively for many assumptions made in determining factors for calculating exposures and intakes. Many of these parameters were determined from statistical analyses on human population characteristics. Often, the database used to summarize a particular exposure parameter (i.e., body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty.

Many of the exposure parameters used to calculate exposures and risks in this report are selected from a distribution of possible values, including USEPA guidance (1991 and 1993a) and dermal guidance (USEPA, 2004). For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. This risk number is used in risk management decisions but does not indicate what a more average or typical exposure might be or what risk range might be expected for individuals in the exposed population.

To address these issues, USEPA (1992) suggested the use of the CTE receptor whose intake variables are often set at approximately the 50th percentile of the distribution. The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Some of the parameters presented in this risk assessment were estimated using professional judgment, although USEPA does provide limited guidance for the CTE evaluation (1993a).

7.6.3 <u>Uncertainty in the Toxicological Evaluation</u>

Uncertainties associated with the toxicity assessment (determination of RfDs and CSFs and use of available criteria) are presented in this section.

Derivation of Toxicity Criteria

Uncertainty in the toxicity assessment is associated with hazard assessment and dose-response evaluations for the COPCs. The hazard assessment deals with characterizing the nature and strength of the evidence of causation or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination using USEPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose related; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the COC is structurally similar to other chemicals for which the toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes the determination of a CSF for the carcinogenic assessment. Uncertainty is introduced from interspecies (animal-to-human) extrapolation, which in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are very similar in age and genotype, so intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity, including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95-percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a non-threshold assumption of carcinogenesis. Evidence suggests, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are non-carcinogenic. Therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

Use of Chronic Toxicity Values for Construction Workers

Under the guidelines established by the Superfund program, exposures to construction workers of 1 year or less are classified as subchronic exposures. Risks for non-carcinogenic effects associated with subchronic exposures should incorporate toxicity values for subchronic and not chronic effects; however, subchronic toxicity values are not as widely available as chronic values. Subchronic toxicity values used in this HHRA were obtained from USEPA's PPRTV internet site if available. Also ATSDR Minimal Risk Levels (MRLs) were used as subchronic toxicity values when PPRTV values were not available. Chronic toxicity values were used when subchronic toxicity values were not available. Using chronic toxicity criteria to evaluate subchronic exposures for construction workers tends to overestimate potential non-carcinogenic risks; however, this overestimation of non-carcinogenic risks does not affect the conclusions of this HHRA because non-carcinogenic risks for construction workers were within acceptable levels.

7.6.4 Uncertainty in the Risk Characterization

Uncertainty in risk characterization resulted from assumptions made regarding additivity of effects from exposure to multiple COPCs from various exposure routes. High uncertainty exists when summing non-cancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Even when compounds affect the same target organs, they may have different mechanisms of action or differ in their fate in the body, so additivity may not have been an appropriate assumption. However, the assumption of additivity was considered acceptable because in most cases it represented a conservative estimate of risk.

Risks to any individual may also have been overestimated by summing multiple assumed exposure pathway risks for any single receptor. Although every effort was made to develop reasonable scenarios, not all individual receptors may have been exposed via all pathways considered.

Also, the risk characterization did not consider antagonistic or synergistic effects. Little or no information was available to determine the potential for antagonism or synergism for the COPCs. Because chemical-specific interactions could not be predicted, the likelihood for risks to be over predicted or under predicted could not be defined, but the methodology used was based on current USEPA guidance.

7.7 SUMMARY AND CONCLUSIONS

This section summarizes the results of the baseline HHRA for SWMU 22, which was performed to characterize the potential risks to likely human receptors under current and potential future land uses. Potential receptors under current land use are industrial workers and construction workers. Potential receptors under future land use are industrial and construction workers, child and adult recreational users, adolescent trespassers, and hypothetical child and adult residents. Although future land use is likely to be the same as current land use, potential future recreational user and resident receptors were evaluated in the baseline HHRA primarily for decision-making purposes.

No COPCs were identified for direct contact to surface soil and subsurface soil. COPCs for direct contact to groundwater were RDX, arsenic, cadmium, hexavalent chromium, lead, and perchlorate. COPCs for direct contact to surface water were RDX, arsenic, and cadmium, and the COPC for direct contact to sediment was arsenic.

Quantitative estimates of non-carcinogenic and carcinogenic risks (HIs and ILCRs, respectively) were developed for potential human receptors. Cumulative HIs under the RME scenario for all receptors with the exception of hypothetical child residents were less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure conditions. HIs on a target-organ basis for all receptors under the RME and CTE scenarios were less than unity (1).

ILCRs for all receptors exposed to groundwater, surface water, and sediment under the RME scenario were less than or within USEPA's and IDEM's target risk range, with the exception of the hypothetical lifelong resident. The cumulative ILCRs for hypothetical lifelong residents were equal to the upper bound of USEPA's and IDEM's target risk range.

ILCRs for all receptors exposed to groundwater, surface water, and sediment under the CTE scenario were less than or within USEPA's and IDEM's target risk range of 10^{-4} to 10^{-6}, with the exception of hypothetical child and lifelong residents. The cumulative ILCRs for hypothetical child residents and lifelong residents were equal to the upper bound of USEPA's and IDEM's target risk range.

Lead was identified as a COPC in groundwater at SWMU 22. Hypothetical residential exposures to lead in groundwater were evaluated using USEPA's IEUBK lead model. Results of the analysis do not exceed the USEPA goal regarding lead exposures (i.e., no more than 5 percent of children [or fetuses of exposed woman] having blood-lead levels exceeding a 10 µg/L blood-lead level).

RDX in subsurface soil was the only chemical identified as exceeding the screening levels for migration from soil to groundwater. RDX is not considered to be a COC for migration from soil to groundwater even though RDX was detected in groundwater because risks from exposures to RDX in groundwater were within acceptable levels.

TABLE 7-1

SCREENING CRITERIA USED IN SELECTION OF COPCS - SOIL
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CAS No.	Chemical	USEPA Regional Screening Levels[1]		Indiana Department of Environmental Management[2]	
		Adjusted Direct Contact Residential	Protection of Groundwater	Residential	Migration to Groundwater
Explosives (mg/kg)					
121-82-4	RDX	5.6 C	0.0046	78 C	0.046 C
Metals (mg/kg)					
7440-38-2	Arsenic	0.39 C	0.026	5.5 C	5.9 M
7440-39-3	Barium	1,500 N	2,400	21,000 N	1,700 M
7440-43-9	Cadmium	7 N	10.4	98 N	7.5 M
7440-47-3	Chromium	12,000 N(3)	56,000,000 (3)	100,000 L(3)	1,000,000 R(3)
7439-92-1	Lead	400	280 (4)	400	270 M
7439-97-6	Mercury	2.3 N(5)	0.66	32 N(5)	2.1 M
7782-49-2	Selenium	39 N	8	550 N	5.3 M
7440-22-4	Silver	39 N	12	550 N	12 N
Miscellaneous Parameters (mg/kg)					
18540-29-9	Hexavalent Chromium	0.29 C	0.012	4.1 C	0.12 C
14797-73-0	Perchlorate	5.5 N	NA	77 N	NA

Notes:

1 - USEPA Regional Screening Level (RSL), November 2012 (USEPA, 2012a). Carcinogenic values represent an incremental cancer risk of 1x10-6. The noncarcinogenic values are the RSL divided by 10 to correspond to a Target Hazard Quotient of 0.1. Protection of groundwater values are risk-based SSLs and have been multiplied by 20 to represent a dilution attenuation factor of 20.
2 - IDEM Closure Guide, March 1, 2013 (IDEM, 2013).
3 - Value is for trivalent chromium.
4 - Value is MCL based soil screening level.
5 - Value is for mercuric chloride (and other mercury salts).

C = Carcinogenic.
CAS = Chemical Abstract Service.
IDEM = Indiana Department of Environmental Management.
L = Capped at 100,000.
M = Maximum contaminant level.
mg/kg = Milligram per kilogram.
N = Noncarcinogenic.
R = Capped at 1,000,000.
USEPA = United States Environmental Protection Agency.

TABLE 7-2

SCREENING CRITERIA USED IN SELECTION OF COPCS - GROUNDWATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CAS No.	Parameter	Adjusted USEPA Regional Screening Level[1] Tap Water		USEPA Maximum Contaminant Level[2]	IDEM[3] Tap Water	
Explosives (ug/L)						
118-96-7	2,4,6-Trinitrotoluene	0.76	N[4]	NA	7.6	N
19406-51-0	4-Amino-2,6-Dinitrotoluene	3	N	NA	30	N
2691-41-0	HMX	78	N	NA	780	N
121-82-4	RDX	0.61	C	NA	6.1	C
Metals (ug/L)						
7440-38-2	Arsenic	0.045	C	10	10	M
7440-39-3	Barium	290	N	2,000	2,000	M
7440-43-9	Cadmium	0.69	N	5	5	M
7440-47-3	Chromium	1,600	N[5]	100 [6]	16,000	N[5]
7439-92-1	Lead	15		15 [7]	15	M
7782-49-2	Selenium	7.8	N	50	50	M
Miscellaneous Parameters (ug/L)						
14797-73-0	Perchlorate (ug/L)	1.1	N	15	15	M

1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. [Cancer benchmark value = 1E-06, Hazard index (HI) = 0.1] (USEPA, 2012a).
2 - 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, 2012b).
3 - IDEM Closure Guide, March 1, 2013 (IDEM, 21013).
4 - Ten percent of the noncarcinogenic value is less than the carcinogenic value, therefore the noncarcinogenic value is presented.
5 - Values are for trivalent chromium.
6 - Value is for total chromium.
7 - The MCL for this parameter is actually a treatment technique. The SDWA action level (at the tap) has been presented.
C = Carcinogenic.
CAS = Chemical Abstract Service.
M = Maximum Contaminant Level.
N = Noncarcinogenic.
NA = Not available.
SDWA = Safe Water Drinking Act.
ug/L = Microgram per liter.
USEPA = United States Environmental Protection Agency.

TABLE 7-3

SCREENING CRITERIA USED IN SELECTION OF COPCS - SURFACE WATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CAS No.	Parameter	Adjusted USEPA Regional Screening Level[(1)] Tap Water	USEPA Maximum Contaminant Level[(2)]	IDEM Groundwater Residential[(3)]
Explosives (ug/L)				
2691-41-0	HMX	78 N	NA	780 N
121-82-4	RDX	0.61 C	NA	6.1 C
Metals (ug/L)				
7440-38-2	Arsenic	0.045 C	10	10 M
7440-39-3	Barium	290 N	2,000	2,000 M
7440-43-9	Cadmium	0.69 N	5	5 M
7440-47-3	Chromium	1,600 N[(5)]	100 [(6)]	16,000 N[(5)]
7439-92-1	Lead	15	15 [(5)]	15 M
7439-97-6	Mercury	0.43 N[(7)]	2	2 M
7782-49-2	Selenium	7.8 N	50	50 M
7440-22-4	Silver	7.1 N	NA	71 N
Miscellaneous Parameters (ug/L)				
14797-73-0	Perchlorate	1.1 N	15	15 M

1 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites,
November, 2012. [Cancer benchmark value = 1E-06, Hazard index (HI) = 0.1] (USEPA, 2012a).
2 - 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, 2012n).
3 - IDEM Closure Guide, March 1, 2013 (IDEM, 2013).
4 - Values are for trivalent chromium.
5 - The MCL for this parameter is actually a treatment technique. The SDWA action level (at the tap) has
6 - Value is for total chromium.
7 - Value is for mercuric chloride (and other mercury salts).

C = Carcinogenic.
CAS = Chemical Abstract Service.
M = Maximum Contaminant Level.
N = Noncarcinogenic.
SDWA = Safe Water Drinking Act.
ug/L = Microgram per liter.
USEPA = United States Environmental Protection Agency.

TABLE 7-4

SCREENING CRITERIA USED IN SELECTION OF COPCS - SEDIMENT
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CAS No,	Chemical	Adjusted USEPA RSL Direct Contact Residential(1)	IDEM Soil Direct(2)
Metals (mg/kg)			
7440-38-2	Arsenic	0.39 C	5.5 C
7440-39-3	Barium	1,500 N	21,000 N
7440-43-9	Cadmium	7 N	98 N
7440-47-3	Chromium	12,000 N(4)	100,000 L(4)
7439-92-1	Lead	400	400
7439-97-6	Mercury	2.3 N(5)	32 N(5)
7782-49-2	Selenium	39 N	550 N
7440-22-4	Silver	39 N	550 N

Notes:

1 - USEPA Regional Screening Level (RSL), November 2012. Carcinogenic values represent an incremental cancer risk of $1x10^{-6}$. The noncarcinogenic values are the RSL divided by 10 to correspond to a Target Hazard Quotient of 0.1 (USEPA, 2012a).
2 - IDEM Closure Guide, March 1, 2013 (IDEM, 2013).
3 - Ten percent of the noncarcinogenic value is less than the carcinogenic value, therefore the noncarcinogenic value is presented.
4 - Value is for trivalent chromium.
5 - Value is for mercuric chloride (and other mercury salts).

C - Carcinogenic.
CAS = Chemical Abstract Service.
IDEM = Indiana Department of Environmental Management.
L = Capped at 100,000.
mg/kg = Milligram per kilogram.
N - Noncarcinogenic.
USEPA = United States Environmental Protection Agency.

TABLE 7-5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(1)	Concentration Used for Screening(2)	Background 95% Upper Tolerance Limit(3)	Adjusted USEPA RSL Residential Soil(4)	IDEM Residential Soil(5)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
Explosives													
121-82-4	RDX	0.37 J	0.37 J	mg/kg	22SS0250002	1/29	0.16 - 0.2	0.37	NA	5.6 C	78 C	No	BSL
Metals													
7440-38-2	Arsenic	2.4 J	9.8 J	mg/kg	22SS0250002	23/23	-	9.8	11.83	**0.39 C**	**5.5 C**	No	BKG
7440-39-3	Barium	12.8 J	144 J	mg/kg	22SB0140002	23/23	-	144	211	1,500 N	21,000 N	No	BSL, BKG
7440-43-9	Cadmium	0.057 J	0.78	mg/kg	22SS0250002	23/23	-	0.78	6.05	7 N	98 N	No	BSL, BKG
7440-47-3	Chromium	3.4 J	25.4 J	mg/kg	22SS0250002	24/24	-	25.4	28.7	12,000 N(7)	100,000 L(7)	No	BSL, BKG
7439-92-1	Lead	2.8 J	31.7 J	mg/kg	22SS0250002	23/23	-	31.7	**27**	400	400	No	BSL
7439-97-6	Mercury	0.02 J	0.6 J	mg/kg	22SS0250002	9/23	0.02 - 0.079	0.6	**0.077**	2.3 N(8)	32 N(8)	No	BSL
7782-49-2	Selenium	0.086 J	0.48 J	mg/kg	22SS0250002	23/23	-	0.48	0.81	39 N	550 N	No	BSL, BKG
7440-22-4	Silver	0.021 J	0.038 J	mg/kg	22SB0110002	5/23	0.04 - 0.04	0.038	0.13	39 N	550 N	No	BSL, BKG
Miscellaneous Compounds													
18540-29-9	Hexavalent Chromium	1.31	1.31	mg/kg	22SB0200002	1/1	-	1.31	(9)	**0.29 C**	4.1 C	No	BKG

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Final Basewide Background Soil Investigation Report (Tetra Tech, 2001).
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012 (USEPA, 2012a). The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
5 - IDEM Closure Guide, March 1, 2013 (IDEM., 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
7 - Value is for trivalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).
9 - Since concentrations of total chromium are within background levels it is assumed that concentrations of hexavalent chromium are also within background levels.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

Associated Samples

22SB0010002	22SB0140002	22SS0080002
22SB0020002	22SB0150002	22SS0220002
22SB0030002	22SB0160002	22SS0250002
22SB0040002	22SB0170002	
22SB0050002	22SB0180002	
22SB0060002	22SB0190002	
22SB0070002	22SB0200002	
22SB0080002	22SS0010002	
22SB0090002	22SS0020002	
22SB0100002	22SS0040002	
22SB0110002	22SS0050002	
22SB0120002	22SS0060002	
22SB0130002	22SS0070002	

TABLE 7-6

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background 95% Upper Tolerance Limit[3]	USEPA RSL Protection of Groundwater[4]	IDEM Migration to Groundwater[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
Explosives													
121-82-4	RDX	0.37 J	0.37 J	mg/kg	22SS0250002	1/29	0.16 - 0.2	0.37	NA	0.0046	0.046 C	Yes	ASL
Metals													
7440-38-2	Arsenic	2.4 J	9.8 J	mg/kg	22SS0250002	23/23	-	9.8	11.83	0.026	5.9 M	No	BKG
7440-39-3	Barium	12.8 J	144 J	mg/kg	22SB0140002	23/23	-	144	211	2400	1700 M	No	BSL, BKG
7440-43-9	Cadmium	0.057 J	0.78	mg/kg	22SS0250002	23/23	-	0.78	6.05	10.4	7.5 M	No	BSL, BKG
7440-47-3	Chromium	3.4 J	25.4 J	mg/kg	22SS0250002	24/24	-	25.4	28.7	56,000,000 [7]	1,000,000 R[7]	No	BSL, BKG
7439-92-1	Lead	2.8 J	31.7 J	mg/kg	22SS0250002	23/23	-	31.7	27	280 [8]	270 M	No	BSL
7439-97-6	Mercury	0.02 J	0.6 J	mg/kg	22SS0250002	9/23	0.02 - 0.079	0.6	0.077	0.66	2.1 M	No	BSL
7782-49-2	Selenium	0.086 J	0.48 J	mg/kg	22SS0250002	23/23	-	0.48	0.81	8	5.3 M	No	BSL, BKG
7440-22-4	Silver	0.021 J	0.038 J	mg/kg	22SB0110002	5/23	0.04 - 0.04	0.038	0.13	12	12 N	No	BSL, BKG
Miscellaneous Compounds													
18540-29-9	Hexavalent Chromium	1.31	1.31	mg/kg	22SB0200002	1/1	-	1.31	(9)	0.012 [7]	0.12 C[7]	No	BKG

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - To determine whether chemical concentrations were within background levels, a statistical analysis was conducted using the site and background datasets.
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012 (USEPA, 2013b). Values are based on a dilution attenuation factor of 20.
5 - IDEM Closure Guide, March 1, 2013 (IDEM, 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
7 - Value is for hexavalent chromium.
8 - Value is MCL based soil screening level.
9 - Since concentrations of total chromium are within background levels it is assumed that concentrations of hexavalent chromium are also within background levels.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples

22SB0010002
22SB0020002
22SB0030002
22SB0040002
22SB0050002
22SB0060002
22SB0070002
22SB0080002
22SB0090002
22SB0100002
22SB0110002
22SB0120002
22SB0130002
22SB0140002
22SB0150002
22SB0160002
22SB0170002
22SB0180002
22SB0190002
22SB0200002
22SS0010002
22SS0020002
22SS0040002
22SS0050002
22SS0060002
22SS0070002
22SS0080002
22SS0220002
22SS0250002

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
M = Maximum Contaminant Level
N = Noncarcinogen
NA = Not Applicable/Not Available
R = Capped at 1,000,000

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 7-7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background 95% Upper Tolerance Limit[3]	Adjusted USEPA RSL Residential Soil[4]	IDEM Residential Soil[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
Metals													
7440-38-2	Arsenic	1.1 J	6.1 J	mg/kg	22SB0110304	14/14	-	6.1	12.5	**0.39 C**	**5.5 C**	No	BKG
7440-39-3	Barium	2.3 J	72.6	mg/kg	22SB0180406	14/14	-	72.6	115	1500 N	21000 N	No	BSL, BKG
7440-43-9	Cadmium	0.086 J	0.25 J	mg/kg	22SB0160305	14/14	-	0.25	0.8	7 N	98 N	No	BSL, BKG
7440-47-3	Chromium	5.3	17.7 J	mg/kg	22SB0160305	14/14	-	17.7	33	12,000 N[7]	100,000 L[7]	No	BSL, BKG
7439-92-1	Lead	2.8 J	10.9	mg/kg	22SB0170305	14/14	-	10.9	19.6	400	400	No	BSL, BKG
7439-97-6	Mercury	0.021 J	0.033 J	mg/kg	22SB0170305	3/14	0.025 - 0.086	0.033	0.18	2.3 N[8]	32 N[8]	No	BSL, BKG
7782-49-2	Selenium	0.06 J	0.46 J	mg/kg	22SB0160305	14/14	-	0.46	1.07	39 N	550 N	No	BSL, BKG
7440-22-4	Silver	0.022 J	0.023 J	mg/kg	22SB0110304	2/14	0.04 - 0.04	0.023	0.14	39 N	550 N	No	BSL, BKG

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Final Basewide Background Soil Investigation Report (Tetra Tech, 2001).
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012 (USEPA, 2012a). The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
5 - IDEM Closure Guide, March 1, 2013 (IDEM, 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
7 - Value is for trivalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
22SB0010305
22SB0020607
22SB0030305
22SB0040305
22SB0060304
22SB0070304
22SB0090305
22SB0100305
22SB0110304
22SB0140203
22SB0160305
22SB0160608
22SB0170305
22SB0180406
22SB0200203

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 7-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SUBSURFACE SOIL TO GROUNDWATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background 95% Upper Tolerance Limit[3]	USEPA RSL Protection of Groundwater[4]	IDEM Migration to Groundwater[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
Metals													
7440-38-2	Arsenic	1.1 J	6.1 J	mg/kg	22SB0110304	14/14	-	6.1	12.5	**0.026**	**5.9 M**	No	BKG
7440-39-3	Barium	2.3 J	72.6	mg/kg	22SB0180406	14/14	-	72.6	115	2400	1700 M	No	BSL, BKG
7440-43-9	Cadmium	0.086 J	0.25 J	mg/kg	22SB0160305	14/14	-	0.25	0.8	10.4	7.5 M	No	BSL, BKG
7440-47-3	Chromium	5.3	17.7 J	mg/kg	22SB0160305	14/14	-	17.7	33	56,000,000 (7)	1,000,000 R(7)	No	BSL, BKG
7439-92-1	Lead	2.8 J	10.9	mg/kg	22SB0170305	14/14	-	10.9	19.6	280 (8)	270 M	No	BSL, BKG
7439-97-6	Mercury	0.021 J	0.033 J	mg/kg	22SB0170305	3/14	0.025 - 0.086	0.033	0.18	0.66	2.1 M	No	BSL, BKG
7782-49-2	Selenium	0.06 J	0.46 J	mg/kg	22SB0160305	14/14	-	0.46	1.07	8	5.3 M	No	BSL, BKG
7440-22-4	Silver	0.022 J	0.023 J	mg/kg	22SB0110304	2/14	0.04 - 0.04	0.023	0.14	12	12 N	No	BSL, BKG

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Final Basewide Background Soil Investigation Report (Tetra Tech, 2001).
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012 (USEPA, 2012a). Values are based on a dilution attenuation factor of 20.
5 - IDEM Closure Guide, March 1, 2013 (IDEM, 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
7 - Value is for trivalent chromium.
8 - Value is MCL based soil screening level.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
22SB0010305
22SB0020607
22SB0030305
22SB0040305
22SB0060304
22SB0070304
22SB0090305
22SB0100305
22SB0110304
22SB0140203
22SB0160305
22SB0160608
22SB0170305
22SB0180406
22SB0200203

Definitions:
COPC = Chemical Of Potential Concern
J = Estimated value
M = Maximum Contaminant Level
N = Noncarcinogen
NA = Not Applicable/Not Available
R = Capped at 1,000,000

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 7-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH GROUNDWATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(1)	Concentration Used for Screening(2)	Range of Background Concentrations(3)	Adjusted USEPA RSL Tapwater(4)	USEPA MCL(5)	IDEM Groundwater Residential(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
Explosives														
118-96-7	2,4,6-Trinitrotoluene	0.47 J	0.47 J	ug/L	22GWT002	1/4	0.266 - 0.266	0.47	ND	0.76 N(8)	NA	7.6 N	No	BSL
19406-51-0	4-Amino-2,6-Dinitrotoluene	0.11 J	0.11 J	ug/L	22GWT002	1/4	0.2 - 0.2	0.11	ND	3 N	NA	30 N	No	BSL
2691-41-0	HMX	1.1 J	1.1 J	ug/L	22GWT002	1/4	0.23 - 0.23	1.1	ND	78 N	NA	780 N	No	BSL
121-82-4	RDX	0.19 J	15 J	ug/L	22GWT002	3/4	0.246 - 0.246	15	0.32	0.61 C	NA	6.1 C	Yes	ASL
Metals (Total)														
7440-38-2	Arsenic	1.9	5.5	ug/L	22GWT003	4/4	-	5.5	1.4 - 11	0.045 C	10	10 M	Yes	ASL
7440-39-3	Barium	16.4	86.6 J	ug/L	22GWT005	4/4	-	86.6	34.2 - 82	290 N	2,000	2,000 M	No	BSL
7440-43-9	Cadmium	0.59	4.7	ug/L	22GWT003	4/4	-	4.7	0.9 - 7.1	0.69 N	5	5 M	Yes	ASL
7440-47-3	Chromium	5	90.8 J	ug/L	22GWT005_20130123	6/6	-	90.8	4 - 19.3	1,600 N(9)	100 (10)	16,000 N(9)	No	BSL
18540-29-9	Hexavalent Chromium	0.046	0.046	ug/L	22GWT005	1/1	-	0.046	NA	0.031 C	100 (10)	0.31 C	Yes	ASL
7439-92-1	Lead	7.5	21.4	ug/L	22GWT003	4/4	-	21.4	3.2 - 49.7	15	15 (11)	15 M	Yes	ASL
7782-49-2	Selenium	0.41 J	5.3	ug/L	22GWT002	4/4	-	5.3	0.45 - 8.1	7.8 N	50	50 M	No	BSL
Metals (Dissolved)														
7440-38-2	Arsenic	0.45	3.2	ug/L	22GWT002	3/3	-	3.2	0.44 - 3.3	0.045 C	10	10 M	Yes	ASL
7440-39-3	Barium	25.2	55.6	ug/L	22GWT005	3/3	-	55.6	23.6 - 28.5	290 N	2,000	2,000 M	No	BSL
7440-43-9	Cadmium	0.45	2.9	ug/L	22GWT002	3/3	-	2.9	0.99 - 3.9	0.69 N	5	5 M	Yes	ASL
7440-47-3	Chromium	1.2	3	ug/L	22GWT002	3/5	1.5 - 1.5	3	0.59 - 1.3	1,600 N(9)	100 (10)	16,000 N(9)	No	BSL
18540-29-9	Hexavalent Chromium	0.034	0.034	ug/L	22GWT005	1/1	-	0.034	NA	0.031 C	100 (10)	0.31 C	Yes	ASL
7439-92-1	Lead	4.2 J	10.6 J	ug/L	22GWT002	3/3	-	10.6	0.72 - 7	15	15 (11)	15 M	No	BSL
7782-49-2	Selenium	0.24 J	3.5	ug/L	22GWT002	3/3	-	3.5	0.56 - 5.7	7.8 N	50	50 M	No	BSL
Miscellaneous Parameters														
14797-73-0	Perchlorate	5.9 J	5.9 J	ug/L	22GWT002	1/4	0.4 - 0.4	5.9	0.25 - 0.44	1.1 N	15	15 M	Yes	ASL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Concentrations in upgradient monitor wells 22MWT01 and 22MWT06. Data is presented for information purposes only.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012 (USEPA, 2012a). RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
5 - 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, 2012b).
6 - IDEM Closure Guide, March 1, 2013 (IDEM., 2013).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - Ten percent of the noncarcinogenic value is less than the carcinogenic value, therefore the noncarcinogenic value is presented.
9 - Values are for trivalent chromium.
10 - Value is for total chromium.
11 - The MCL for this parameter is actually a treatment technique. The SDWA action level (at the tap) has been presented.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
22GWT002
22GWT003
22GWT004
22GWT005
22GWT005_20130123

Definitions:
C = Carcinogen
CAS = Chemical Abstracts Service
COPC = Chemical Of Potential Concern
M = Maximum Contaminant Level
J = Estimated value
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level.

For elimination as a COPC:
BSL = Below COPC Screening Level

TABLE 7-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Range of Background Concentrations[3]	Adjusted USEPA RSL Tapwater[4]	USEPA MCL[5]	IDEM Groundwater Residential[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
Explosives														
2691-41-0	HMX	0.15 J	0.87	ug/L	22SW003	7/15	0.23 - 0.48	0.87	0.88 - 11	78 N	NA	780 N	No	BSL
121-82-4	**RDX**	0.39 J	2.5	ug/L	22SW017	7/15	0.246 - 0.48	2.5	**0.79 - 0.98**	**0.61 C**	NA	6.1 C	**Yes**	ASL
Metals (Total)														
7440-38-2	**Arsenic**	0.18 J	1.5	ug/L	22SW004	8/12	0.18 - 0.18	1.5	**0.41**	**0.045 C**	10	10 M	**Yes**	ASL
7440-39-3	Barium	26.4	74.8	ug/L	22SW003	12/12	-	74.8	76.5	290 N	2,000	2,000 M	No	BSL
7440-43-9	**Cadmium**	0.23 J	1.7 J	ug/L	22SW024	6/12	0.04 - 0.083	1.7	**ND**	**0.69 N**	5	5 M	**Yes**	ASL
7440-47-3	Chromium	0.4 J	3	ug/L	22SW004	11/11	-	3	**0.45 J**	1,600 N[8]	100	16,000 N[8]	No	BSL
7439-92-1	Lead	0.86 J	9.6	ug/L	22SW006	7/11	0.22 - 0.22	9.6	**ND**	15	15 [9]	15 M	No	BSL
7439-97-6	Mercury	0.065 J	0.1 J	ug/L	22SW017_20120511	5/12	0.12 - 0.12	0.1	**ND**	0.43 N[10]	2	2 M	No	BSL
7782-49-2	Selenium	0.1 J	0.56 J	ug/L	22SW024	5/12	0.2 - 0.2	0.56	**0.24 J**	7.8 N	50	50 M	No	BSL
7440-22-4	Silver	0.032 J	0.032 J	ug/L	22SW009	1/12	0.06 - 0.19	0.032	**ND**	7.1 N	NA	71 N	No	BSL
Metals (Dissolved)														
7440-38-2	**Arsenic**	0.19 J	0.35	ug/L	22SW018	5/9	0.18 - 0.18	0.35	0.44 J	**0.045 C**	10	10 M	**Yes**	ASL
7440-39-3	Barium	26	73.9	ug/L	22SW003	9/9	-	73.9	77.4 J	290 N	2000	2000 M	No	BSL
7440-43-9	Cadmium	0.066 J	0.26 J	ug/L	22SW007	3/9	0.04 - 0.043	0.26	**ND**	0.69 N	5	5 M	No	BSL
7440-47-3	Chromium	0.27 J	0.75	ug/L	22SW004	8/8	-	0.75	**0.46 J**	1,600 N[8]	100	16,000 N[8]	No	BSL
7439-92-1	Lead	0.11 J	0.69 J	ug/L	22SW007	3/8	0.22 - 0.22	0.69	0.12 J	15	15 [9]	15 M	No	BSL
7439-97-6	Mercury	0.067 J	0.068 J	ug/L	22SW004	2/9	0.12 - 0.12	0.068	0.084 J	0.43 N[10]	2	2 M	No	BSL
7440-22-4	Silver	0.057 J	0.067 J	ug/L	22SW006	2/9	0.06 - 0.06	0.067	**ND**	7.1 N	NA	71 N	No	BSL
Miscellaneous Parameters														
14797-73-0	Perchlorate	0.4 J	0.4 J	ug/L	22SW002	1/8	0.4 - 0.4	0.4	**ND**	1.1 N	15	15 M	No	BSL

Footnotes:

1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Surface water samples 22SW011, 22SW012, 22SW013, 22SW014, 22SW015, and 22SW016. Only sample 22SW011 was analyzed for metals, therefore a background comparison could not be performed. Concentrations are presented for information purposes only.
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012 (USEPA, 2012a). The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
5 - 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, 2012b).
6 - IDEM Closure Guide, March 1, 2013 (IDEM, 2013).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - Values are for trivalent chromium.
9 - The MCL for this parameter is actually a treatment technique. The SDWA action level (at the tap) has been presented.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples

22SW001 22SW017_20120511
22SW002 22SW018
22SW003 22SW019
22SW004 22SW020
22SW006 22SW021
22SW007 22SW023
22SW009 22SW024
22SW010 22SW010_20120512
22SW017

Definitions:

C = Carcinogen
CAS = Chemical Abstracts Service
COPC = Chemical Of Potential Concern
J = Estimated value
M = Maximum Contaminant Level
N = Noncarcinogen
NA = Not Applicable/Not Available
ND = Not Detected

Rationale Codes:

For selection as a COPC:
ASL = Above Screening Level/ARAR/TBC

For elimination as a COPC:
BSL = Below COPC Screening Level

TABLE 7-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Range of Background Concentrations[3]	Adjusted USEPA RSL Residential Soil[4]	IDEM Residential Soil[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
Metals													
7440-38-2	**Arsenic**	1.2 J	14.7	mg/kg	22SD0230006	17/17	-	14.7	**5.5**	**0.39 C**	**5.5 C**	**Yes**	ASL
7440-39-3	Barium	8.6 J	173 J	mg/kg	22SD0030006	17/17	-	173	**42.1**	1500 N	21000 N	No	BSL
7440-43-9	Cadmium	0.071 J	0.88 J	mg/kg	22SD0060006	17/17	-	0.88	**0.28**	7 N	98 N	No	BSL
7440-47-3	Chromium	2.5 J	16.2 J	mg/kg	22SD0030006	17/17	-	13.9	**10**	12,000 N[7]	100,000 L[7]	No	BSL
7439-92-1	Lead	4 J	20 J	mg/kg	22SD0080624	17/17	-	20	**11.3**	400	400	No	BSL
7439-97-6	Mercury	0.038 J	0.26	mg/kg	22SD0090006	4/17	0.03 - 0.056	0.26	**0.086 J**	2.3 N[8]	32 N[8]	No	BSL
7782-49-2	Selenium	0.044 J	0.61	mg/kg	22SD0230006	17/17	-	0.61	**0.42**	39 N	550 N	No	BSL
7440-22-4	Silver	0.02 J	0.025 J	mg/kg	22SD0010006	3/17	0.04 - 0.04	0.025	**ND**	39 N	550 N	No	BSL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Sediment sample 22SD0170006. There is only one upgradient sediment sample, therefore a background comparison could not be performed. Concentrations are presented for information purposes only.
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012 (USEPA, 2012a). The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
5 - IDEM Closure Guide, March 1, 2013 (IDEM, 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
7 - Value is for trivalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
22SD0010006
22SD0020006
22SD0030006
22SD0040006
22SD0050006
22SD0060006
22SD0060624
22SD0070006
22SD0070624
22SD0080006
22SD0080624
22SD0090006
22SD0100006
22SD0100006_20120512
22SD0110006
22SD0180006
22SD0180006_20120512
22SD0230006
22SD0240006

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000
N = Noncarcinogen
NA = Not Applicable/Not Available
ND = Not Detected

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level

For elimination as a COPC:
BSL = Below COPC Screening Level

TABLE 7-12

CHEMICALS RETAINED AS CHEMICALS OF POTENTIAL CONCERN (COPCs)
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical	Surface Soil		Subsurface Soil		Groundwater	Surface Water	Sediment
	Direct Contact	Soil to Groundwater	Direct Contact	Soil to Groundwater			
Explosives							
RDX		E, I			E, I	E	
Metals							
Arsenic					E, I	E	E, I
Cadmium					E, I	E	
Hexavalent Chromium					E		
Lead					E, I		
Miscellaneous Parameters							
Perchlorate					E		

Notes
E - Chemical exceeded USEPA screening criteria and was retained as a COPC.
I - Chemical exceeded IDEM screening criteria and was retained as a COPC.

TABLE 7-13

SELECTION OF EXPOSURE PATHWAYS
SWMU 22 – LEAD AZIDE POND
NSA CRANE, CRANE INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil	Surface Soil	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None None	No COPCs were identified for surface soil.
				Industrial Worker	Adult	Ingestion Dermal	None None	No COPCs were identified for surface soil.
				Trespassers	Adolescent	Ingestion Dermal	None None	No COPCs were identified for surface soil.
		Air	SWMU 22	Construction Workers	Adult	Inhalation	None	No COPCs were identified for surface soil.
				Industrial Worker	Adult	Inhalation	None	No COPCs were identified for surface soil.
				Trespassers	Adolescent	Inhalation	None	No COPCs were identified for surface soil.
	Subsurface Soil	Subsurface Soil	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
				Industrial Worker	Adult	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
				Trespassers	Adolescent	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
		Air	SWMU 22	Construction Workers	Adult	Inhalation	None	No COPCs were identified for subsurface soil.
				Industrial Worker	Adult	Inhalation	None	No COPCs were identified for subsurface soil.
				Trespassers	Adolescent	Inhalation	None	No COPCs were identified for subsurface soil.
	Groundwater	Groundwater	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None Quant	Construction workers may have contact with groundwater during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	None None	Industrial workers are not exposed to groundwater.
				Trespassers	Adolescent	Ingestion Dermal	None None	Current trespassers are not exposed to groundwater.
		Air	SWMU 22	Construction Workers	Adult	Inhalation	None	No volatile COPCs were identified in groundwater.
				Industrial Worker	Adult	Inhalation	None	Industrial workers are not expected to be exposed to COPCs that have volatilized from groundwater.
				Trespassers	Adolescent	Inhalation	None	Current trespassers are not exposed to groundwater.
			Vapor Intrusion	Industrial Worker	Adult	Inhalation	None	No COPCs were identified for vapor intrusion.

TABLE 7-13

SELECTION OF EXPOSURE PATHWAYS
SWMU 22 – LEAD AZIDE POND
NSA CRANE, CRANE INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Water	Surface Water	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None None	Construction workers are not exposed to surface water.
				Industrial Worker	Adult	Ingestion Dermal	None None	Industrial workers are not exposed to surface water.
				Trespassers	Adolescent	Ingestion Dermal	Quant Quant	Trespassers may be exposed to surface water while at the site.
	Sediment	Sediment	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None None	Construction workers are not exposed to sediment.
				Industrial Worker	Adult	Ingestion Dermal	None None	Industrial workers are not exposed to sediment.
				Trespassers	Adolescent	Ingestion Dermal	Quant Quant	Current trespassers may be exposed to sediment while at the site.
Future	Surface Soil	Surface Soil	SWMU 22	Recreational Users	Child	Ingestion Dermal	None None	No COPCs were identified for surface soil.
					Adult	Ingestion Dermal	None None	
				Residents	Child	Ingestion Dermal	None None	No COPCs were identified for surface soil.
					Adult	Ingestion Dermal	None None	
		Air	SWMU 22	Recreational Users	Child	Inhalation	None	No COPCs were identified for surface soil.
					Adult	Inhalation	None	
				Residents	Child	Inhalation	None	No COPCs were identified for surface soil.
					Adult	Inhalation	None	
	Subsurface Soil	Subsurface Soil	SWMU 22	Recreational Users	Child	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
					Adult	Ingestion Dermal	None None	
				Residents	Child	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
					Adult	Ingestion Dermal	None None	

TABLE 7-13

SELECTION OF EXPOSURE PATHWAYS
SWMU 22 – LEAD AZIDE POND
NSA CRANE, CRANE INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Subsurface Soil	Air	SWMU 22	Recreational Users	Child	Inhalation	None	No COPCs were identified for subsurface soil.
					Adult	Inhalation	None	
				Residents	Child	Inhalation	None	No COPCs were identified for subsurface soil.
					Adult	Inhalation	None	
	Groundwater	Groundwater	SWMU 22	Recreational Users	Child	Ingestion Dermal	None None	Recreational users are not expected to be exposed to groundwater.
					Adult	Ingestion Dermal	None None	
				Residents	Child	Ingestion Dermal	Quant Quant	Although a future residential scenario is considered unlikely at the site this scenario is included to aid in future risk management decisions.
					Adult	Ingestion Dermal	Quant Quant	
		Air	SWMU 22	Recreational Users	Child	Inhalation	None	Recreational users are not expected to be exposed to groundwater.
					Adult	Inhalation	None	
				Residents	Child	Inhalation	None	No volatile COPCs were identified for groundwater.
					Adult	Inhalation	None	
			Vapor Intrusion	Residents	Child	Inhalation	None	No COPCs were identified for vapor intrusion.
					Adult	Inhalation	None	
	Surface Water	Surface Water	SWMU 22	Recreational Users	Child	Ingestion Dermal	Quant Quant	Recreational users may be exposed to surface water while at the site.
					Adult	Ingestion Dermal	Quant Quant	
				Residents	Child	Ingestion Dermal	Quant Quant	Although a future residential scenario is considered unlikely at the site this scenario is included to aid in future risk management decisions.
					Adult	Ingestion Dermal	Quant Quant	

TABLE 7-13

SELECTION OF EXPOSURE PATHWAYS
SWMU 22 – LEAD AZIDE POND
NSA CRANE, CRANE INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Sediment	Sediment	SWMU 22	Recreational Users	Child	Ingestion	Quant	Recreational users may be exposed to sediment while at the site.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	
				Residents	Child	Ingestion	Quant	Although a future residential scenario is considered unlikely at the site this scenario is included to aid in future risk management decisions.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	

Notes:
COPC - Chemical of potential concern.
Quant - Quantitative.

TABLE 7-14

RECEPTORS AND EXPOSURE ROUTES FOR QUANTITATIVE EVALUATION
SWMU 22 – LEAD AZIDE POND
NSA CRANE
CRANE INDIANA

Receptors	Exposure Routes
Construction Workers (current/future land use)	• Groundwater dermal contact (during excavation)
Adolescent Trespassers (6 to 17 years) (current/future land use)	• Surface water/sediment dermal contact • Surface water/sediment incidental ingestion
Small Child (0 to 6 years) and Adult Recreational Users (future land use)	• Surface water/sediment dermal contact • Surface water/sediment incidental ingestion
Residents (Adult/Children) (future land use)	• Ingestion of groundwater • Groundwater dermal contact (showering/bathing) • Surface water/sediment dermal contact • Surface water/sediment incidental ingestion

TABLE 7-15

EXPOSURE POINT CONCENTRATIONS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical	Groundwater (ug/L)	Surface Water (ug/L)	Sediment (mg/kg)
Explosives			
RDX	15	0.85	NA
Metals			
Arsenic	5.5	0.64	6.2
Cadmium	4.7	0.58	NA
Hexavalent Chromium	0.046	NA	NA
Lead	13.8	NA	NA
Perchlorate	5.9	NA	NA

Notes:
The exposure point concentrations (EPCs) for surface water and sediment were calculated using USEPA's ProUCL software Version 4.1.01 (USEPA, 2010a).
The maximum detected concentration was used as the EPC for groundwater.
See the RAGS Part D Table 3s in Appendix E for details concerning the EPCs.
NA - Not applicable. Not a COPC for this media.

TABLE 7-16

SUMMARY OF EXPOSURE INPUT PARAMETERS - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE INDIANA

Parameter Code	Exposure Parameter	Construction Worker	Adolescent Trespasser	Child Recreational User	Adult Recreational User	On-Site Child Resident	On-Site Adult Resident
All Exposures							
C_{soil}	Exposure concentration for soil (mg/kg)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)
ED	Exposure Duration (years)	1(2)	10(3)	6(4)	24(4)	6(4)	24(4)
BW	Body Weight (kg)	70(5)	43(5)	15(4)	70(4)	15(4)	70(4)
AT-N	Averaging Time (Non-Cancer) (days)	365(5)	3,650(5)	2,190(5)	8,760(5)	2,190(5)	8,760(5)
AT-C	Averaging Time (Cancer) (days)	25,550(5)	25,550(5)	25,550(5)	25,550(5)	25,550(5)	25,550(5)
Ingestion/Dermal Contact with Groundwater							
C_{gw}	Exposure concentration for groundwater (ug/L)	95% UCL(1)	NA	NA	NA	95% UCL(1)	95% UCL(1)
IR	Ingestion Rate (L/day)	NA	NA	NA	NA	1.5(6)	2(5)
EF	Exposure Frequency (days/year)	30(7)	NA	NA	NA	350(4)	350(4)
ET/t_{event}	Exposure Time (hours/day)/ Event Duration (hours/event)	4(7)	NA	NA	NA	1(8)	0.58(8)
EV	Event Frequency (events/day)	1(7)	NA	NA	NA	1(2)	1(2)
SA	Skin Surface Available for Contact (cm^2)	3,300(9)	NA	NA	NA	6,600(8)	18,000(8)
	Kp (cm/hour), t* (hour/event), t (hour), and B (unitless)	chemical-specific(8)	NA	NA	NA	chemical-specific(8)	chemical-specific(8)
Ingestion/Dermal Contact with Surface Water							
C_{sw}	Exposure concentration for surface water (ug/L)	NA	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)
CR	Contact Rate (L/hr)	NA	0.01(10)	0.01(10)	0.01(10)	0.01(10)	0.01(10)
EF	Exposure Frequency (days/year)	NA	26(11)	52(12)	52(12)	52(12)	52(12)
ET/t_{event}	Exposure Time (hours/day)/ Event Duration (hours/event)	NA	4(2)	4(2)	4(2)	4(2)	4(2)
EV	Event Frequency (events/day)	NA	1(2)	1(2)	1(2)	1(2)	1(2)
SA	Skin Surface Available for Contact (cm^2)	NA	3,280(13)	2,800(8)	5,700(8)	2,800(8)	5,700(8)
CF	Conversion Factor (L/m^3)	NA	0.001	0.001	0.001	0.001	0.001
	Kp (cm/hour), t* (hour/event), t (hour), and B (unitless)	NA	chemical-specific(8)	chemical-specific(8)	chemical-specific(8)	chemical-specific(8)	chemical-specific(8)
Incidental Ingestion/Dermal Contact with Sediment							
C_{sed}	Exposure concentration for sediment (mg/kg)	NA	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)
IR	Ingestion Rate (mg/day)	NA	100(4)	200(4)	100(4)	200(4)	100(4)
EF	Exposure Frequency (days/year)	NA	26(11)	52(12)	52(12)	52(12)	52(12)
FI	Fraction Ingested (unitless)	NA	1(5)	0.5(2)	0.5(2)	0.5(2)	0.5(2)
SA	Skin Surface Available for Contact (cm^2)	NA	3,280(13)	2,800(8)	5,700(8)	2,800(8)	5,700(8)

TABLE 7-16

SUMMARY OF EXPOSURE INPUT PARAMETERS - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE INDIANA

Parameter Code	Exposure Parameter	Construction Worker	Adolescent Trespasser	Child Recreational User	Adult Recreational User	On-Site Child Resident	On-Site Adult Resident
Incidental Ingestion/Dermal Contact with Sediment (Continued)							
AF	Soil to Skin Adherence Factor (mg/cm^2/event)	NA	0.2[(8)]	0.2[(8)]	0.07[(8)]	0.2[(8)]	0.07[(8)]
ABS	Absorption Factor (unitless)	NA	chemical-specific[(8)]	chemical-specific[(8)]	chemical-specific[(8)]	chemical-specific[(8)]	chemical-specific[(8)]
CF	Conversion Factor (kg/mg)	NA	1E-06	1E-06	1E-06	1E-06	1E-06

Notes:
1 - USEPA, 2002a. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.
2 - Professional judgment.
3 - Adolescents ages 7 to 16 years old.
4 - USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
5 - USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
6 - USEPA, 1997b: Exposure Factors Handbook. EPA/600/P-95/002F a-c.
7 - Professional judgment. Assumes construction workers are only exposed to groundwater water during part of the construction project.
8 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. PA/540/R/99/005.
9 - USEPA, 2002d: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9365.4-24.
10 - USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.
11 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.
12 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.
13 - Assume 25 percent of total body surface area is exposed, USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002F a-c.

TABLE 7-17

SUMMARY OF EXPOSURE INPUT PARAMETERS - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE INDIANA

Parameter Code	Exposure Parameter	Construction Worker	Adolescent Trespasser	Child Recreational User	Adult Recreational User	On-Site Child Resident	On-Site Adult Resident
All Exposures							
C_{soil}	Exposure concentration for soil (mg/kg)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)
ED	Exposure Duration (years)	1(2)	10(3)	2(4)	7(4)	2(4)	7(4)
BW	Body Weight (kg)	70(5)	43(4)	15(4)	70(4)	15(4)	70(4)
AT-N	Averaging Time (Non-Cancer) (days)	365(5)	3,650(5)	730(5)	2,555(5)	730(5)	2,555(5)
AT-C	Averaging Time (Cancer) (days)	25,550(5)	25,550(5)	25,550(5)	25,550(5)	25,550(5)	25,550(5)
Ingestion/Dermal Contact with Groundwater							
C_{gw}	Exposure concentration for groundwater (ug/L)	95% UCL(1)	NA	NA	NA	95% UCL(1)	95% UCL(1)
IR	Ingestion Rate (L/day)	NA	NA	NA	NA	1.5(6)	2(5)
EF	Exposure Frequency (days/year)	15(7)	NA	NA	NA	234(4)	234(4)
ET/t_{event}	Exposure Time (hours/day)/ Event Duration (hours/event)	4(7)	NA	NA	NA	0.33(8)	0.25(8)
EV	Event Frequency (events/day)	1(2)	NA	NA	NA	1(2)	1(2)
SA	Skin Surface Available for Contact (cm^2)	3,300(9)	NA	NA	NA	6,600(8)	18,000(8)
	Kp (cm/hour), t* (hour/event), τ (hour), and B (unitless)	chemical-specific(8)	NA	NA	NA	chemical-specific(8)	chemical-specific(8)
Ingestion/Dermal Contact with Surface Water							
C_{sw}	Exposure concentration for surface water (ug/L)	NA	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)
CR	Contact Rate (L/hr)	NA	0.01(10)	0.01(10)	0.01(10)	0.01(10)	0.01(10)
EF	Exposure Frequency (days/year)	NA	13(11)	26(12)	26(12)	26(12)	26(12)
ET/t_{event}	Exposure Time (hours/day)/ Event Duration (hours/event)	NA	2(7)	2(7)	2(7)	2(7)	2(7)
EV	Event Frequency (events/day)	NA	1(2)	1(2)	1(2)	1(2)	1(2)
SA	Skin Surface Available for Contact (cm^2)	NA	3,280(13)	2,800(8)	5,700(8)	2,800(8)	5,700(8)
CF	Conversion Factor (L/m^3)	NA	0.001	0.001	0.001	0.001	0.001
	Kp (cm/hour), t* (hour/event), τ (hour), and B (unitless)	NA	chemical-specific(8)	chemical-specific(8)	chemical-specific(8)	chemical-specific(8)	chemical-specific(8)
Incidental Ingestion/Dermal Contact with Sediment							
C_{sed}	Exposure concentration for sediment (mg/kg)	NA	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)	95% UCL(1)
IR	Ingestion Rate (mg/day)	NA	50(4)	100(4)	50(4)	100(4)	50(4)
EF	Exposure Frequency (days/year)	NA	13(11)	26(12)	26(12)	26(12)	26(12)

TABLE 7-17

SUMMARY OF EXPOSURE INPUT PARAMETERS - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE INDIANA

Parameter Code	Exposure Parameter	Construction Worker	Adolescent Trespasser	Child Recreational User	Adult Recreational User	On-Site Child Resident	On-Site Adult Resident
Incidental Ingestion/Dermal Contact with Sediment (Continued)							
FI	Fraction Ingested (unitless)	NA	1(5)	0.5(2)	0.5(2)	0.5(2)	0.5(2)
SA	Skin Surface Available for Contact (cm^2)	NA	3,280(13)	2,800(8)	5,700(8)	2,800(8)	5,700(8)
AF	Soil to Skin Adherence Factor (mg/cm^2/event)	NA	0.04(8)	0.04(8)	0.01(8)	0.04(8)	0.01(8)
ABS	Absorption Factor (unitless)	NA	chemical-specific(8)	chemical-specific(8)	chemical-specific(8)	chemical-specific(8)	chemical-specific(8)
CF	Conversion Factor (kg/mg)	NA	1E-06	1E-06	1E-06	1E-06	1E-06

Notes:
1 - USEPA, 2002a. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.
2 - Professional judgment.
3 - Adolescents ages 7 to 16 years old.
4 - USEPA, 1993a: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
5 - USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
6 - Assume that head, arms, hands, lower legs, and feet are exposed (USEPA, 1997).
7 - Central tendency exposure is assumed to be one-half the reasonable maximum exposure value.
8 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. PA/540/R/99/005.
9 - USEPA, 2002d: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9365.4-24.
10 - Assume 50 percent of total body surface area is exposed, USEPA, 2004.
11 - Assume 1 day a week in warm weather months for RME and every other week for CTE.
12 - Assume 2 days a week in warm weather months for RME and one day a week for CTE.
13 - Assume 25 percent of total body surface area is exposed, U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002F a-c.

TABLE 7-18

INTERMEDIATE VARIABLES FOR CALCULATING DA(EVENT)
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Media	Dermal Absorption Fraction (soil)	FA	Kp		t(event)		τ		t*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
Explosives												
RDX	Groundwater, Surface Water	0.015	1	3.4E-04	cm/hr	(1)	hr	1.8E+00	hr	4.4E+00	hr	1.9E-03
Metals												
Arsenic	Groundwater, Surface Water, Sediment	0.03	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Cadmium	Groundwater, Surface Water	0.001	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Hexavalent Chromium	Groundwater	0	1	2.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Lead	Groundwater	0	1	1.0E-04	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Miscellaneous Parameters												
Perchlorate	Groundwater	0	1	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA

Notes:
All values from EPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, July 2004.
1 - See Tables 7-16 and 7-17 for values for T(event).
FA = Fraction Absorbed Water
Kp = Dermal Permeability Coefficient of Compound in Water
t(event) = Event Duration
τ = Lag Time
t* = Time to Reach Steady-State
B = Dimensionless Ratio of the Permeability Coefficient of a Compound Through the Stratum Corneum Relative to its Permeability Coefficient Across the Viable Epidermis
NA = Not applicable.

TABLE 7-19

NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Explosives										
RDX	Subchronic	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	Central Nervous System	30/1	ATSDR	1/2012
	Chronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Prostate	100/1	IRIS	4/15/2013
Inorganics										
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, Cardiovascular System	3/1	IRIS	4/15/2013
Cadmium	Chronic	5.0E-04	mg/kg/day	0.05	2.5E-05	mg/kg/day	Kidney	10/1	IRIS	4/15/2013
Hexavalent Chromium	Subchronic	2.0E-02	mg/kg/day	0.025	5.0E-04	mg/kg/day	None Reported	100/3	HEAST	9/97
	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	None Reported	300/3	IRIS	4/15/2013
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Compounds										
Perchlorate	Chronic	7.0E-04	mg/kg/day	1	7.0E-04	mg/kg/day	Thyroid	10/1	IRIS	4/15/2013

Notes:

1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

Definitions:

ATSDR = Agency for Toxic Substances and Disease Registry

IRIS = Integrated Risk Information System

NA = Not Available.

PPRTV = Provisional Peer Reviewed Toxicity Value.

TABLE 7-20

NON-CANCER TOXICITY DATA -- INHALATION
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Explosives									
RDX	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics									
Arsenic	Chronic	1.5E-05	mg/m3	4.3E-06	(mg/kg/day)	Skin, Cardiovascular System	NA	Cal EPA	9/2009
Cadmium	Chronic	2.0E-05	mg/m3	5.7E-06	(mg/kg/day)	Kidney, Respiratory	NA	Cal EPA	9/2009
Hexavalent Chromium	Chronic	1.0E-04	mg/m3	2.9E-05	(mg/kg/day)	Respiratory	300/1	IRIS	4/15/2013
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Compounds									
Perchlorate	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - Extrapolated RfD = RfC *20m^3/day / 70 kg

Definitions:
Cal EPA = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.
NA = Not Applicable

TABLE 7-21

CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal(1)	Absorbed Cancer Slope Factor for Dermal(2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Explosives								
RDX	1.1E-01	$(mg/kg/day)^{-1}$	1	1.1E-01	$(mg/kg/day)^{-1}$	C (Possible human carcinogen)	IRIS	4/15/2013
Inorganics								
Arsenic	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A / human carcinogen	IRIS	4/15/2013
Cadmium	NA	NA	NA	NA	NA	B1 /Known/likely human carcinogen.	IRIS	4/15/2013
Hexavalent Chromium	5.0E-01	$(mg/kg/day)^{-1}$	0.025	2.0E+01	$(mg/kg/day)^{-1}$	Carcinogenic potential cannot be determined (Oral route)	NJDEP	4/8/2009
Lead	NA	NA	NA	NA	NA	B2 / Probable human carcinogen	IRIS	4/15/2013
Miscellaneous Compounds								
Perchlorate	NA	NA	NA	NA	NA	Not likely to be carcinogenic to humans	IRIS	4/15/2013

Notes:

1 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral absorption efficiency for dermal.

IRIS = Integrated Risk Information System.

NA = Not Available.

NJDEP = New Jersey Department of Environmental Protection.

TABLE 7-22

CANCER TOXICITY DATA -- INHALATION
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Explosives							
RDX	NA	NA	NA	NA	C (Possible human carcinogen)	IRIS	4/15/2013
Inorganics							
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	4/15/2013
Cadmium	1.8E-03	$(ug/m^3)^{-1}$	6.3E+00	$(mg/kg/day)^{-1}$	B1 /Known/likely human carcinogen.	IRIS	4/15/2013
Hexavalent Chromium	8.4E-02	$(ug/m^3)^{-1}$	2.9E+02	$(mg/kg/day)^{-1}$	Known/likely human carcinogen (Inhalation route)	IRIS	4/15/2013
Lead	NA	NA	NA	NA	B2 / Probable human carcinogen	IRIS	4/15/2013
Miscellaneous Compounds							
Perchlorate	NA	NA	NA	NA	Not likely to be carcinogenic to humans	IRIS	4/15/2013

Notes:
1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

Definitions:
IRIS = Integrated Risk Information System.
NA = Not Available.

TABLE 7-23

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Workers	Groundwater	Dermal Contact	2E-09	--	--	--	0.003	--
		Total	2E-09	--	--	--	0.003	--
Adolescent Trespassers	Surface Water	Incidental Ingestion	2E-08	--	--	--	0.0005	--
		Dermal Contact	6E-09	--	--	--	0.001	--
		Total	3E-08	--	--	--	0.002	--
	Sediment	Incidental Ingestion	1E-07	--	--	--	0.002	--
		Dermal Contact	4E-08	--	--	--	0.0007	--
		Total	2E-07	--	--	--	0.002	--
	Total Surface Water and Sediment		2E-07				0.004	
Child Recreational Users	Surface Water	Incidental Ingestion	3E-08	--	--	--	0.001	--
		Dermal Contact	9E-09	--	--	--	0.003	--
		Total	4E-08	--	--	--	0.004	--
	Sediment	Incidental Ingestion	8E-07	--	--	--	0.02	--
		Dermal Contact	1E-07	--	--	--	0.003	--
		Total	9E-07	--	--	--	0.02	--
	Total Surface Water and Sediment		9E-07				0.02	
Adult Recreational Users	Surface Water	Incidental Ingestion	3E-08	--	--	--	0.0003	--
		Dermal Contact	2E-08	--	--	--	0.001	--
		Total	5E-08	--	--	--	0.001	--
	Sediment	Incidental Ingestion	3E-07	--	--	--	0.002	--
		Dermal Contact	8E-08	--	--	--	0.0005	--
		Total	4E-07	--	--	--	0.003	--
	Total Surface Water and Sediment		5E-07				0.004	
Lifelong Recreational Users	Surface Water	Incidental Ingestion	6E-08	--	--	--	NA	--
		Dermal Contact	3E-08	--	--	--	NA	--
		Total	9E-08	--	--	--	NA	--
	Sediment	Incidental Ingestion	1E-06	--	--	--	NA	--
		Dermal Contact	2E-07	--	--	--	NA	--
		Total	1E-06	--	--	--	NA	--
	Total Surface Water and Sediment		1E-06					

TABLE 7-23

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Child Residents	Groundwater	Incidental Ingestion	5E-05	--	Arsenic	RDX	3	Target Organs HI ≤ 1
		Dermal Contact	7E-07	--	--	--	0.09	--
		Total	6E-05	--	Arsenic	RDX	3	Target Organs HI ≤ 1
	Surface Water	Incidental Ingestion	2E-08	--	--	--	0.0007	--
		Dermal Contact	5E-09	--	--	--	0.001	--
		Total	2E-08	--	--	--	0.002	--
	Sediment	Incidental Ingestion	4E-07	--	--	--	0.010	--
		Dermal Contact	6E-08	--	--	--	0.002	--
		Total	4E-07	--	--	--	0.01	--
	Total Groundwater, Surface Water, and Sediment		5E-05				3	
Adult Residents	Groundwater	Incidental Ingestion	9E-05	--	RDX, Arsenic	--	1	--
		Dermal Contact	7E-07	--	--	--	0.03	--
		Total	9E-05	--	RDX, Arsenic	--	1	--
	Surface Water	Incidental Ingestion	3E-08	--	--	--	0.0003	--
		Dermal Contact	2E-08	--	--	--	0.001	--
		Total	5E-08	--	--	--	0.001	--
	Sediment	Incidental Ingestion	3E-07	--	--	--	0.002	--
		Dermal Contact	8E-08	--	--	--	0.0005	--
		Total	4E-07	--	--	--	0.003	--
	Total Groundwater, Surface Water, and Sediment		9E-05				1	
Lifelong (Child and Adult)	Groundwater	Incidental Ingestion	1E-04	--	RDX, Arsenic	--	NA	--
		Dermal Contact	1E-06	--	--	--	NA	--
		Total	1E-04	--	RDX, Arsenic	--	NA	--
	Surface Water	Incidental Ingestion	5E-08	--	--	--	NA	--
		Dermal Contact	2E-08	--	--	--	NA	--
		Total	7E-08	--	--	--	NA	--
	Sediment	Incidental Ingestion	7E-07	--	--	--	NA	--
		Dermal Contact	1E-07	--	--	--	NA	--
		Total	8E-07	--	--	--	NA	--
	Total Groundwater, Surface Water, and Sediment		2E-04					

TABLE 7-24

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Workers	Groundwater	Dermal Contact	6E-10	--	--	--	0.0008	--
		Total	6E-10	--	--	--	0.0008	--
Adolescent Trespassers	Surface Water	Incidental Ingestion	5E-09	--	--	--	0.0001	--
		Dermal Contact	2E-09	--	--	--	0.0003	--
		Total	7E-09	--	--	--	0.0004	--
	Sediment	Incidental Ingestion	3E-08	--	--	--	0.0004	--
		Dermal Contact	8E-09	--	--	--	0.0001	--
		Total	4E-08	--	--	--	0.0005	--
	Total Surface Water and Sediment		5E-08				0.0009	
Child Recreational Users	Surface Water	Incidental Ingestion	3E-09	--	--	--	0.0003	--
		Dermal Contact	8E-10	--	--	--	0.0007	--
		Total	4E-09	--	--	--	0.001	--
	Sediment	Incidental Ingestion	6E-08	--	--	--	0.005	--
		Dermal Contact	4E-09	--	--	--	0.0003	--
		Total	7E-08	--	--	--	0.005	--
	Total Surface Water and Sediment		7E-08				0.006	
Adult Recreational Users	Surface Water	Incidental Ingestion	2E-09	--	--	--	0.00007	--
		Dermal Contact	1E-09	--	--	--	0.0003	--
		Total	3E-09	--	--	--	0.0004	--
	Sediment	Incidental Ingestion	2E-08	--	--	--	0.0005	--
		Dermal Contact	2E-09	--	--	--	0.00004	--
		Total	3E-08	--	--	--	0.0006	--
	Total Surface Water and Sediment		3E-08				0.001	
Lifelong Recreational Users	Surface Water	Incidental Ingestion	5E-09	--	--	--	NA	--
		Dermal Contact	2E-09	--	--	--	NA	--
		Total	7E-09	--	--	--	NA	--
	Sediment	Incidental Ingestion	9E-08	--	--	--	NA	--
		Dermal Contact	6E-09	--	--	--	NA	--
		Total	9E-08	--	--	--	NA	--
	Total Surface Water and Sediment		1E-07					

TABLE 7-24

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Child Residents	Groundwater	Incidental Ingestion	2E-05	--	Arsenic	RDX	1	--
		Dermal Contact	2E-07	--	--	--	0.02	--
		Total	2E-05	--	Arsenic	RDX	1	--
	Surface Water	Incidental Ingestion	1E-09	--	--	--	0.0002	--
		Dermal Contact	4E-10	--	--	--	0.0003	--
		Total	2E-09	--	--	--	0.0005	--
	Sediment	Incidental Ingestion	3E-08	--	--	--	0.002	--
		Dermal Contact	2E-09	--	--	--	0.0002	--
		Total	3E-08	--	--	--	0.003	--
	Total Groundwater, Surface Water, and Sediment		2E-05				1	
Adult Residents	Groundwater	Incidental Ingestion	1E-05	--	--	RDX, Arsenic	0.5	--
		Dermal Contact	9E-08	--	--	--	0.01	--
		Total	1E-05	--	--	RDX, Arsenic	0.5	--
	Surface Water	Incidental Ingestion	2E-09	--	--	--	0.00007	--
		Dermal Contact	1E-09	--	--	--	0.0003	--
		Total	3E-09	--	--	--	0.0004	--
	Sediment	Incidental Ingestion	2E-08	--	--	--	0.0005	--
		Dermal Contact	2E-09	--	--	--	0.00004	--
		Total	3E-08	--	--	--	0.0006	--
	Total Groundwater, Surface Water, and Sediment		1E-05				0.5	
Lifelong (Child and Adult)	Groundwater	Incidental Ingestion	4E-05	--	Arsenic	RDX	NA	--
		Dermal Contact	3E-07	--	--	--	NA	--
		Total	4E-05	--	Arsenic	RDX	NA	--
	Surface Water	Incidental Ingestion	4E-09	--	--	--	NA	--
		Dermal Contact	2E-09	--	--	--	NA	--
		Total	5E-09	--	--	--	NA	--
	Sediment	Incidental Ingestion	6E-08	--	--	--	NA	--
		Dermal Contact	4E-09	--	--	--	NA	--
		Total	6E-08	--	--	--	NA	--
	Total Groundwater, Surface Water, and Sediment		4E-05					

TABLE 7-25

RISKS ASSOCIATED WITH NATURALLY OCCURRING CHEMICALS - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Workers	Surface Soil	Incidental Ingestion	2E-07	--	--	--	0.03	--
		Dermal Contact	2E-08	--	--	--	0.003	--
		Inhalation	2E-07	--	--	--	0.04	--
		Total	4E-07	--	--	--	0.07	--
	Subsurface Soil	Incidental Ingestion	2E-07	--	--	--	0.03	--
		Dermal Contact	2E-08	--	--	--	0.002	--
		Inhalation	3E-08	--	--	--	0.03	--
		Total	2E-07	--	--	--	0.06	--
Industrial Workers	Surface Soil	Incidental Ingestion	3E-06	--	--	Arsenic	0.02	--
		Dermal Contact	6E-07	--	--	--	0.003	--
		Inhalation	8E-09	--	--	--	0.00006	--
		Total	4E-06	--	--	Arsenic	0.02	--
	Subsurface Soil	Incidental Ingestion	2E-06	--	--	Arsenic	0.01	--
		Dermal Contact	4E-07	--	--	--	0.003	--
		Inhalation	1E-09	--	--	--	0.00005	--
		Total	2E-06	--	--	Arsenic	0.01	--
Adolescent Trespassers	Surface Soil	Incidental Ingestion	3E-07	--	--	--	0.003	--
		Dermal Contact	4E-08	--	--	--	0.0006	--
		Inhalation	4E-10	--	--	--	0.000003	--
		Total	3E-07	--	--	--	0.004	--
	Subsurface Soil	Incidental Ingestion	2E-07	--	--	--	0.002	--
		Dermal Contact	3E-08	--	--	--	0.0005	--
		Inhalation	2E-11	--	--	--	0.000003	--
		Total	2E-07	--	--	--	0.003	--
Child Recreational Users	Surface Soil	Incidental Ingestion	9E-07	--	--	--	0.02	--
		Dermal Contact	1E-07	--	--	--	0.003	--
		Inhalation	9E-10	--	--	--	0.000006	--
		Total	1E-06	--	--	--	0.02	--
	Subsurface Soil	Incidental Ingestion	5E-07	--	--	--	0.01	--
		Dermal Contact	9E-08	--	--	--	0.002	--
		Inhalation	3E-11	--	--	--	0.000005	--
		Total	6E-07	--	--	--	0.01	--
Adult Recreational Users	Surface Soil	Incidental Ingestion	3E-07	--	--	--	0.002	--
		Dermal Contact	1E-07	--	--	--	0.0007	--
		Inhalation	1E-09	--	--	--	0.000006	--
		Total	4E-07	--	--	--	0.003	--
	Subsurface Soil	Incidental Ingestion	2E-07	--	--	--	0.001	--
		Dermal Contact	8E-08	--	--	--	0.0005	--
		Inhalation	1E-10	--	--	--	0.000005	--
		Total	3E-07	--	--	--	0.002	--
Lifelong Recreational Users	Surface Soil	Incidental Ingestion	1E-06	--	--	--	NA	--
		Dermal Contact	2E-07	--	--	--	NA	--
		Inhalation	2E-09	--	--	--	NA	--
		Total	1E-06	--	--	--	NA	--
	Subsurface Soil	Incidental Ingestion	7E-07	--	--	--	NA	--
		Dermal Contact	2E-07	--	--	--	NA	--
		Inhalation	1E-10	--	--	--	NA	--
		Total	9E-07	--	--	--	NA	--

TABLE 7-25

RISKS ASSOCIATED WITH NATURALLY OCCURRING CHEMICALS - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Child Residents	Surface Soil	Incidental Ingestion	1E-05	--	--	Arsenic, Chromium VI	0.2	--
		Dermal Contact	7E-07	--	--	--	0.02	--
		Inhalation	4E-08	--	--	--	0.0003	--
		Total	1E-05	--	--	Arsenic, Chromium VI	0.2	--
	Subsurface Soil	Incidental Ingestion	7E-06	--	--	Arsenic	0.2	--
		Dermal Contact	6E-07	--	--	--	0.02	--
		Inhalation	1E-09	--	--	--	0.0002	--
		Total	8E-06	--	--	Arsenic	0.2	--
Adult Residents	Surface Soil	Incidental Ingestion	5E-06	--	--	Arsenic	0.02	--
		Dermal Contact	5E-07	--	--	--	0.003	--
		Inhalation	6E-08	--	--	--	0.0003	--
		Total	6E-06	--	--	Arsenic	0.02	--
	Subsurface Soil	Incidental Ingestion	3E-06	--	--	Arsenic	0.02	--
		Dermal Contact	4E-07	--	--	--	0.002	--
		Inhalation	5E-09	--	--	--	0.0002	--
		Total	3E-06	--	--	Arsenic	0.02	--
Lifelong Residents	Surface Soil	Incidental Ingestion	2E-05	--	Chromium VI	Arsenic	NA	--
		Dermal Contact	1E-06	--	--	--	NA	--
		Inhalation	1E-07	--	--	--	NA	--
		Total	2E-05	--	Chromium VI	Arsenic	NA	--
	Subsurface Soil	Incidental Ingestion	1E-05	--	--	Arsenic	NA	--
		Dermal Contact	1E-06	--	--	--	NA	--
		Inhalation	6E-09	--	--	--	NA	--
		Total	1E-05	--	--	Arsenic	NA	--

TABLE 7-26

RISKS ASSOCIATED WITH NATURALLY OCCURRING CHEMICALS - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Workers	Surface Soil	Incidental Ingestion	7E-08	--	--	--	0.009	--
		Dermal Contact	3E-09	--	--	--	0.0005	--
		Inhalation	1E-07	--	--	--	0.02	--
		Total	2E-07	--	--	--	0.03	--
	Subsurface Soil	Incidental Ingestion	4E-08	--	--	--	0.007	--
		Dermal Contact	3E-09	--	--	--	0.0004	--
		Inhalation	1E-08	--	--	--	0.01	--
		Total	5E-08	--	--	--	0.02	--
Industrial Workers	Surface Soil	Incidental Ingestion	4E-07	--	--	--	0.01	--
		Dermal Contact	2E-08	--	--	--	0.0003	--
		Inhalation	2E-09	--	--	--	0.00005	--
		Total	4E-07	--	--	--	0.01	--
	Subsurface Soil	Incidental Ingestion	3E-07	--	--	--	0.006	--
		Dermal Contact	1E-08	--	--	--	0.0002	--
		Inhalation	4E-10	--	--	--	0.00004	--
		Total	3E-07	--	--	--	0.006	--
Adolescent Trespassers	Surface Soil	Incidental Ingestion	6E-08	--	--	--	0.0007	--
		Dermal Contact	6E-09	--	--	--	0.00009	--
		Inhalation	1E-10	--	--	--	0.000001	--
		Total	7E-08	--	--	--	0.001	--
	Subsurface Soil	Incidental Ingestion	4E-08	--	--	--	0.0006	--
		Dermal Contact	5E-09	--	--	--	0.00007	--
		Inhalation	6E-12	--	--	--	0.0000006	--
		Total	5E-08	--	--	--	0.0007	--
Child Recreational Users	Surface Soil	Incidental Ingestion	8E-08	--	--	--	0.004	--
		Dermal Contact	4E-09	--	--	--	0.0003	--
		Inhalation	9E-11	--	--	--	0.000002	--
		Total	8E-08	--	--	--	0.004	--
	Subsurface Soil	Incidental Ingestion	4E-08	--	--	--	0.003	--
		Dermal Contact	3E-09	--	--	--	0.0002	--
		Inhalation	2E-12	--	--	--	0.000001	--
		Total	4E-08	--	--	--	0.003	--
Adult Recreational Users	Surface Soil	Incidental Ingestion	3E-07	--	--	--	0.002	--
		Dermal Contact	1E-07	--	--	--	0.0007	--
		Inhalation	1E-09	--	--	--	0.000006	--
		Total	4E-07	--	--	--	0.003	--
	Subsurface Soil	Incidental Ingestion	2E-07	--	--	--	0.001	--
		Dermal Contact	8E-08	--	--	--	0.0005	--
		Inhalation	1E-10	--	--	--	0.000005	--
		Total	3E-07	--	--	--	0.002	--
Lifelong Recreational Users	Surface Soil	Incidental Ingestion	1E-06	--	--	--	NA	--
		Dermal Contact	2E-07	--	--	--	NA	--
		Inhalation	2E-09	--	--	--	NA	--
		Total	1E-06	--	--	--	NA	--
	Subsurface Soil	Incidental Ingestion	7E-07	--	--	--	NA	--
		Dermal Contact	2E-07	--	--	--	NA	--
		Inhalation	1E-10	--	--	--	NA	--
		Total	9E-07	--	--	--	NA	--

TABLE 7-26

RISKS ASSOCIATED WITH NATURALLY OCCURRING CHEMICALS - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Child Residents	Surface Soil	Incidental Ingestion	2E-06	--	--	--	0.1	--
		Dermal Contact	3E-08	--	--	--	0.003	--
		Inhalation	1E-08	--	--	--	0.0002	--
		Total	2E-06	--	--	--	0.1	--
	Subsurface Soil	Incidental Ingestion	8E-07	--	--	--	0.06	--
		Dermal Contact	3E-08	--	--	--	0.002	--
		Inhalation	3E-10	--	--	--	0.0001	--
		Total	8E-07	--	--	--	0.06	--
Adult Residents	Surface Soil	Incidental Ingestion	5E-07	--	--	--	0.01	--
		Dermal Contact	1E-08	--	--	--	0.0003	--
		Inhalation	9E-09	--	--	--	0.0002	--
		Total	5E-07	--	--	--	0.01	--
	Subsurface Soil	Incidental Ingestion	3E-07	--	--	--	0.006	--
		Dermal Contact	1E-08	--	--	--	0.0002	--
		Inhalation	9E-10	--	--	--	0.0001	--
		Total	3E-07	--	--	--	0.006	--
Lifelong Residents	Surface Soil	Incidental Ingestion	2E-06	--	--	--	NA	--
		Dermal Contact	4E-08	--	--	--	NA	--
		Inhalation	2E-08	--	--	--	NA	--
		Total	2E-06	--	--	--	NA	--
	Subsurface Soil	Incidental Ingestion	1E-06	--	--	--	NA	--
		Dermal Contact	4E-08	--	--	--	NA	--
		Inhalation	1E-09	--	--	--	NA	--
		Total	1E-06	--	--	--	NA	--

TABLE 7-27

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - INDUSTRIAL EXPOSURES TO SETTLING BASIN - 22SD/SW011
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
	Exposure Point Concentration (mg/kg)	RSL[1] (mg/kg)	Estimated ILCR	Primary Target Organs	RSL[1] (mg/kg)	Estimated HQ
Metals						
Arsenic	12.3	1.6	8E-06	Skin, Cardiovascular System	260	0.05
Barium	38.3	NA	NA	Kidney	190,000	0.0002
Cadmium	0.26	9,300	3E-11	Kidney	800	0.0003
Chromium[2]	16	NA	NA	None Specified	1,500,000	0.00001
Lead	11	NA	NA	NA	800	NA
Selenium	0.19	NA	NA	Skin, Central Nervous System	5100	0.00004
		Total ILCR	**8E-06**		Total HI	**0.05**

1 - USEPA Regional Screening Level Table (November 2012a). Carcinogenic values correspond to a $1x10^{-6}$ cancer risk level. Noncarcinogenic values corresponds to a hazard index of 1.
2 - Values are for trivalent chromium.
NA - Not applicable. There are no cancer slope factors (CSF) and/or reference dose (RfD) available for this chemical.

TABLE 7-28

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - RESIDENTIAL EXPOSURES TO SETTING BASIN - 22SD/SW011
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
	Exposure Point Concentration (mg/kg)	RSL[1] (mg/kg)	Estimated ILCR	Primary Target Organs	RSL[1] (mg/kg)	Estimated HQ
Metals						
Arsenic	12.3	0.39	3E-05	Skin, Cardiovascular System	22	0.6
Barium	38.3	NA	NA	Kidney	15,000	0.003
Cadmium	0.26	1,800	1E-10	Kidney	70	0.004
Chromium[2]	16	NA	NA	None Specified	120,000	0.0001
Lead	11	NA	NA	NA	400	NA
Selenium	0.19	NA	NA	Skin, Central Nervous System	390	0.0005
		Total ILCR	**3E-05**	Total HI (as trivalent chromium)		**0.6**

1 - USEPA Regional Screening Level Table (November 2012a). Carcinogenic values correspond to a $1x10^{-6}$ cancer risk level. Noncarcinogenic values corresponds to a hazard index of 1.
2 - Values are for trivalent chromium.
NA - Not applicable. There are no cancer slope factors (CSF) and/or reference dose (RfD) available for this chemical.

TABLE 7-29

COMPARISON OF SETTLING BASIN SEDIMENTS TO MIGRATION CRITERIA
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION SAMPLE ID SAMPLE DATE SAMPLE CODE MATRIX SAMPLE TYPE SUBMATRIX TOP DEPTH BOTTOM DEPTH	**USEPA Protection of Groundwater SSLs[(1)]**	**IDEM Soil Migration to Groundwater[(2)]**	**22SD/SW011 22SD0110006 20110120 NORMAL SD NORMAL SD 0 0.5**
Metals (mg/kg)			
Arsenic	0.026	5.9 M	12.3 J
Barium	2,400	1,700 M	38.3 J
Cadmium	10.4	7.5 M	0.26 J
Chromium	560,000,000 [(3)]	1,000,000 R	16.2 J
Lead	280 [(4)]	270 M	11.3 J
Selenium	8	5.3 M	0.19 J

1 - USEPA Regional Screening Level (RSL), November 2012. Protection of groundwater values are risk-based SSLs and have been multiplied by 20 to represent a dilution attenuation factor of 20.
2 - IDEM Closure Guide, March 1,2013.
3 - Values are for trivalent chromium.
4 - Value is MCL based soil screening level.

C - Carcinogenic.
IDEM = Indiana Department of Environmental Management.
M - Maximum contaminant level.
mg/kg = Milligram per kilogram.
N - Noncarcinogenic.
R = Capped at 1,000,000.
SSL = Soil screening level.
USEPA = United States Environmental Protection Agency.

Exceeds USEPA SSL
Exceeds IDEM Screening Level
Exceeds Both USEPA SSL and IDEM Screening Level

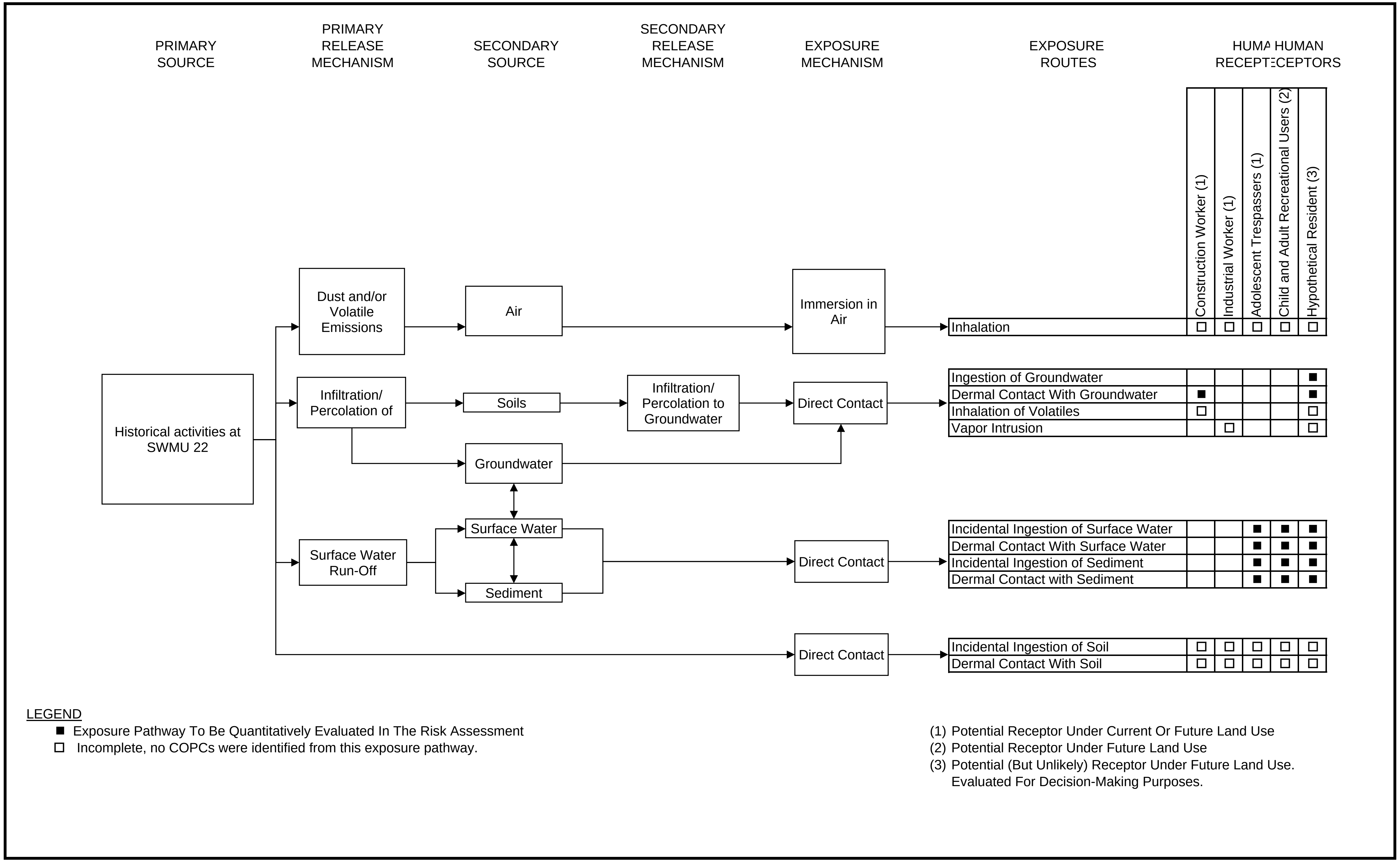
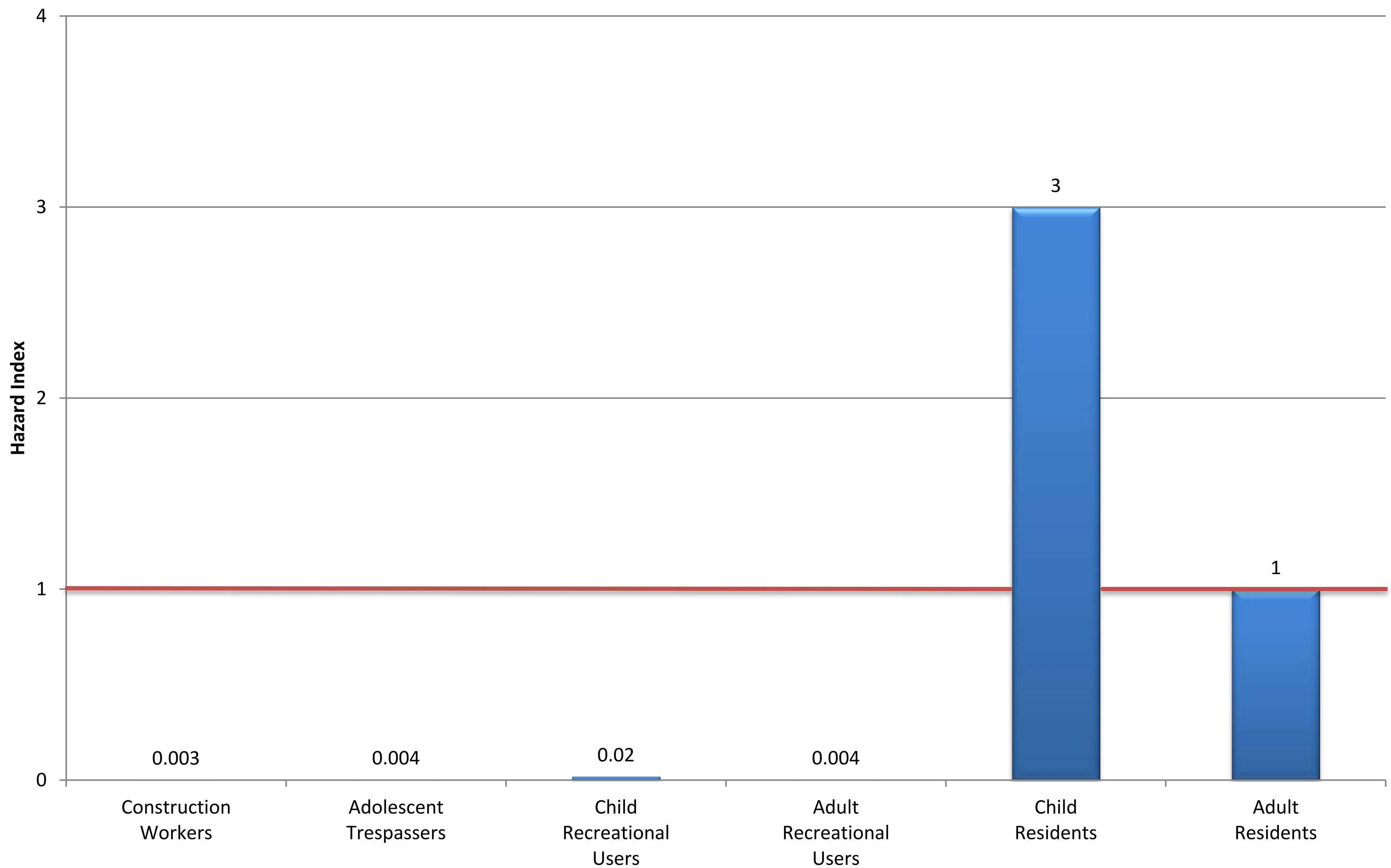


FIGURE 7-1

HUMAN HEALTH CONCEPTUAL SITE MODEL
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

FIGURE 7-2
SUMMARY OF CUMULATIVE HAZARD INDICES - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZIDE AREA
NSA CRANE
CRANE, INDIANA



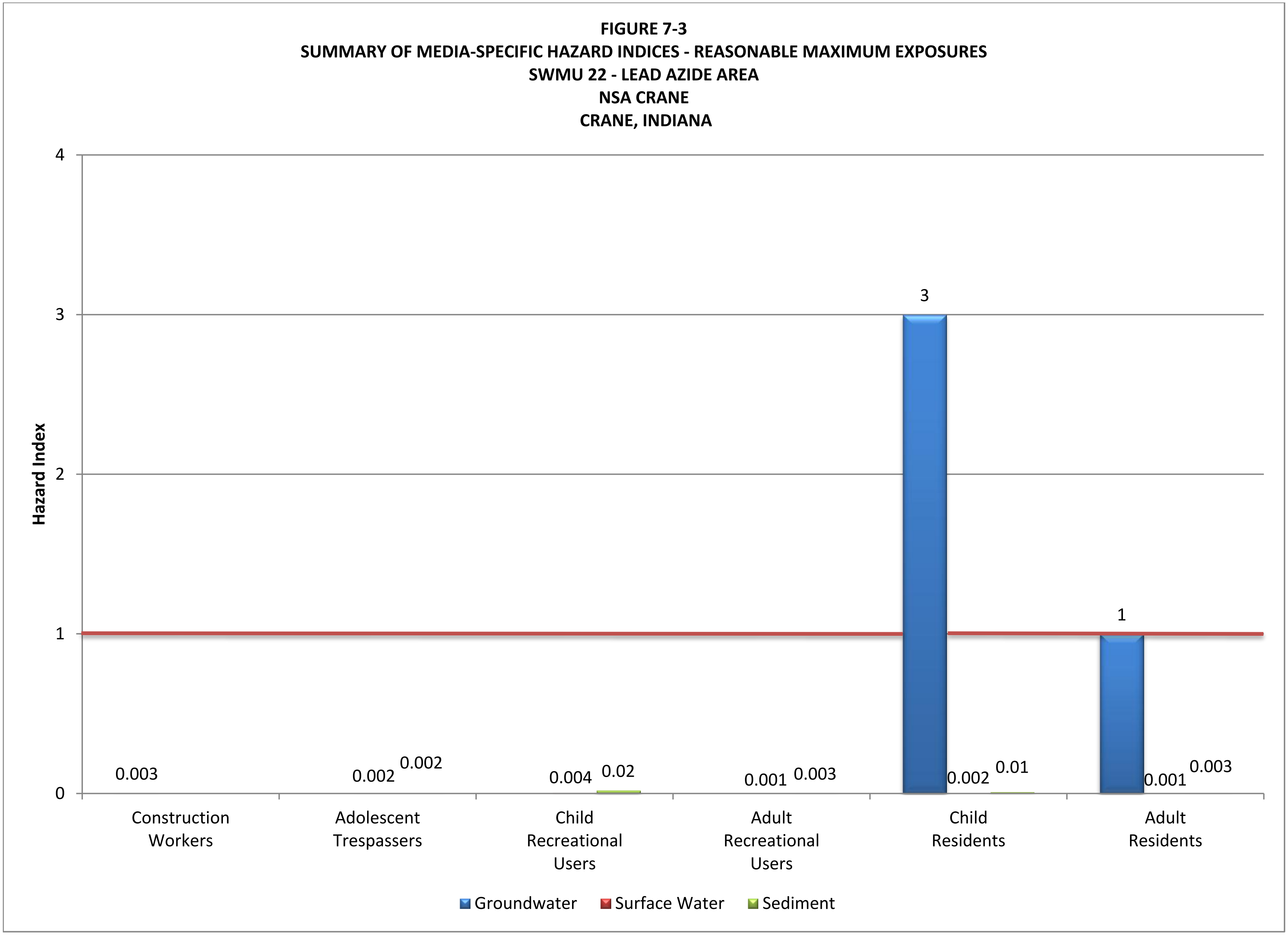


FIGURE 7-3
SUMMARY OF MEDIA-SPECIFIC HAZARD INDICES - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZIDE AREA
NSA CRANE
CRANE, INDIANA
Hazard Index
4
3
2
1
0
3
1
0.003
0.002
0.002
0.004
0.02
0.001
0.003
0.002
0.01
0.001
0.003
Construction Workers
Adolescent Trespassers
Child Recreational Users
Adult Recreational Users
Child Residents
Adult Residents
Groundwater
Surface Water
Sediment

FIGURE 7-4
SUMMARY OF CUMULATIVE HAZARD INDICES - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE AREA
NSA CRANE
CRANE, INDIANA

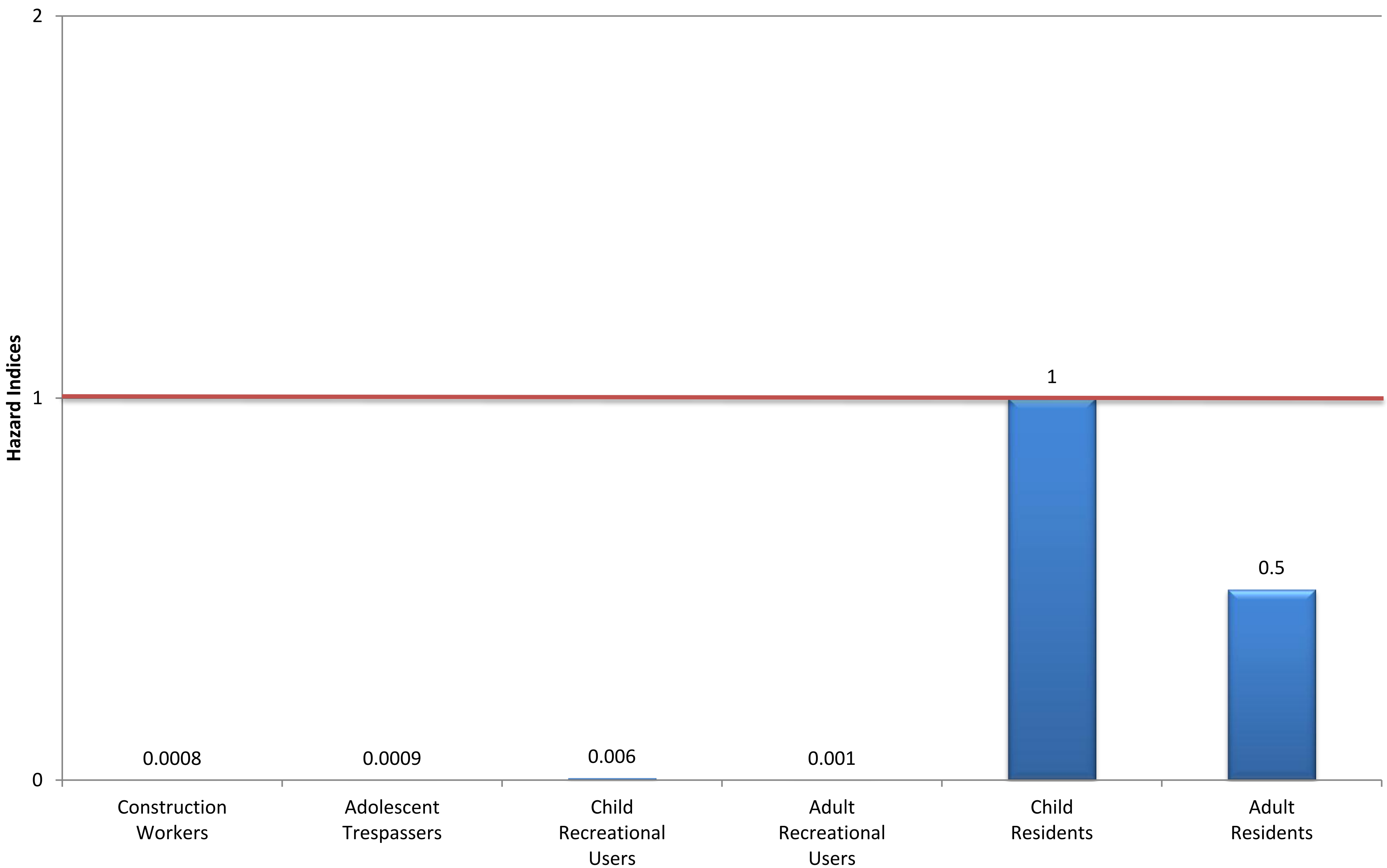


FIGURE 7-5
SUMMARY OF MEDIA-SPECIFIC HAZARD INDICES - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE AREA
NSA CRANE
CRANE, INDIANA

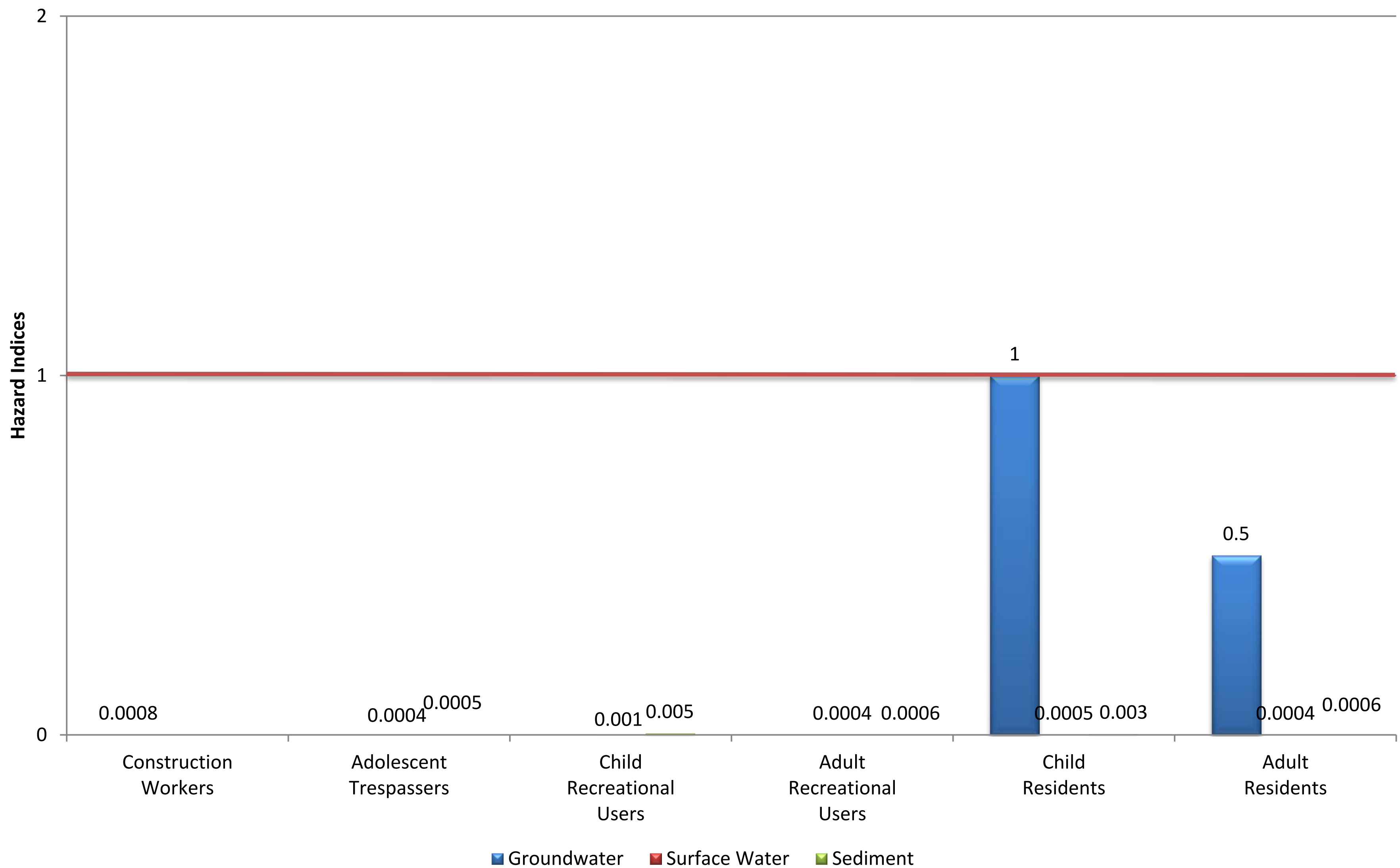


FIGURE 7-6
SUMMARY OF CUMULATIVE CANCER RISKS - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZIDE AREA
NSA CRANE
CRANE, INDIANA

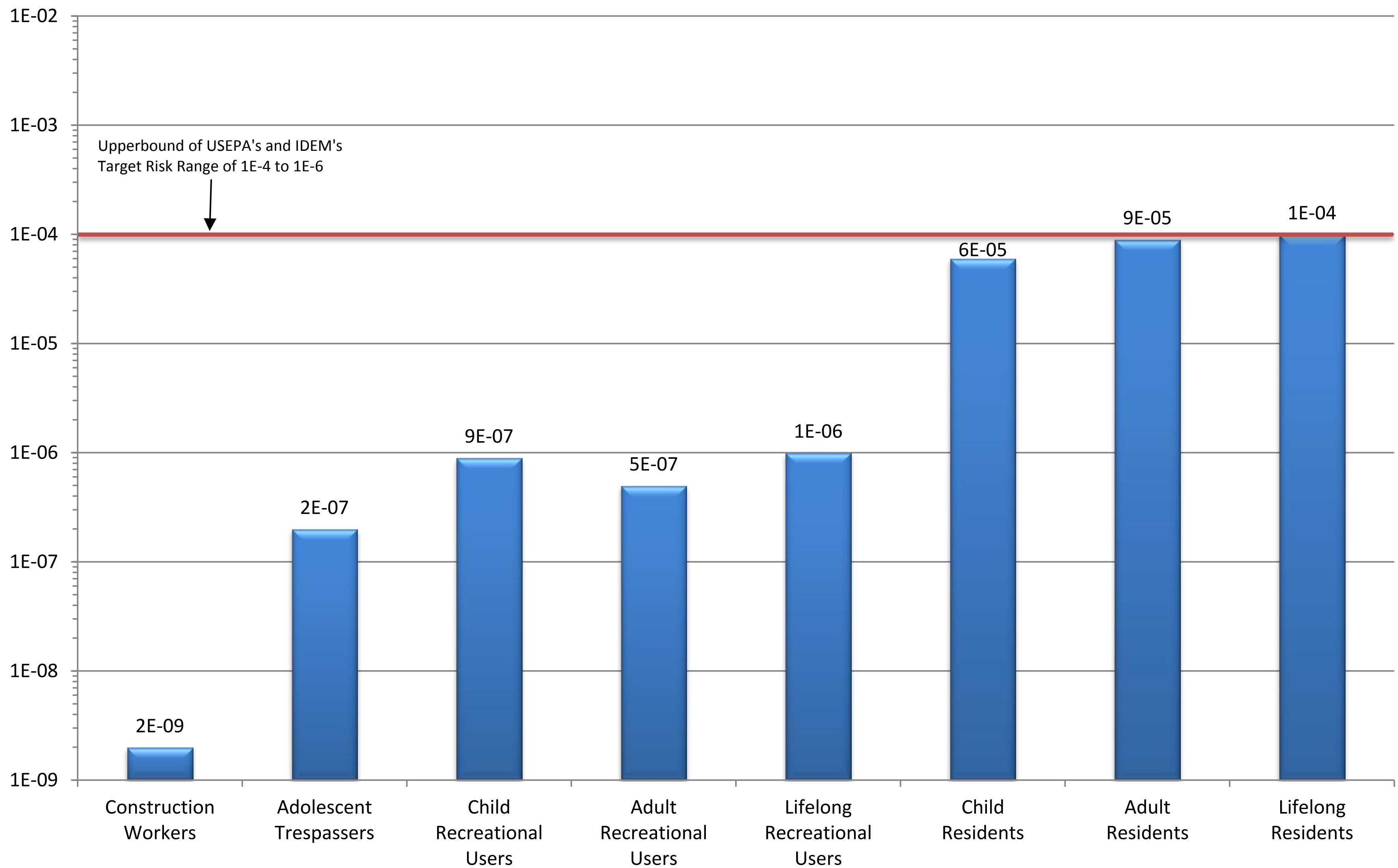
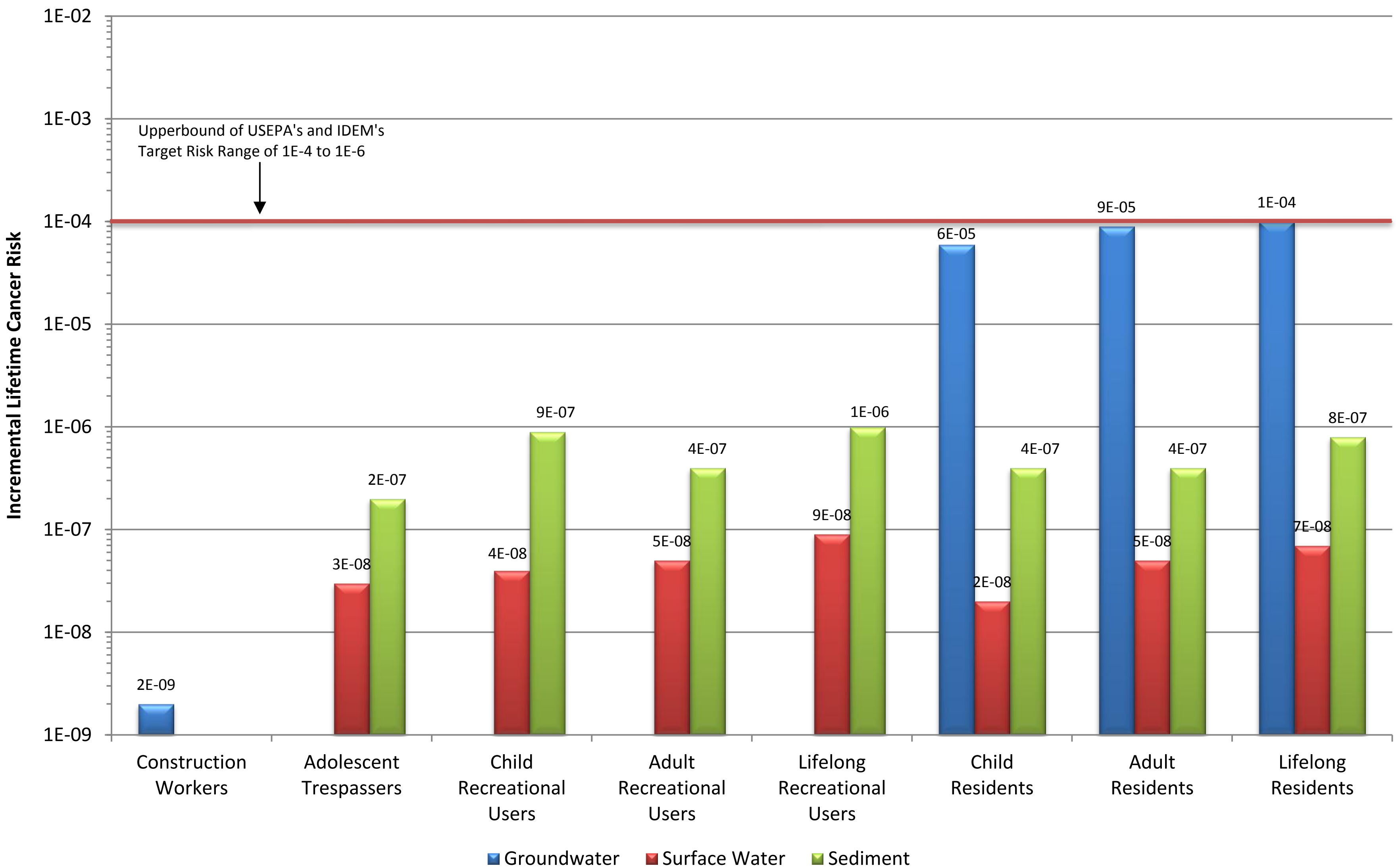


FIGURE 7-7
SUMMARY OF MEDIA-SPECIFIC CANCER RISKS - REASONABLE MAXIMUM EXPOSURES
SWMU 22 - LEAD AZID AREA
NSA CRANE
CRANE, INDIANA



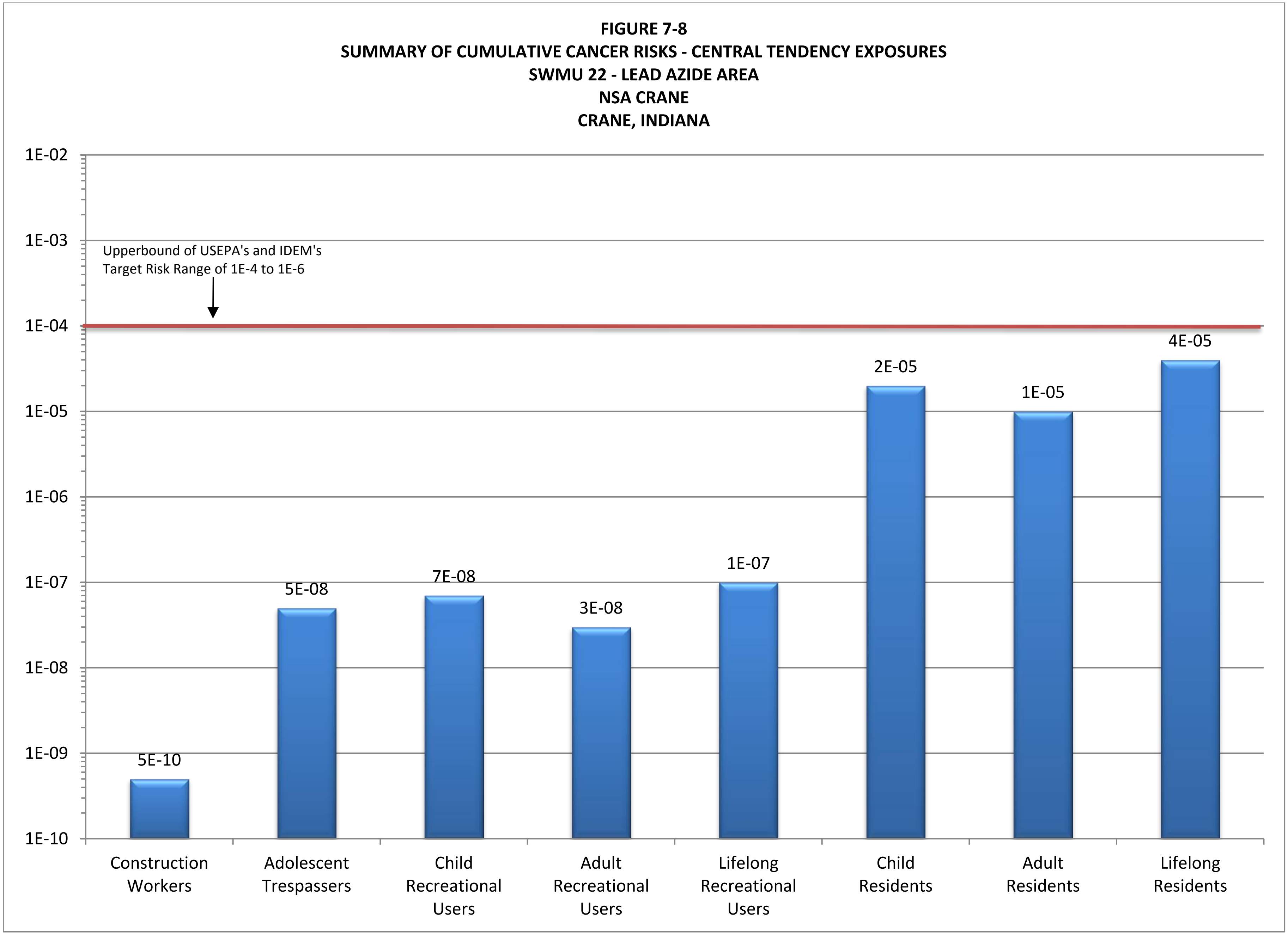
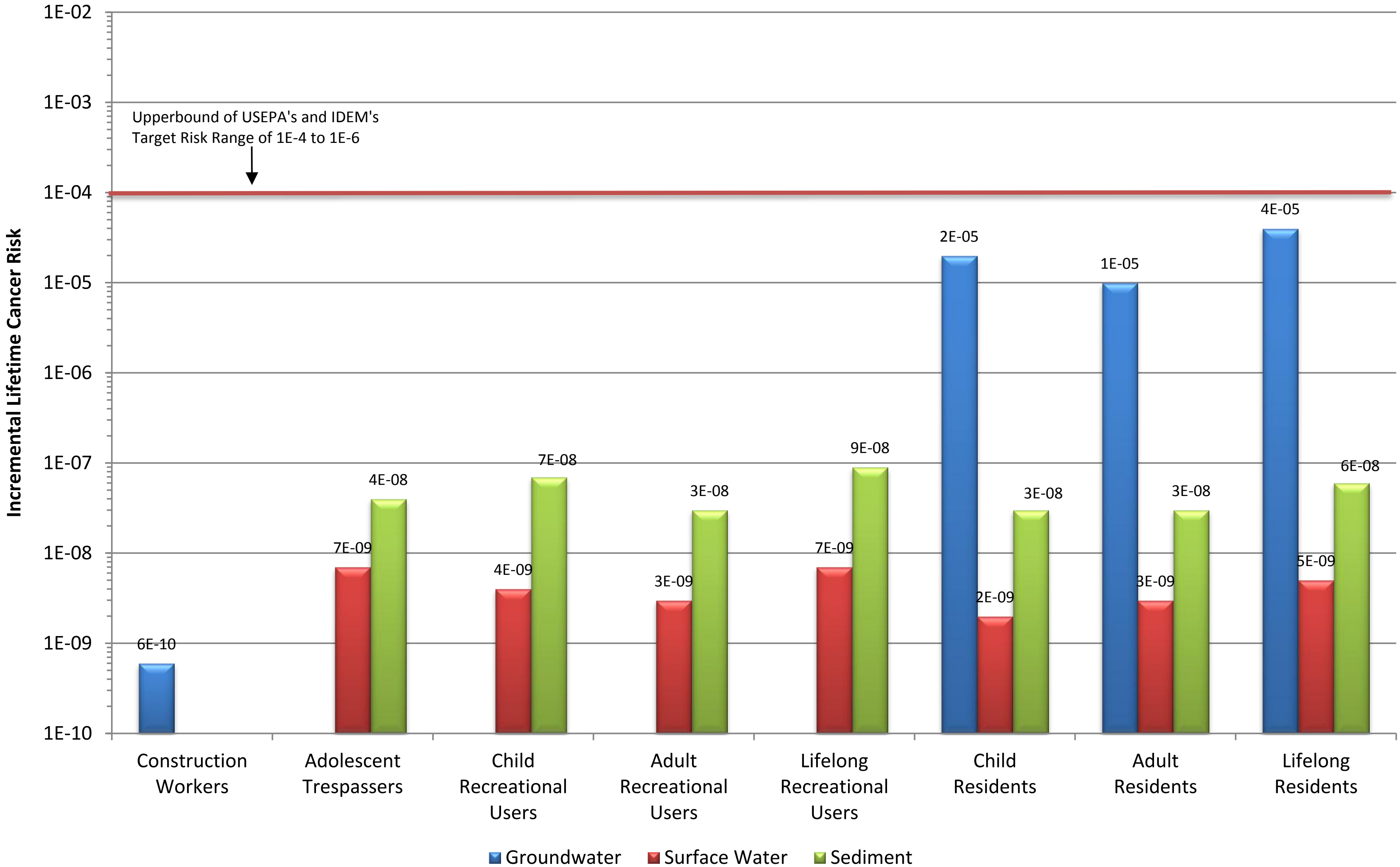


FIGURE 7-8
SUMMARY OF CUMULATIVE CANCER RISKS - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE AREA
NSA CRANE
CRANE, INDIANA
1E-02
1E-03
1E-04
1E-05
1E-06
1E-07
1E-08
1E-09
1E-10
Upperbound of USEPA's and IDEM's Target Risk Range of 1E-4 to 1E-6
5E-10
5E-08
7E-08
3E-08
1E-07
2E-05
1E-05
4E-05
Construction Workers
Adolescent Trespassers
Child Recreational Users
Adult Recreational Users
Lifelong Recreational Users
Child Residents
Adult Residents
Lifelong Residents

FIGURE 7-9
SUMMARY OF MEDIA-SPECIFIC CANCER RISKS - CENTRAL TENDENCY EXPOSURES
SWMU 22 - LEAD AZIDE AREA
NSA CRANE
CRANE, INDIANA



8.0 ECOLOGICAL RISK ASSESSMENT

The goal of the SLERA for SWMU 22 was to evaluate the potential for adverse ecological impacts due to site-related contamination. This goal was accomplished by identifying COPCs detected at concentrations that exceed screening levels, identifying the locations of these exceedances, and concluding whether or not further investigation and/or remedial action at SWMU 22 at NSA Crane is warranted from an ecological perspective.

8.1 INTRODUCTION

The SLERA methodology used at NSA Crane is in accordance with the following guidance documents:

- Department of Navy Environmental Policy Memorandum 97-04: Use of Ecological Risk Assessments dated May 16, 1997.
- Navy Policy for Conducting Ecological Risk Assessments (1999).
- Final Guidelines for Ecological Risk Assessment (USEPA, 1998).
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997a).

This SLERA consists of Steps 1, 2, and 3a of the eight-step ecological risk evaluation process discussed in USEPA guidance (1997a and 1998) and the Navy Policy for Conducting ERAs (1999). The first two screening steps comprise the SLERA and correspond with Tier 1 of the Navy policy (1999), during which conservative exposure estimates are compared to screening-level and threshold toxicity values. Step 3a is the first step of a baseline ecological risk assessment (BERA) and consists of refining the Tier 1 assumptions following Steps 1 and 2 to further focus the ERA process on the chemicals of greatest concern at a site. Step 3a corresponds with the first part of Tier 2 of the Navy policy (1999). Steps 3b through 7 are conducted if additional evaluations or investigations are necessary. Aspects of Step 8, risk management, are addressed throughout the ERA process, in cooperation with Region 5 regulators.

A schematic diagram of the general risk assessment process is provided on Figure 8-1.

8.2 TIER 1, STEP 1: SCREENING-LEVEL PROBLEM FORMULATION

The screening-level problem formulation is the first step of the ERA and includes identification of potential receptor groups, COPCs, and the mechanisms for contaminant fate, transport, and toxicity. The complete exposure pathways that exist at a site are determined at this point to facilitate receptor selection. The problem formulation process enables the risk assessor to identify the ecological resources to be protected (known as assessment endpoints), the measurements that were used to evaluate risks to those resources (known as measurement endpoints) and the chemicals, geographic areas, and environmental media relevant to the risk assessment.

As part of receptor identification, site habitats and potential ecological receptors, as they apply to ecological risk, are described in the following subsections.

8.2.1 <u>Environmental Setting</u>

8.2.1.1 Basewide Environmental Setting

A biological characterization of NSA Crane, including a list of plants and animals found at the facility, is presented in the Installation Assessment (IA) (Army, 1978) and IAS (NEESA, 1983) and is summarized in the Environmental Monitoring Reports (EMRs) (Halliburton NUS, 1992a and 1992b). A list of the species that may inhabit NSA Crane and that are protected under the United States Endangered Species Act, Indiana Department of Natural Resources Heritage Data Center, or United States Fish and Wildlife Service (USFWS) is provided in the RCRA Facility Permit and below. The following paragraphs briefly summarize the environmental setting at the base.

Eighty percent of NSA Crane's approximately 63,000 acres is classified as Central Hardwoods Forest of the United States (NEESA, 1983). In addition, some former agricultural fields are in various stages of succession. Open spaces on dry upland sites contain almost pure stands of grasses with some clumps of woody plants such as persimmon, sassafras, and sumac. Wetter sites have river birch, willow, sycamore, and cottonwood. Hillside communities have mostly hickory, white and black oak, red maple, sugar maple, tulip poplar, ash, and beech (NEESA, 1983).

The great variety of habitats at NSA Crane (i.e., many stages of forest succession, streams, ponds, Lake Greenwood, grassy open spaces) lead to great diversity of animal species (NEESA, 1983). These species include but are not limited to mammals such as white-tailed deer, beaver, coyote, hawks, red fox, rabbits, raccoons, and mice; birds such as ducks, geese, wild turkey, bobwhite quail, red-tailed hawks, and American robins; and various amphibians, reptiles, fish, and invertebrates.

Six main creeks receive drainage in five separate drainage basins at NSA Crane: First Creek, Sulphur Creek, Little Sulphur Creek, Boggs Creek, Turkey Creek, and Seed Tick Creek. There are also many smaller streams, creeks, and drainage ditches located at the facility, along with several small man-made ponds and one large lake, Lake Greenwood. Lake Greenwood is the source of potable water for NSA Crane. Surface water from the facility eventually discharges to the East Fork of the White River, which is located south of the facility.

Threatened and Endangered Species

The Integrated Natural Resources Management Plan (INRMP) for NSA Crane (Navy, 2010) identified the federal and state threatened and endangered species and species of special concern potentially present at the facility. Information included in the INRMP was obtained from studies and surveys conducted by the Navy and other agencies and groups such as universities and research institutions. A small subset of these studies include the inventory of neotropical migratory birds, mist net surveys for the Indiana Bat, bobcat trapping, rattlesnake survey, Purdue University wildlife studies, and several fish surveys and bird counts. These studies and others that were used in compiling the list of endangered species present at NSA Crane are described in more detail in the INRMP (Navy, 2010) and below.

The Indiana bat is the only federally threatened or endangered species documented to occur at NSA Crane. No mist nets were located at SWMU 22 during the mist net surveys for the Indiana Bat; however, one mist net site was located approximately 1 mile northeast of SWMU 22. Three male Indiana bats were captured at the location northeast of SWMU 22 in June 2005.

The USFWS issued a notice in the Federal Register (72 FR 37346 et seq.) on July 9, 2007, that effective August 8, 2007, the American bald eagle would be removed from the federal List of Endangered and Threatened Wildlife and Plants. The American bald eagle is still protected by the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act. The bald eagle is known to be present in Lake Greenwood approximately 1.5 miles north of SWMU 22.

In addition, a number of state endangered and state species of concern have been listed for NSA Crane (Navy, 2010). The state endangered species list includes one mammal (Indiana bat), one reptile (timber rattlesnake), and several birds (bald eagle, osprey, loggerhead shrike, yellow-crowned night-heron, Virginia Rail, King Rail, and Henslow’s sparrow).

Boggs Creek and Turkey Creek discharge from NSA Crane to the East Fork of the White River. River otters, a state species of concern, are being reintroduced to Indiana. The otters are expanding from their original release sites into other watersheds including the East Fork of the White River (IDNR, 2004). Also, the East Fork of the White River is the site of an ongoing study of lake sturgeon populations, another state endangered species (IDNR, 2004). Finally, the spotted darter, a state species of special concern, has been found in the East Fork of the White River (IDNR, 2000).

8.2.1.2 Site-Specific Environmental Setting

SWMU 22 – Lead Azide Pond is located in the north-central portion of NSA Crane in the EAD/Booster Area (see Figure 1-2). The site covers approximately 50 acres. Site operations occur within a fenced area that encloses approximately 20 acres. The site is currently used for the production of small explosive charges and fuse maintenance. SWMU 22 is bounded on the west by Highway H-45. A tributary of Turkey Creek is located approximately 550 feet east of the site outside of the fenced area. The eastern and southern sides slope gently from 760 to 650 feet. Within the fenced area, habitat is limited to mowed grass. Outside of the area of operations, portions of the site are forested.

Most of NSA Crane is forested, including the area surrounding SWMU 22. Surface runoff from SWMU 22 discharges to a tributary of Turkey Creek, which discharges into Turkey Creek approximately 1.5 miles south of the site. Near the area of operations, limited surface water is present. Several stream beds purposed for sampling surface water and sediment were dry, and soil was collected in these areas instead of sediment. Within the fenced area, surface water samples were collected from standing puddles after a rain event, a concrete drainage ditch, and two other drainageways with flows of about 1 inch in depth. The tributary of Turkey Creek, east of the site, ranged from approximately 5 to 12 feet across with depths ranging from 2 to 8 inches.

8.2.2 <u>Contaminants, Ecotoxicity, and Fate and Transport</u>

Based on historical site usage, explosives and metals are among the site-related chemical contaminants known to be present or potentially present in environmental media at SWMU 22.

8.2.2.1 Physical and Chemical Characteristics

Physical and chemical characteristics of contaminants may affect their mobility, transport, and bioavailability in the environment. These characteristics include bioaccumulation factors (BAFs), organic carbon-water partitioning coefficients (K_{OC}s), and octanol-water partitioning coefficients (K_{OW}s).

8.2.3 Potential Exposure Pathways

Section 1.2 of this RFI describes the operational history for SWMU 22, and Section 1.3 presents detailed descriptions of previous investigations at SWMU 22. The site was constructed to load 5-inch rockets during World War II, and the area is currently used in the production of small explosive charges and fuse maintenance. An unlined retention pond (i.e., the lead azide pond) that received overflow wastewater was located within the site. The retention pond was removed in 1981. Chemicals may have entered surface soil, sediment, and surface water primarily from wastewater generated in processes at the site. Lead salts and other constituents in wastewater were discharged to the retention pond. Water was collected in sumps at the building; however, the retention pond received overflow via sewer lines. Infiltration through the unlined pond and leaking sewer lines are potential sources of contamination. Overflow from the pond may have been released to surface water because a drainage pathway leads from the pond to the eastern slope of the site and into a stream. Metals, primarily lead, and explosives-related compounds are potential site-related constituents.

8.2.3.1 Surface Soil

Several groups of terrestrial ecological receptors can be exposed to contaminants in surface soil. Invertebrates such as earthworms are exposed to contaminants as they move through the soil and ingest soil particles while searching for food. Plants are exposed to contaminants via direct contact as contaminants are absorbed through the roots, and contaminants are then translocated to different parts of the plants (e.g., leaves, seeds). These pathways were evaluated in the SLERA.

Small mammals may be exposed to contaminants in soil via several exposure routes. They may be exposed by direct contact as they search for food or burrow into the soil. Exposure of terrestrial wildlife to contaminants in the soil via dermal contact is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons are expected to minimize transfer of contaminants across dermal tissue. Therefore, the dermal pathway was not evaluated in the SLERA. Small mammals also may be exposed to contaminants in soil via incidental ingestion of soil and ingestion of plants and/or invertebrates that have accumulated contaminants from the soil. These pathways were evaluated in the SLERA.

Larger predatory species such as the red fox and red-tailed hawk can be indirectly exposed to soil contaminants by ingesting small mammals that have accumulated contaminants from soil.

8.2.3.2 Groundwater

Ecological receptors are not directly exposed to contaminants in groundwater at the site. Previous sampling indicated the presence of explosives in surface water, which could be from groundwater discharge. However, there are no known seeps within the site to indicate that groundwater is discharging to the Turkey Creek tributary. Therefore, groundwater was not evaluated in the SLERA.

8.2.3.3 Surface Water/Sediment

Contaminants in soil may enter the Turkey Creek tributaries at SWMU 22 via overland flow. Benthic invertebrates and other aquatic organisms can be exposed to chemicals in surface water and sediment. Piscivorous receptors may be exposed to contaminants in sediment via incidental ingestion of sediment and ingestion of invertebrates that have accumulated contaminants from the sediment. Piscivorous receptors are likely only present in the tributary to Turkey Creek; however, data from samples collected from drainageways are also included in the evaluation. Terrestrial receptors and piscivorous receptors may be exposed to contaminants in surface water via ingestion of surface water and ingestion of organisms that have accumulated contaminants from surface water. These pathways are evaluated in the SLERA. One sediment sample (22SD026) was collected from within a concrete settling basin. Benthic invertebrates, aquatic organisms, and piscivorous receptors are not substantially exposure to sediment located within the covered settling basin; therefore, data from this sample were not evaluated in the SLERA.

8.2.3.4 Air

Inhalation of particulates by mammals and birds is not considered a complete pathway at SWMU 22 because there are no activities causing air contamination. Also, inhalation pathways are not typically evaluated in an ERAs because of the uncertainty inherent in estimating exposure levels and toxicological effects. Therefore, the air inhalation pathway is not evaluated in the SLERA.

8.2.4 Assessment Endpoints and Measurement Endpoints

Assessment endpoints are explicit expressions of the environmental value that is to be protected (USEPA, 1997a). The selection of these endpoints is based on the habitats present, migration pathways of probable contaminants, and relevant exposure routes for the receptors. Measurement endpoints are estimates of measurable biological impacts (e.g., mortality, growth, and reproduction) that are used to evaluate the assessment endpoints. The assessment endpoints and measurement endpoints for SWMU 22 are presented in Table 8-1.

8.2.4.1 Assessment Endpoints

Based on the habitat at SWMU 22, which consists of mostly grass with nearby forested areas, and the chemicals present at the site, the assessment endpoints include protection of the following groups of receptors from adverse effects of contaminants on their growth, survival, and reproduction:

- Terrestrial vegetation
- Soil invertebrates
- Aquatic organisms
- Sediment invertebrates
- Herbivorous birds and mammals
- Invertivorous birds and mammals
- Piscivorous birds and mammals

The following paragraphs discuss these assessment endpoints.

Terrestrial Vegetation: Terrestrial vegetation at SWMU 22 consists of grasses, shrubs, and trees. They serve as a food source and provide shade and cover for many organisms, and they help to prevent soil erosion, among other important functions. They also can accumulate some contaminants that can then be transferred to the higher trophic-level organisms that consume plants.

Soil Invertebrates: Soil invertebrates are present in soil at SWMU 22. They aid in the formation of soil and the redistribution and decomposition of organic matter in the soil, and they serve as a food source for higher trophic-level organisms. They also can accumulate bioaccumulative contaminants that can then be transferred to the higher trophic-level organisms that consume soil invertebrates.

Aquatic Organisms: Aquatic organisms such as amphibians, insects, and other invertebrates serve as a food source for higher trophic-level organisms (i.e., birds, mammals). They can also accumulate contaminants that can be transferred to higher trophic-level organisms that consume them.

Sediment Invertebrates: Sediment invertebrates serve as a food source for higher trophic-level organisms (i.e., fish, amphibians, birds, mammals). They can also accumulate contaminants that can be transferred to higher trophic-level organisms that consume invertebrates.

Herbivorous Birds and Mammals: Herbivorous birds and mammals (i.e., animals that consume only plant tissue) forage in some portions of SWMU 22. Their role in the community is essential because, without them, higher trophic levels could not exist (Smith, 1966). They may be exposed to and accumulate contaminants present in the plants they consume.

Invertivorous Birds and Mammals: Invertivorous birds and mammals are present throughout the base in different terrestrial habitats (e.g., forested, open field) and are present at SWMU 22. These are considered first-level carnivores, and they serve as a food source for higher trophic-level carnivores. They may be exposed to and accumulate contaminants present in the food items they consume.

Piscivorous Birds and Mammals: The term “piscivorous” is used here in a broad sense to describe birds and mammals that prey upon not only fish, but on a variety of aquatic and sediment-dwelling organisms (e.g., crayfish, frogs). Piscivorous birds and mammals can be exposed to and accumulate site-related contaminants that have accumulated in prey items obtained from the site.

Not all of the potential assessment endpoints listed above were evaluated in this SLERA. As indicated in USEPA guidance (1997a), “it is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at a site. Instead, assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants from the site.” Therefore, the SLERA focused on the endpoints that would tend to yield the highest risks, which was expected account for endpoints associated with lower risks.

Omnivores were not selected as assessment endpoints because exposure to contaminants in plants is greatest for herbivores, and exposure to contaminants in animals is greatest for invertivores. Therefore, omnivores are protected by protecting herbivores and invertivores. Large carnivorous birds and mammals were not selected as assessment endpoints because their home range (hundreds of acres) is much larger than SWMU 22 (approximately 50 acres), so they would only consume a small portion of food from the site. Therefore, risks would be greater to small mammals and birds that may obtain all of their food from the site. Although amphibians and reptiles may be present near the stream, they were not selected as assessment endpoints because of the general lack of toxicity information and lack of methods to evaluate their exposure to chemicals.

8.2.4.2 Measurement Endpoints

The following measurement endpoints were used to evaluate the assessment endpoints in the SLERA:

- Soil screening values - Mortality, growth, and reproduction of plants and soil invertebrates were evaluated by comparing the measured concentrations of chemicals in surface soil to screening values designed to be protective of ecological receptors.

- Surface water screening values - Mortality, growth, and reproduction of aquatic organisms were evaluated by comparing the measured concentrations of chemicals in surface water to screening values designed to be protective of ecological receptors.

- Sediment screening values - Mortality, growth, and reproduction of sediment invertebrates were evaluated by comparing the measured concentrations of chemicals in sediment to screening values designed to be protective of ecological receptors.

- Wildlife toxicity reference values (TRVs) - Mortality, reproductive, and/or developmental effects of birds and mammals were evaluated by comparing the estimated doses incurred (based on conservative and average assumptions) from ingestion of contaminants in surface soil, sediment, plants, and invertebrates to wildlife TRVs.

8.2.4.3 Selection of Receptor Species

Many receptors in the terrestrial/aquatic environment at SWMU 22 are typically grouped into general categories such as invertebrates and vegetation. This is a reflection of the nature of the threshold values, effects values, or criteria typically used to characterize risk for such organisms. However, for vertebrate receptors, selection of a representative species is required so that risks to these upper-level species incurred by intake through eating and drinking can be estimated.

Ingestion is the primary route of exposure for most mammals and birds. The selection of species used to represent the receptor groups identified in Section 8.2.4.1 was based on considerations of their preferred habitat, body size, sensitivity to contaminants, home range, abundance, commercial or sport utilization, legal status, and functional role (e.g., predators). The availability of exposure parameters such as body mass, feeding rate, and drinking rate was also a factor in selecting surrogate species. The following surrogate species were used in the food-chain modeling conducted as part of this SLERA:

- Herbivorous mammal – Meadow vole
- Herbivorous bird – Bobwhite quail
- Invertivorous mammal – Short-tailed shrew
- Invertivorous bird – American woodcock

- Piscivorous mammal – Mink
- Piscivorous bird – Belted kingfisher

Receptor profiles for each of the species above are presented in Appendix F.

8.2.4.4 Conceptual Site Model

A CSM in problem formulation is a written description and visual representation of predicted relationships between ecological entities and the stressors to which they may be exposed. The conceptual model consists of two primary components: predicted relationships among stressor, exposure, and assessment endpoint response and a diagram that illustrates the relationships (USEPA, 1998). The CSM is discussed in Section 6 and below.

The primary sources of known or potential contamination at SWMU 22 were identified based on past operational practices and the physical characteristics of the site. The primary sources of contamination are releases from munitions and explosives manufacturing and handling operations via spills, leaks from underground piping, aerial deposition from ventilation, releases as wastewater traveled through sumps into the retention pond, and infiltration from wastewater containing metals and explosives discharged to the retention pond.

The primary stressors to ecological receptors are contaminants in surface soil, sediment, and surface water. The primary receptors for contaminants in surface soil, sediment, and surface water are plants, soil invertebrates, aquatic organisms, sediment invertebrates, amphibians, and reptiles, and secondary receptors are birds and mammals. Figure 8-2 represents the ecological CSM for SWMU 22.

8.3 TIER 1, STEP 2: SCREENING-LEVEL EXPOSURE ESTIMATE AND RISK QUOTIENTS

8.3.1 <u>Ecological Effects Evaluation</u>

The preliminary ecological effects evaluation is an investigation of the relationship between the magnitude of exposure to a chemical and the nature and magnitude of adverse effects resulting from exposure. In addition to being a toxicological evaluation, it may also include descriptions of apparent effects (e.g., stressed vegetation). Toxicity thresholds are usually expressed in units of concentration when the medium of concern is in intimate contact with the receptor, such as soil for soil invertebrates. For vertebrates such as mammals and birds, toxicity data are typically available as doses, with units equal to mass of contaminant per unit of body mass per unit of time (usually mg/kg-day).

8.3.1.1 Exposure Characterization

As the first step in the ecological effects evaluation, COPCs were selected by comparing contaminant concentrations in surface soil, sediment, and surface water to ecological screening levels. For surface soil, chemical concentrations were compared to USEPA Ecological Soil Screening Levels (Eco SSLs) (2007a and supporting documents) because they are the most current screening levels. If USEPA Eco SSLs were not available, Region 5 soil ecological screening levels (ESLs) (USEPA, 2003a) were used next in order of preference, followed by values from Canadian Soil Quality Guidelines (SQGs) (CCME, 1999a, 1999b, and 2001) and ORNL Toxicological Benchmarks for plants (Efroymson et al., 1997a) and invertebrates (Efroymson et al., 1997b), Ecotoxicology of Explosives (Sunahara, et al., 2009), and Los Alamos National Laboratory (LANL) ECORISK database (Version 3.1; 2012). Because most of the Region 5 ESLs are based on risks to mammals, screening levels specific to plants or invertebrates from other sources were used preferentially for those endpoints, when available. Table 8-2 presents the SSLs for plants, invertebrates, mammals, and birds for each chemical and the sources of each value. For sediment, the Region 5 sediment ESLs (USEPA, 2003a), followed by Region 3 freshwater sediment ESLs (USEPA, 2006b) and freshwater sediment screening levels from the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRTs) (Buchman, 2008) were used in COPC selection. These sediment screening values are protective of sediment invertebrates. For surface water, USEPA National Recommended Water Quality Criteria, chronic freshwater (2009a), followed by USEPA Region 5 water ESLs (2003a) and Region 3 freshwater ESLs (USEPA, 2006c) were used in COPC selection. A value for perchlorate was obtained from Dean et al. (2004). These surface water screening values are protective of aquatic organisms.

The following rules were used to select COPCs for SWMU 22:

- A contaminant was retained as a COPC for risks to terrestrial plants, soil invertebrates, sediment invertebrates, or aquatic organisms if the maximum detected concentration in surface soil, sediment, or surface water exceeded the associated screening level or if a screening level was not available.

- If a contaminant had a maximum detected concentration that exceeded the associated SSL for birds or mammals or if a screening level was not available for a bioaccumulative chemical, then the chemical was retained for food-chain modeling for wildlife. If the ecological effects quotients (EEQs) were greater than 1.0 based on the conservative food-chain model, the chemical was selected as a COPC. The EEQ is defined in Section 8.3.1.2.

- All bioaccumulative chemicals detected in sediment were retained for food-chain modeling for wildlife. If the EEQs were greater than 1.0 based on the conservative food-chain model, the chemical was selected as a COPC.

Contaminants retained as COPCs were further evaluated as part of Step 3a of the eight-step ERA process.

The doses in mg/kg-day were estimated for terrestrial wildlife (mammals and birds) using exposure dose equations. The food-chain models were conducted on a dry-weight basis to be consistent with the soil and sediment concentrations, which were reported on a dry-weight basis. Therefore, the concentrations in food items were estimated on a dry-weight basis. The following generic equation was used to calculate the EPCs for terrestrial wildlife from exposure to chemicals in soil, sediment, surface water, and associated food items such as plants, soil invertebrates, sediment invertebrates, and fish:

$$CDI = \frac{[(Cf * If) + (Cs * Is) + (Cw * Iw)] * H}{BW}$$

where:

CDI	=	Chronic daily intake (mg/kg)-day
Cf	=	Chemical concentration in food – (see discussion below)
Cs	=	Chemical concentration in surface soil or sediment (mg/kg)
Cw	=	Chemical concentration in surface water (mg/L)
If	=	Food ingestion rate (kg/day)
Is	=	Incidental surface soil ingestion rate (kg/day)
Iw	=	Water ingestion rate (L/day)
H	=	Portion of food intake from the contaminated area (unitless)
BW	=	Body weight (kg)

The exposure factors used for the food-chain model, their derivation, and the receptor profiles for the surrogate species are presented in Appendix F. The exposure assumptions (e.g., ingestion rate, body weight) were obtained primarily from the Wildlife Exposure Factors Handbook (USEPA, 1993b) and USEPA Eco SSL Guidance Attachment 4-1 (2007a), with other sources used as necessary.

Chemical concentrations in food items for soil invertivorous and herbivorous receptors were calculated using soil-to-invertebrate or soil-to-plant BAFs and regression equations from the USEPA Eco SSL

Guidance Document Attachment 4-1 (2007a) or BAFs from published sources. The following equation was used to calculate chemical concentrations in plants or invertebrates when BAFs were used:

$$\text{Cf} = \text{Cs} * \text{BAF}$$

where:

Cf	=	Contaminant concentration in food (mg/kg)
Cs	=	Contaminant concentration in surface soil (mg/kg)
BAF	=	Biota-soil bioaccumulation factor (unitless)

Chemical concentrations in food items for piscivorous receptors were calculated using sediment-to-fish biota-sediment bioaccumulation factors (BSAFs) and sediment-to-invertebrate BSAFs. Contaminant concentrations in food items for piscivorous receptors were calculated as follows:

$$\text{Cf (for inorganics)} = \text{Csd} * \text{BSAF}$$

Where:

Cf	=	Contaminant concentration in food (mg/kg)
Csd	=	Contaminant concentration in sediment (mg/kg)
BSAF	=	Biota-sediment bioaccumulation factor (unitless)

$$\text{Cf (for organics)} = \text{Csd} * \left(\text{BSAF} * \frac{\%\text{L}}{\%\text{TOC}} \right)$$

where:

Cf	=	Contaminant concentration in food (mg/kg)
Csd	=	Contaminant concentration in sediment (mg/kg)
BSAF	=	Biota-sediment bioaccumulation factor (for organics) (unitless)
%L	=	Percent lipids [14.4% (dry weight)]
%TOC	=	Percent total organic carbon (1.2% average of site data; see Table 8-4)

A default value of 1.0 was used for the BAF and BSAF when chemical-specific data were not available. Sources of BAFs and BSAFs are documented in Appendix F.

The food-chain model scenarios were calculated using various exposure assumptions to present a range of potential risks. For selecting chemicals as COPCs, the following Tier 1 exposure assumptions were used:

- Maximum soil concentrations.
- 90th Percentile BAFs (or maximum value if a 90th percentile value was not available) or regression equations.
- Conservative receptor body weight and ingestion rates.
- Receptors spend 100 percent of their time at the site.

8.3.1.2 Risk Characterization

An EEQ approach was used to characterize the risk to ecological receptors. This approach characterizes potential effects by comparing exposure concentrations with effects data. The EEQs for terrestrial receptors were calculated as follows:

$$EEQ = \frac{Css}{SSSL}$$

where:

EEQ	=	Ecological effects quotient (unitless)
C_{ss}	=	Contaminant concentration in surface soil (µg/kg or mg/kg)
SSSL	=	Surface soil screening level (µg/kg or mg/kg)

The EEQs for sediment invertebrates were calculated as follows:

$$EEQ = \frac{Csd}{SdSL}$$

where:

EEQ	=	Ecological effects quotient (unitless)
Csd	=	Chemical concentration in sediment (µg/kg or mg/kg)
SdSL	=	Sediment screening level (µg/kg or mg/kg)

The EEQs for aquatic organisms were calculated as follows:

$$EEQ = \frac{Csw}{SwSL}$$

where:

EEQ	=	Ecological effects quotient (unitless)
Csw	=	Chemical concentration in surface water (µg/L)
SwSL	=	Surface water screening level (µg/L)

The EEQs for terrestrial wildlife were calculated as follows:

$$EEQ = \frac{CDI}{TRV}$$

where:

EEQ	=	Ecological effects quotient (unitless)
CDI	=	Chronic daily intake dose (mg/kg-day)
TRV	=	Toxicity reference value [no observed adverse effect (NOAEL) or low observed adverse effect (LOAEL)] (mg/kg-day)

An EEQ of greater than 1.0 was considered to indicate potential risk, although such values do not necessarily indicate that an effect will occur but only that a low (i.e., conservative) threshold has been exceeded.

8.3.2 Tier 1, Step 2: Selection of Contaminants of Potential Concern

Tables 8-3 through 8-5 provide the results of the COPC selection for surface soil, sediment, and surface water, respectively. Tables 8-6 and 8-7 present the results of the Tier 1 food-chain model for surface soil and sediment, respectively.

8.3.2.1 Soil Invertebrates

Table 8-3 presents the COPC selection for soil invertebrates in SWMU 22 surface soil. Three inorganics (chromium, hexavalent chromium, and mercury) were selected as COPCs because they were detected at maximum concentrations that resulted in EEQs greater than 1.0.

8.3.2.2 Terrestrial Plants

Table 8-3 presents the COPC selection for terrestrial plants in SWMU 22 surface soil. Hexavalent chromium was selected as a COPC because the concentration resulted in an EEQ greater than 1.0.

8.3.2.3 Sediment Invertebrates

Table 8-4 presents the COPC selection for sediment invertebrates in the Turkey Creek tributary. Three inorganics (arsenic, barium, and mercury) were selected as COPCs because they were detected at maximum concentrations that resulted in EEQs greater than 1.0.

8.3.2.4 Aquatic Organisms

Table 8-5 presents the COPC selection for aquatic organisms in the Turkey Creek tributary. Two total inorganics (cadmium and lead) and one filtered inorganic (cadmium) were selected as COPCs because they were detected at maximum concentrations that resulted in EEQs greater than 1.0.

8.3.2.5 Wildlife

Tables 8-6 and 8-7 summarize the results of the Tier 1 inputs food-chain modeling for terrestrial (invertivorous and herbivorous) and piscivorous receptors, respectively. Appendix F presents the calculation worksheets. The following summarizes the results of the food-chain modeling for terrestrial receptors using maximum concentrations and Tier 1 input parameters:

- Herbivorous mammal and bird: One inorganic (mercury) had an EEQ greater than 1.0 in the food-chain model.

- Invertivorous mammal: Two inorganics (cadmium and mercury) had EEQs greater than 1.0 in the food-chain model

- Invertivorous bird: Two inorganics (lead and mercury) had EEQs greater than 1.0 in the food-chain model

- Piscivorous mammal: Two inorganics (arsenic and mercury) had EEQs greater than 1.0 in the food-chain model

- Piscivorous bird: Two inorganics (lead and mercury) had EEQs greater than 1.0 in the food-chain model

8.4 TIER 2, STEP 3A – COPC REFINEMENT

Step 3a consists of refining the conservative exposure assumptions/concentrations used to evaluate potential risks to ecological receptors and re-evaluating the analytical data using benchmarks that are more appropriate for the assessment endpoints. The objective of the Step 3a refinement was to better define those chemicals that contribute to potentially unacceptable levels of ecological risk and to identify and eliminate from further consideration those COPCs that were retained because of the use of very conservative exposure scenarios. The Step 3a evaluation is designed to eliminate chemicals from further evaluation for certain groups of receptors. For example, a chemical might not be retained as a COPC in soil based on low risks to plants but might be retained for evaluating risks to wildlife. This is important because if the site proceeds further to a BERA, the studies in the BERA should only focus on the receptors that are at potential risk.

For chemicals evaluated further in Step 3a, the following factors were evaluated, as appropriate, to determine if the risks are great enough to warrant additional evaluations [i.e., proceed to a BERA, develop cleanup levels, proceed to a Corrective Measures Study (CMS)] (all factors may not be discussed for all chemical and/or receptor groups):

- Magnitude of criterion exceedance: Although the magnitude of risks may not relate directly to the magnitude of a criterion exceedance, the magnitude of the criterion exceedance may be one item used in a lines-of-evidence approach to determine the need for further site evaluation. The greater the criterion exceedance, the greater the probability and concern that an unacceptable risk exists.

- Frequency of chemical detection and spatial distribution: A chemical detected at a low frequency typically is of less concern than a chemical detected at higher frequency if toxicity, concentrations, and spatial areas represented by the data are similar. All else being equal, chemicals detected frequently were given greater consideration than those detected relatively infrequently. In addition, the spatial distribution of a chemical may be evaluated to determine the area that a sample result represents.

- Contaminant bioavailability: Many contaminants (especially inorganics) are present in the environment in forms that are typically not bioavailable, and limited bioavailability was considered when evaluating exposures of receptors to site contaminants. Contaminants with generally less bioavailability are considered to be less toxic than more bioavailable contaminants, all other factors being equal.

- Habitat: Although exceedances of criteria may occur, potential risks to ecological receptors may be minimal if there is little habitat for those receptors. Therefore, the extent of habitat was used qualitatively when considering additional evaluation. Areas with little habitat were less of a concern than areas with suitable habitat to support the receptors of interest.

- Alternate benchmarks: These benchmarks are used to further evaluate risks to specific groups of ecological receptors (e.g., plants, invertebrates).

- Food-chain modeling: Exposure via the food chain is a major pathway of concern for chemicals known to significantly bioaccumulate and/or biomagnify. Thus, potential risk to upper-level receptors was evaluated using food-chain models. The Tier 1 exposure doses calculated for terrestrial wildlife were recalculated using the following Tier 2, Step 3a exposure assumptions and chemical concentrations:

  - Average soil/sediment/surface water concentrations
  - Median or mean BAFs (if available)
  - Average receptor body weights and ingestion rates

- Background: Concentrations of chemicals in surface soil were compared to background concentration data. If the concentration of a detected chemical was not statistically greater than the background concentration, the chemical was considered similar to background, not site-related, and eliminated as a COPC. Section 5 presents the statistical background evaluation for surface soil. For this reason, cadmium and chromium were eliminated as COPCs in surface soil and were not further evaluated. Chromium speciation was performed on one surface soil sample in which hexavalent chromium was detected at a concentration of 1.31 mg/kg. The concentration of total chromium in this same sample was 16.5 mg/kg. No background data are available for hexavalent chromium. However, concentrations of total chromium were within background levels; consequently, concentrations of hexavalent chromium are also considered to be within background levels. Hexavalent chromium was not further evaluated.

Summaries of the Step 3a evaluation for soil invertebrates, sediment invertebrates, and aquatic organisms are presented in Tables 8-8 to 8-10, respectively. As part of the Step 3a evaluation for terrestrial wildlife, Tables 8-11 and 8-12 present the results of the food-chain models for surface soil and sediment, respectively, using Step 2a exposure assumptions and chemical concentrations. A detailed evaluation of the Step 3a evaluation is discussed in the following sections.

8.4.1 Tier 2, Step 3a: Soil Invertebrates

Mercury was initially selected as a COPC for soil invertebrates because the maximum concentration exceeded the screening value. The Region 5 soil ESL for mercury is based on the ORNL benchmark for invertebrates (Efroymson et al., 1997b). The ORNL document states that there is significant uncertainty in the value because of the limited data set. However, a Canadian SQG of 12 mg/kg for the protection of plants and invertebrates was developed for mercury using a much more robust data set (CCME, 1999b). All mercury concentrations were less than the Canadian SQG, so risks to soil invertebrates are expected to be minimal. Mercury was eliminated as a COPC for soil invertebrates.

8.4.2 Tier 2, Step 3a: Terrestrial Plants

No chemicals were retained as COPCs for terrestrial plants.

8.4.3 Tier 2, Step 3a: Sediment Invertebrates

Arsenic, barium, and mercury were initially selected as COPCs for sediment invertebrates because maximum concentrations exceeded screening values.

Arsenic was initially selected as a COPC because the maximum detected concentration of 14.7 mg/kg exceeded the screening level of 9.79 mg/kg. The screening level is a threshold effect concentration (TEC), which is the concentration at which adverse effects are not expected (MacDonald et al., 2000). The probable effect concentration (PEC) for arsenic is 33 mg/kg. No samples had arsenic concentrations greater than the PEC; therefore, arsenic was eliminated as a COPC for potential risks to sediment invertebrates.

Barium was initially selected as a COPC because the maximum detected concentration of 173 mg/kg at SD03 exceeded the screening level of 48 mg/kg. This location is east of the site in the tributary to Turkey Creek. The source of barium at this location is probably not related to SWMU 22 because much lower concentrations were found in the upstream samples. Also, much lower concentrations were found at downstream locations and in site drainage ditches, indicating that barium is not a widespread contaminant. This is further supported by the fact that barium concentrations in only two samples exceeded the screening level, and barium was detected at concentrations much lower than 173 mg/kg in nearby surface soil samples. Barium is not generally considered toxic and although there are limited toxicity data for sediment invertebrates, the NOAA SQUIRT lists a threshold effects level (TEL) for barium of 130.1 mg/kg (Buchman, 2008). TELs are similar to TECs except they are saltwater values. The maximum detected concentration only slightly exceeds the TEL. Therefore, because only the maximum concentration of barium slightly exceeds the TEL and because barium is not a widespread contaminant, barium was eliminated as a COPC for potential risks to sediment invertebrates.

Mercury was initially selected as a COPC because the maximum detected concentration of 0.26 mg/kg exceeded the screening level of 0.174 mg/kg. The mercury concentration in only one sample exceeded the screening level, and none of the concentrations were greater than the PEC of 1.06 mg/kg (MacDonald et al., 2000). Therefore, potential impacts from mercury are unlikely, and mercury was eliminated as a COPC for potential risks to sediment invertebrates.

8.4.4 Tier 2, Step 3a: Aquatic Organisms

Total cadmium, dissolved cadmium, and total lead were detected at maximum concentrations exceeding screening values.

Total cadmium and dissolved cadmium were detected at maximum concentrations (1.7 and 0.26 µg/kg, respectively) exceeding the screening value of 0.25 µg/kg. The dissolved cadmium concentration only slightly exceeded the screening value in one sample. In accordance with USEPA (1993c), dissolved metals more closely approximate the bioavailable fraction of metals in the water column than total recoverable metal; therefore, impacts to aquatic organisms from cadmium are expected to be minimal. For these reasons, cadmium was eliminated as a COPC.

Total lead was detected at a maximum concentration (9.6 µg/kg) exceeding the screening value of 2.5 µg/kg; however, the maximum concentration of dissolved lead was less than the screening value. Therefore, risks to aquatic organisms are expected to be minimal, and lead was eliminated as a COPC.

8.4.5 Tier 2, Step 3a: Terrestrial Wildlife

As presented in Section 8.3.2.5, the EEQs from the terrestrial food-chain modeling were greater than 1.0 for several inorganics using maximum chemical concentrations and Tier 1 exposure assumptions. Therefore, as part of the Step 3a refinement, risks were recalculated using average chemical concentrations, and the Tier 2, Step 3a, exposure parameters as presented in Appendix F. These parameters are summarized in the exposure factors table in Appendix F. The food-chain model calculation sheets are also provided in Appendix F.

Tables 8-11 and 8-12 present the result of the less conservative food-chain model for surface soil and sediment, respectively. Associated risks to mammal and birds are as follows:

- Herbivorous mammal and bird: No EEQs were greater than 1.0; therefore, impacts to herbivorous mammals and birds are not expected from chemicals detected in surface soil at SWMU 22.

- Invertivorous mammal and bird: The EEQ for mercury for the shrew (1.2) and woodcock (8.3) were greater than 1.0 using the NOAEL as the TRV. The mercury EEQ for the shrew was only slightly greater than 1.0. The LOAEL EEQ for mercury was less than 1.0 for the shrew and woodcock. Although the SWMU boundary encompasses 50 acres, the majority of the surface soil samples were collected within the fenced area, where there is very little habitat for ecological receptors. Also, the average mercury soil concentration of 0.05 mg/kg used in the Tier 2 food-chain model was only slightly greater than the average mercury background concentration of 0.04 mg/kg. Therefore, site risks are only slightly greater than background risks. For that reason, impacts to invertivorous mammals and birds are expected to be minimal, and mercury was eliminated as a COPC.

- Piscivorous mammals and birds: No EEQs were greater than 1.0; therefore, impacts to piscivorous mammals and birds are not expected from chemicals detected in sediment at SWMU 22.

8.5 ECOLOGICAL RISK UNCERTAINTY ANALYSIS

This section discusses some of the uncertainties associated with the SWMU 22 ERA.

8.5.1 Uncertainty in Assessment Endpoints and Measurement Endpoints

Measurement endpoints were used to evaluate the assessment endpoints selected for the ERA. For the SLERA, the measurement endpoints were not the same as the assessment endpoints. Measurement endpoints were used to predict effects to the assessment endpoints by selecting surrogate species to be evaluated. For example, a decrease in reproduction of a shrew was used to assess a decrease in reproduction of the small mammal population. However, predicting a decrease in reproduction of a shrew may either underprotect or overprotect the small mammal population based on differences in ingestion rates, toxicity, food preferences, home ranges, etc. among different species.

Risks to reptiles were not quantitatively evaluated because exposure factors are not established for most species and because toxicity data are very limited (see below for a discussion of potential risks to the timber rattlesnake). As discussed in Section 8.2.1.1, several endangered and threatened species or species of special concern are present at NSA Crane and potentially may inhabit SWMU 22. Risks to these species were not specifically calculated, so the uncertainties of not calculating risks to these species are presented here. Unacceptable risks to the bobcat, bald eagle, Northern harrier, and osprey are not expected because habitat is not available. The bobcat has a significantly larger home range. The bald eagle and osprey require open water habitat, which is not available at SWMU 22, but is available in Lake Greenwood. The Northern harrier prefers wetlands habitat, which is not available at SWMU 22. However, there is uncertainty with this conclusion because risks were not quantitatively evaluated.

The loggerhead shrike and sedge wren consume mostly aboveground insects such as caterpillars, beetles, spiders, and flies, as opposed to the worms that are consumed by the American woodcock in the food-chain model. Because worms are in direct contact with soil, it is expected that they would have greater levels of SWMU 22 contaminants than aboveground insects; therefore, risks to the woodcock from consuming worms are expected to be greater than risks to the loggerhead shrike and sedge wren from consuming aboveground insects. By protecting the woodcock, these other invertivorous birds will also be protected. The American bittern is a marshland bird that feeds on fish, frogs, eels, insects, and water snakes. The tributaries at SWMU 22 do not provide preferred habitat (marshes) for the bittern, so it is not likely that it will be present in this area. As mentioned in Section 8.2.1.1, the presence of the Indiana bat has not been documented at SWMU 22; however, three Indiana bats were captured approximately 1 mile from the site. Because the site is mainly mowed grass and is limited forest, limited habitat exists for the Indiana bat at SWMU 22.

Finally, there are uncertainties in risks to reptiles because there is a lack of exposure factors for reptiles and a lack of reptile toxicity data for the detected chemicals. As discussed in Section 8.2.1.1, one threatened reptilian species, the timber rattlesnake, is listed as potentially present at NSA Crane. Based on the preferred habitat of the timber rattlesnake and the ecology of SWMU 22, this species likely does not inhabit areas of SWMU 22. Risks to carnivorous reptiles were not specifically calculated; however, risks are accounted for by using invertivorous birds and mammals as surrogates.

8.5.2 Uncertainty in Exposure Characterization

The contaminant dose to terrestrial wildlife was calculated using an equation that incorporates ingestion rates, body weights, BAFs, and other exposure factors. The exposure factors were obtained from literature studies or predicted using various equations. Ingestion rates and body weights vary among species, especially among species inhabiting different areas. This was taken into account when selecting exposure parameters from USEPA (1993b), and an attempt was made to minimize the uncertainties associated with the exposure characterization by selecting exposure parameters from studies conducted in Indiana and surrounding states.

Bioaccumulation of contaminants into various biological media (e.g., plants, invertebrates, small mammals) depends on characteristics of the media such as pH, organic carbon, etc. Therefore, actual BAFs at the sites may be different than those used in the SLERA and obtained from the literature. Also, the bioavailability of contaminants reported in toxicity studies is typically greater than the bioavailability of these contaminants in environmental media. Typically, highly bioavailable forms of the chemicals are used when conducting toxicity tests and/or conducting dosing studies for wildlife.

There is uncertainty in the chemical data collected at the site. Measured levels of chemicals are only estimates of true site chemical concentrations. At SWMU 22, samples were deliberately biased toward known or suspected high concentrations, so predicted doses are probably higher than actual doses. Whereas this is a conservative approach in predicting exposure concentrations, actual exposure of ecological receptors to chemical concentrations at SWMU 22 is likely overestimated. In particular, wildlife that typically roam over multiple sample locations are unlikely to obtain all of their food from within the most contaminated areas at SWMU 22.

8.5.3 <u>Uncertainty in Ecological Effects Data</u>

Uncertainty exists in the ecological effects data, including the screening levels and wildlife TRVs. Several of the screening levels are very conservative and typically are based on studies where the bioavailability of the chemical is much greater than it is in the environment. Also, toxicity data were not available or were limited for some chemicals.

The NOAELs/LOAELs used for the wildlife endpoint species are based on species other than the endpoint species (e.g., rats, mice). Uncertainty exists in the application of toxicity data across species because the contaminant may be more or less toxic to the endpoint species than it was to the test study species.

8.5.4 <u>Uncertainty in Risk Characterization</u>

Risks are possible if an EEQ is greater than or equal to 1.0 regardless of the magnitude of the EEQ. However, the magnitude of effects to ecological receptors cannot be inferred based on the magnitude of the EEQ. Rather, an EEQ greater than 1.0 simply indicates that the dose used to derive the TRV was exceeded.

Finally, there is uncertainty in how the predicted risks to a species at a site translate into risk to the population in the area as a whole.

8.6 ECOLOGICAL RISK SUMMARY AND CONCLUSIONS

This ERA evaluated surface soil, sediment, and surface water. Based on the initial screening of the chemical data, several chemicals were initially selected as COPCs in surface soil, sediment, and surface water because they were detected at concentrations that exceeded conservative screening levels, they had EEQs greater than 1.0 in the conservative food-chain model, or because they did not have screening levels.

These chemicals were then further evaluated to refine the list of COPCs, and to better characterize risks to ecological receptors. The following presents the results of the SLERA.

8.6.1 Soil Invertebrates and Terrestrial Plants

No chemicals were retained as COPCs for risks to terrestrial plants or soil invertebrates.

8.6.2 Sediment Invertebrates and Aquatic Organisms

No chemicals were retained as COPCs for risks to sediment invertebrates or aquatic organisms.

8.6.3 Mammals and Birds

No chemicals were retained as COPCs for herbivorous receptors, invertivorous receptors, or piscivorous receptors.

TABLE 8-1

ASSESSMENT ENDPOINTS AND MEASUREMENT ENDPOINTS
SWMU 22
NSA CRANE, CRANE, INDIANA

Assessment Endpoint	Measurement Endpoint
Adverse effects on the survival, reproduction, and/or growth of soil invertebrates	• Survival, growth, and/or reproduction of soil invertebrates were evaluated by comparing the measured concentrations of chemicals in the surface soil to invertebrate soil screening levels.
Adverse effects on the survival, reproduction, and/or growth of sediment invertebrates	• Survival, growth, and/or reproduction of sediment invertebrates were evaluated by comparing the measured concentrations of chemicals in the sediment to sediment screening levels.
Adverse effects on the survival, reproduction, and/or growth of aquatic organisms	• Survival, growth, and/or reproduction of aquatic organisms were evaluated by comparing the measured concentrations of chemicals in the surface water to surface water screening levels.
Adverse effects on the survival, reproduction, and/or growth of terrestrial plants	• Survival, growth, and/or reproduction of terrestrial plants were evaluated by comparing the measured concentrations of chemicals in the surface soil to plant soil screening levels.
Adverse effects on the survival, reproduction, and/or increase in development effects of invertivorous birds and mammals	• Survival, reproduction, and/or increase in development effects of invertivorous birds and mammals were evaluated by comparing the estimated ingested dose of contaminants in the surface soil and earthworms to No Observed Adverse Effects Levels (NOAELs) and Lowest Observed Adverse Effects Levels (LOAELs) for surrogate wildlife species.
Adverse effects on the survival, reproduction, and/or increase in development effects of herbivorous birds and mammals	• Survival, reproduction, and/or increase in development effects of herbivorous birds and mammals were evaluated by comparing the estimated ingested dose of contaminants in the surface soil and plants to NOAELs and LOAELs for surrogate wildlife species.
Adverse effects on the survival, reproduction, and/or increase in development effects of piscivorous birds and mammals	• Survival, reproduction, and/or increase in development effects of piscivorous birds and mammals were evaluated by comparing the estimated ingested dose of contaminants in the sediment and aquatic organisms to NOAELs and LOAELs for surrogate wildlife species.

TABLE 8-2

ECOLOGICAL SOIL SCREENING LEVELS
SWMU 22
NSA CRANE
CRANE, INDIANA

Parameter	Ecological Soil Screening Level							
	Plant		Invertebrate		Avian		Mammal	
Explosives (mg/kg)	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**
RDX	9537	Sunahara	98	Sunahara	12	LANL	130	LANL
Inorganics (mg/kg)								
ARSENIC	18	EcoSSL	17	CCME	43	EcoSSL	46	EcoSSL
BARIUM	500	ORNL	330	EcoSSL	820	LANL	2000	EcoSSL
CADMIUM	32	EcoSSL	140	EcoSSL	0.77	EcoSSL	0.36	EcoSSL
CHROMIUM	78	CCME	0.4	Region 5(1)	26	EcoSSL	34	EcoSSL
HEXAVALENT CHROMIUM	0.4	CCME(2)	0.4	Region 5(1); CCME(2)	26	EcoSSL(2)	130	EcoSSL
LEAD	120	EcoSSL	1700	EcoSSL	11	EcoSSL	56	EcoSSL
MERCURY	12	CCME	0.1	Region 5	0.013	LANL	1.7	LANL
SELENIUM	0.52	EcoSSL	4.1	EcoSSL	1.2	EcoSSL	0.63	EcoSSL
SILVER	560	EcoSSL	50	ORNL(4)	4.2	EcoSSL	14	EcoSSL

Ecological Screening Level sources used in the order of preference:
EcoSSL - EPA Ecological Soil Screening Levels (USEPA, 2005a-d, 2006a, 2007b, 2008)
Region 5 - USEPA Region 5 Ecological Screening Levels (USEPA, 2003).
CCME - Canadian Soil Quality Guidelines (CCME, 1999a, 1999b, 2001).
ORNL - Oak Ridge National Laboratory Toxicological Benchmarks for plants and invertebrates (Efroymson et al., 1997a, 1997b).
Sunahara (Sunahara, et al., 2009)
LANL (3.1 database; LANL, 2012)

Footnotes:
1 - Value from ORNL benchmark, which is based on a hexavalent chromium study.
2 - Provisional value based on risk to plants.
3 - Based on total chromium.
4 - Value for microorganisms.

TABLE 8-3

SURFACE SOIL ECOLOGICAL COPC SELECTION
SWMU 22
NSA CRANE
CRANE, INDIANA

parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Sample of Maximum Detection	Range of Nondetects	Average of Detections(1)	Average of All Results(2)	Screening Levels(3) Plants	Screening Levels(3) Invertebrates	Screening Levels(3) Birds	Screening Levels(3) Mammals	EEQs(4) Plants	EEQs(4) Invertebrates	EEQs(4) Birds	EEQs(4) Mammals	Deletion or Selection of COPCs for Invertebrates/Plants: COPC (yes/no)?	Deletion or Selection of COPCs for Invertebrates/Plants: Rationale	Further Evaluated in Terrestrial Food Chain Modeling(5): Evaluated (yes/no)?	Further Evaluated in Terrestrial Food Chain Modeling(5): Rationale
Explosives (mg/kg)																			
RDX	1/29	0.37 J	0.37 J	22SS0250002	0.16 - 0.20	0.37	0.094	9537	98	12	130	0.00004	0.004	0.03	0.003	NO	BSL	NO	BSL
Inorganics (mg/kg)																			
ARSENIC	23/23	2.4	9.8 J	22SS0250002	-	4.6	4.6	18	17	43	46	0.54	0.58	0.23	0.21	NO	BSL	NO	BSL
BARIUM	23/23	12.8 J	144 J	22SB0140002	-	52	52	500	330	820	2000	0.29	0.44	0.18	0.07	NO	BSL	NO	BSL
CADMIUM	23/23	0.057 J	0.78	22SS0250002	-	0.22	0.22	32	140	0.77	0.36	0.02	0.01	**1.01**	**2.17**	NO	BSL	YES	ASL
CHROMIUM	24/24	3.4 J	25.4 J	22SS0250002	-	12.0	12.0	78	0.4	26	34	0.33	**63.5**	0.98	0.75	YES	ASL	NO	BSL
HEXAVALENT CHROMIUM	1/1	1.31	1.31	22SB0200002	-	1.31	1.31	0.4	0.4	26	130	**3.3**	**3.3**	0.05	0.01	YES	ASL	NO	BSL
LEAD	23/23	2.8 J	31.7 J	22SS0250002	-	10.1	10.1	120	1700	11	56	0.26	0.02	**2.88**	0.57	NO	BSL	YES	ASL
MERCURY	9/23	0.02 J	0.6 J	22SS0250002	0.02 - 0.079	0.10	0.05	12	0.1	0.013	1.7	0.05	**6.00**	**46.2**	0.35	YES	ASL	YES	ASL
SELENIUM	23/23	0.086 J	0.48 J	22SS0250002	-	0.26	0.26	0.52	4.1	1.2	0.63	0.92	0.12	0.40	0.76	NO	BSL	NO	BSL
SILVER	5/23	0.021 J	0.038 J	22SB0110002	0.04 - 0.04	0.028	0.022	560	50	4.2	14	0.0001	0.001	0.01	0.003	NO	BSL	NO	BSL
Miscellaneous Parameters																			
PH (S.U.)	3/3	7.3	8.2	22SB0080002	-	7.7	7.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON (mg/kg)	2/2	4100	11000	22SS0220002	-	7550	7550	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Shaded chemical name indicates that the chemical was selected as a COPC or retained for food chain modeling. Shaded cells indicate that the EEQ exceeds 1.

1 - Average of detected concentrations only.
2 - Average of all analytical results including one-half of the detection limit for non-detects.
3 - The sources of the screening levels are presented in Table 8-2.
4 - EEQ is calculated by dividing the chemical concentration by its screening level. Value is unitless.
5 - Chemicals with EEQs for birds or mammals greater than 1.0 or bioaccumulative chemicals without bird or mammal screening values are retained for food chain modeling.

Abbreviations:
COPC - Chemical of Potential Concern
EEQ - Ecological Effects Quotient
NA - Not applicable
S.U. - Standard Units

Rationale Codes for COPC Selection:
ASL - Above COPC Screening Level
BSL - Below COPC Screening Level

TABLE 8-4

SEDIMENT ECOLOGICAL COPC SELECTION
SWMU 22
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Sample of Maximum Detection	Average of Detections(1)	Average of All Results(2)	Screening Level(3)	Source of Screening Level	EEQ(4)	COPC for Sediment Invertebrates (yes/no)?	Rationale for COPC selection	Retained for Food Chain Model(5)
Inorganics (mg/kg)												
ARSENIC	17/17	1.2 J	14.7	22SD0230006	4.1	4.1	9.79	Region 5	1.5	**YES**	**ASL**	YES
BARIUM	17/17	8.6 J	173 J	22SD0030006	37.3	37.3	48	NOAA	3.6	**YES**	**ASL**	NO
CADMIUM	17/17	0.071 J	0.88 J	22SD0060006	0.3	0.3	0.99	Region 5	0.9	NO	BSL	YES
CHROMIUM	17/17	2.5 J	13.9 J	22SD0030006	7.4	7.4	43.4	Region 5	0.3	NO	BSL	YES
LEAD	17/17	4 J	20 J	22SD0080624	9.7	9.7	35.8	Region 5	0.6	NO	BSL	YES
MERCURY	5/17	0.038 J	0.26	22SD0090006	0.1	0.04	0.174	Region 5	1.5	**YES**	**ASL**	YES
SELENIUM	17/17	0.044 J	0.61	22SD0230006	0.2	0.2	2	Region 3	0.3	NO	BSL	YES
SILVER	3/17	0.02 J	0.025 J	22SD0010006	0.02	0.02	0.5	Region 5	0.1	NO	BSL	YES
Miscellaneous Parameters												
PH (S.U.)	3/3	6.1	7.3	22SD0060624	6.7	6.7	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON (mg/kg	19/19	670	39000	22SD0180006_20120512	11988	11988	NA	NA	NA	NA	NA	NA

Shaded chemical name indicates that the chemical was selected as a COPC. Shaded cells indicate that the EEQ exceeds 1.

1 - Average of detected concentrations only.
2 - Average of all analytical results including one-half of the detection limit for non-detects.
3 - Order of preference was Region 5, Region 3, and NOAA
 - Region 5 - USEPA Region 5 Ecological Screening Levels (USEPA, 2003a)
 - Region 3 - USEPA Region 3 BTAG Freshwater Sediment Screening Levels (USEPA, 2006)
 - NOAA - National Oceanic and Atmospheric Administration marine sediment screening value (Buchman, 2008)
4 - EEQ is calculated by dividing the maximum detected chemical concentration by its screening level. Value is unitless.
5 - Chemicals classified as bioaccumulative chemicals in accordanace with USEPA (2000) are retained for food chain modeling.

Abbreviations:
COPC - Chemical of Potential Concern
EEQ - Ecological Effects Quotient
NA - Not applicable
S.U. - Standard Units

Rationale Codes for COPC Selection:
ASL - Above COPC Screening Level
BSL - Below COPC Screening Level

TABLE 8-5

SURFACE WATER ECOLOGICAL COPC SELECTION
SWMU 22
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Sample of Maximum Detection	Range of Nondetects	Average of Detections[1]	Average of All Results[2]	Screening Level[3]	Source of Screening Level	EEQ[4]	COPC (yes/no)?	Rationale for COPC selection
Explosives (µg/L)												
HMX	7/15	0.15 J	0.87	22SW003	0.23 - 0.48	0.59	0.35	150	Region 3	0.006	NO	BSL
PERCHLORATE	1/8	0.4 J	0.4 J	22SW002	0.4 - 0.4	0.40	0.23	9300	Dean et al.	0.00004	NO	BSL
RDX	7/15	0.39 J	2.5	22SW017	0.246 - 0.48	1.04	0.57	360	Region 3	0.007	NO	BSL
Inorganics (µg/L)												
ARSENIC	8/12	0.18 J	1.5	22SW004	0.18 - 0.18	0.58	0.42	150	NRWQC	0.010	NO	BSL
BARIUM	12/12	26.4	74.8	22SW003	-	55	55	220	Region 5	0.34	NO	BSL
CADMIUM	6/12	0.23 J	1.7 J	22SW024	0.04 - 0.083	0.54	0.28	0.25	NRWQC	**6.8**	YES	ASL
CHROMIUM	11/11	0.4 J	3	22SW004	-	0.92	0.92	11	NRWQC	0.27	NO	BSL
LEAD	7/11	0.86 J	9.6	22SW006	0.22 - 0.22	4.3	2.7	2.5	NRWQC	**3.8**	YES	ASL
MERCURY	5/12	0.065 J	0.1 J	22SW017_20120511	0.12 - 0.12	0.08	0.07	0.77	NRWQC	0.13	NO	BSL
SELENIUM	5/12	0.1 J	0.56 J	22SW024	0.2 - 0.2	0.21	0.15	5	NRWQC	0.11	NO	BSL
SILVER	1/12	0.032 J	0.032 J	22SW009	0.06 - 0.19	0.03	0.04	3.2	NRWQC	0.010	NO	BSL
Filtered Inorganics (µg/L)												
ARSENIC	5/9	0.19 J	0.35	22SW018	0.18 - 0.18	0.24	0.42	150	NRWQC	0.002	NO	BSL
BARIUM	9/9	26	73.9	22SW003	-	47	55	220	Region 5	0.34	NO	BSL
CADMIUM	3/9	0.066 J	0.26 J	22SW007	0.04 - 0.043	0.19	0.28	0.25	NRWQC	**1.04**	YES	ASL
CHROMIUM	8/8	0.27 J	0.75	22SW004	-	0.40	0.92	11	NRWQC	0.068	NO	BSL
LEAD	3/8	0.11 J	0.69 J	22SW007	0.22 - 0.22	0.39	2.7	2.5	NRWQC	0.28	NO	BSL
MERCURY	2/9	0.067 J	0.068 J	22SW004	0.12 - 0.12	0.07	0.07	0.77	NRWQC	0.09	NO	BSL
SILVER	2/9	0.057 J	0.067 J	22SW006	0.06 - 0.06	0.06	0.04	3.2	NRWQC	0.021	NO	BSL
Miscellaneous Parameters (S.U.)												
PH	1/1	6.3	6.3	22SW023	-	6.3	6.3	NA	NA	NA	NA	NA

Shaded chemical name indicates that the chemical was selected as a COPC. Shaded cells indicate that the EEQ exceeds 1.

1 - Average of detected concentrations only.
2 - Average of all analytical results including one-half of the detection limit for non-detects.
3 - Order of preference was Region 5, Region 3, and NOAA
- NRWQC - USEPA National Recommended Water Quality Criteria (USEPA, 2009)
- Region 5 - USEPA Region 5 Ecological Screening Levels (USEPA, 2003a)
- Region 3 - USEPA Region 3 BTAG Freshwater Sediment Screening Levels (USEPA, 2006)
- Dean - Dean et al., (2004) was used for perchlorate.

4 - EEQ is calculated by dividing the maximum detected chemical concentration by its screening level. Value is unitless.

Abbreviations:
COPC - Chemical of Potential Concern
EEQ - Ecological Effects Quotient
NA - Not applicable
S.U. - Standard units

Rationale Codes for COPC Selection:
ASL - Above COPC Screening Level
BSL - Below COPC Screening Level

TABLE 8-6

TERRESTRIAL FOOD CHAIN MODEL - TIER 1 SCENARIO
INVERTIVOROUS AND HERBIVOROUS RECEPTORS
SWMU 22
NSA CRANE
CRANE, INDIANA

	Herbivorous Receptors EEQs				Invertivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		Woodcock		Short-Tailed Shrew	
Chemical	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based
Inorganics								
CADMIUM	4.5E-02	1.0E-02	4.4E-02	4.9E-03	8.6E-01	2.0E-01	1.5E+00	1.7E-01
LEAD	3.9E-01	6.5E-02	3.6E-02	5.6E-03	2.0E+00	3.4E-01	5.1E-01	7.9E-02
MERCURY	4.9E+01	4.9E+00	5.5E+00	1.1E+00	2.9E+01	2.9E+00	4.9E+00	9.9E-01

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE 8-7

TERRESTRIAL FOOD CHAIN MODEL - TIER 1 SCENARIO
PISCIVOROUS RECEPTORS
SWMU 22
NSA CRANE
CRANE, INDIANA

	Receptor EEQs			
	Belted Kingfisher		Mink	
Chemical	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based
Inorganics				
ARSENIC	6.6E-01	3.3E-01	1.1E+00	2.6E-01
CADMIUM	6.7E-01	1.5E-01	9.4E-01	1.1E-01
CHROMIUM	3.7E-01	6.2E-02	3.3E-01	1.4E-02
LEAD	1.1E+00	1.8E-01	3.0E-01	4.7E-02
MERCURY	1.6E+01	1.6E+00	2.5E+00	4.9E-01
SELENIUM	3.0E-01	1.1E-01	4.8E-01	1.0E-01
SILVER	1.8E-03	6.0E-05	4.7E-04	2.4E-05

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE 8-8

STEP 3A EVALUATION FOR RISKS TO SOIL INVERTEBRATES
SURFACE SOIL COPCs
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Frequency of Detection	Maximum Detected Concentration	Screening Level[1]	Maximum EEQ[2]	Step 3a Evaluation[3]			Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
					Alternate Benchmark		Step 3a Factors Considered in Evaluation		
					Value	Source	Invertebrates		
Inorganics (mg/kg)									
MERCURY	9/23	0.6	0.1	6.0	12	Canadian SQG	Less than alternate benchmark.	Acceptable	No

Footnotes:

1 Sources of ecological screening levels presented in Table 8-2.
2 Maximum detection divided by screening level. Value is unitless.
3 See Section 8.4 for a more detailed Step 3a evaluation.

Acronyms:
COPC = Chemical of Potential Concern
EEQ = Ecological Effects Quotient
Canadian SQG = Canadian Soil Quality Guideline for protection of plants and soil invertebrates (CCME, 1999b).

TABLE 8-9

STEP 3A EVALUATION FOR RISKS TO BENTHIC INVERTEBRATES
SEDIMENT COPCs
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Frequency of Detection	Maximum Detected Concentration	Screening Level(1)	Maximum EEQ(2)	Step 3a Evaluation: Alternate Benchmark Value	Step 3a Evaluation: Alternate Benchmark Source	Step 3a Factors Considered in Evaluation(3)	Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
Inorganics (mg/kg)									
ARSENIC	17/17	14.7	9.79	1.5	33	PEC	No samples exceeded alternate benchmark.	Acceptable	No
BARIUM	17/17	173	48	3.6	130.1	TEL	Only two samples exceeded the screening level. Contamination is not widespread. Only one sample slightly exceeded alternate benchmark.	Acceptable	No
MERCURY	5/17	0.26	0.174	1.5	1.06	PEC	Only one sample exceeded the screening level. No samples exceeded alternate benchmark.	Acceptable	No

Footnotes:
1 Sources of ecological screening level presented in Table 8-4.
2 Maximum detection divided by the screening level. Value is unitless.
3 See Section 8.4 for a more detailed Step 3a evaluation.

Acronyms:
COPC = Chemical of Potential Concern
EEQ = Ecological Effects Quotient
PEC = Probable Effects Concentration (MacDonald, et al., 2000)
TEL = Threshold Effects Level (Buchman, 2008)

TABLE 8-10

STEP 3A EVALUATION FOR RISKS TO AQUATIC ORGANISMS
SURFACE WATER COPCs
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Frequency of Detection	Maximum Detected Concentration	Screening Level[1]	Maximum EEQ[2]	Step 3a Factors Considered in Evaluation[3]	Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
Inorganics (µg/L)							
CADMIUM	6/12	1.7	0.25	6.8	Dissolved metals more closely approximate the bioavailable fraction of metals in the water column and dissolved cadmium concentrations only slightly exceeded the screening value in one sample.	Acceptable	No
LEAD	7/11	9.6	2.5	3.8	Dissolved metals are more closely approximate the bioavailable fraction of metals in the water column and dissolved lead concentrations were less than the screening value.	Acceptable	No
Filtered Inorganics (µg/L)							
CADMIUM	3/9	0.26	0.25	1.04	Concentration in one sample only slightly exceeded the screening level.	Acceptable	No

Footnotes:
1 Sources of ecological screening level presented in Table 8-5.
2 Maximum detection divided by the screening level. Value is unitless.
3 See Section 8.4 for a more detailed Step 3a evaluation.

Acronyms:
COPC = Chemical of Potential Concern
EEQ = Ecological Effects Quotient

TABLE 8-11

TERRESTRIAL FOOD CHAIN MODEL - TIER 2, STEP 3A SCENARIO
INVERTIVOROUS AND HERBIVOROUS RECEPTORS
SWMU 22
NSA CRANE
CRANE, INDIANA

	Herbivorous Receptors EEQs				Invertivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		Woodcock		Short-Tailed Shrew	
Chemical	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based
Inorganics								
CADMIUM	1.6E-02	3.7E-03	1.7E-02	2.0E-03	2.3E-01	5.3E-02	3.2E-01	3.5E-02
LEAD	7.9E-02	1.3E-02	1.1E-02	1.8E-03	4.8E-01	8.0E-02	1.1E-01	1.7E-02
MERCURY	4.6E-01	4.6E-02	5.1E-02	1.0E-02	8.3E+00	8.3E-01	1.2E+00	2.4E-01

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE 8-12

TERRESTRIAL FOOD CHAIN MODEL - TIER 2, STEP 3A SCENARIO
PISCIVOROUS RECEPTORS
SWMU 22
NSA CRANE
CRANE, INDIANA

	Receptor EEQs			
	Belted Kingfisher		Mink	
Chemical	NOAEL-based	LOAEL-based	NOAEL-based	LOAEL-based
Inorganics				
ARSENIC	3.6E-02	1.8E-02	3.6E-02	8.3E-03
LEAD	7.0E-02	1.2E-02	1.3E-02	2.1E-03
MERCURY	9.2E-01	9.2E-02	6.8E-02	1.4E-02

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

FIGURE 8-1

NAVY ECOLOGICAL RISK ASSESSMENT TIERED APPROACH
SWMU 22
NSA CRANE
CRANE, INDIANA

RPM Input and Risk Management Consideration[(3)]

Step 8: Risk Management

Tier 1. Screening Risk Assessment (SRA): Identify pathways and compare exposure point concentrations to benchmarks.
Step 1: Site visit; Pathway Identification/Problem Formulation; Toxicity Evaluation
Step 2: Exposure Estimate; Risk Calculation (SMDP)[(1)]
Proceed to Exit Criteria for SRA

Exit Criteria for the Screening Risk Assessment (SRA): Decision for exiting or continuing the ecological risk assessment.
(1) Site passes SRA. A determination is made that the site poses acceptable risk and shall be closed out for ecological concerns.
(2) Site fails SRA: The site must have both complete pathway and unacceptable risk. As a result, the site will either have an interim cleanup or moves to the Tier 2.

Tier 2. Baseline Ecological Risk Assessment (BERA):
Detailed assessment of exposure and hazard to "assessment endpoints" (ecological qualities to be protected). Develop site-specific values that are protective of the environment.
Step 3a: Refinement of Conservative Exposure Assumptions[(2)] (SRA)----**Proceed to Exit Criteria for Step 3a**

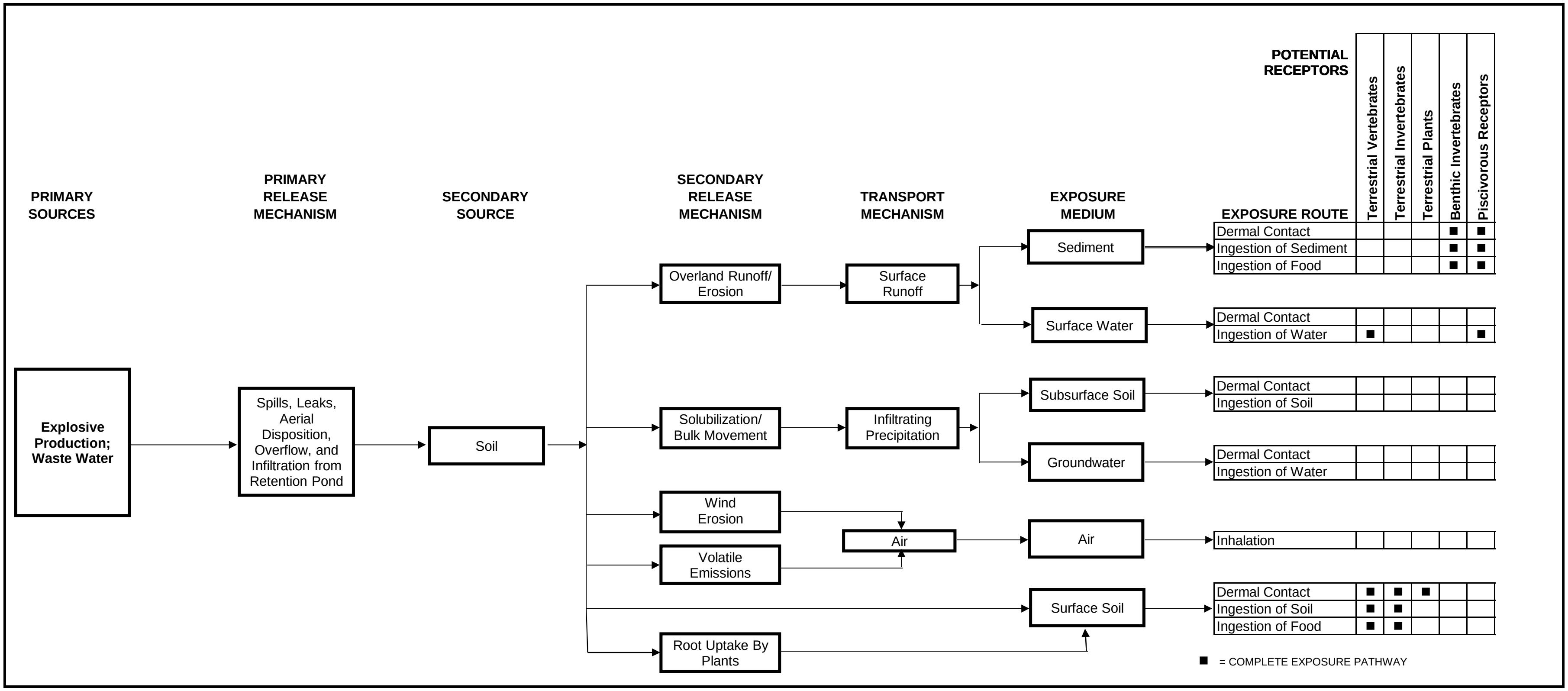
Step 3b: Problem Formulation - Toxicity Evaluation; Assessment Endpoints; Conceptual Model; Risk Hypothesis (SMDP)
Step 4: Study Design/DQO - Line of Evidence; Measurement Endpoints; Work Plan and Sampling & Analysis Plan (SMDP)
Step 5: Verification of Field Sampling Design (SMDP)
Step 6: Site Investigation and Data Analysis (SMDP)
Step 7: Risk Characterization
Proceed to Exit Criteria for BERA

Exit Criteria Step 3a Refinement
(1) If re-evaluation of the conservative exposure assumptions (SRA) supports an acceptable risk determination, then the site exits the ecological risk assessment process.
(2) If re-evaluation of the conservative exposure assumptions (SRA) does not support an acceptable risk determination, then the site continues in the BERA process. **Proceed to Step 3b.**

Exit Criteria Baseline Risk Assessment
1) If the site poses acceptable risk, then no further evaluation and no remediation from an ecological perspective is warranted.
2) If the site poses unacceptable ecological risk and additional evaluation in the form of remedy development and evaluation is appropriate, proceed to Tier 3.

Tier 3. Evaluation of Remedial Alternative (RAGS C)
A. Develop site-specific, risk-based cleanup values.
B. Qualitatively evaluate risk posed to the environment by implementation of each alternative (short-term) impacts and estimate risk reduction provided by each (long-term) impacts; provide quantitative evaluation where appropriate. Weigh alternative using the remaining CERCLA 9 Evaluation Criteria. Plan for monitoring and site closeout.

Notes:
1 See USEPA's 8 Steps ERA Process for requirements for each Scientific Management Decision Point (SMDP).
2 Refinement includes but is not limited to background, bioavailability, detection frequency, etc.
3 Risk management is incorporated throughout the tiered approach.



Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

FIGURE 8-2

ECOLOGICAL CONCEPTUAL SITE MODEL
SWMU 22
NSA CRANE, CRANE, INDIANA

9.0 SUMMARY AND RECOMMENDATIONS

Several metals were detected in surface and subsurface soil at SWMU 22. Five metals (arsenic, cadmium, chromium, lead, and mercury) in soil exceeded either human health or ecological risk-based screening values. However, arsenic, cadmium, and chromium concentrations were within the applicable background soil concentration ranges. Metals concentrations in SWMU 22 subsurface soil samples did not exceed the background value. Perchlorate was not detected in soil at SWMU 22, and RDX was only detected in one surface soil sample (location 22SS025).

Several metals (arsenic, cadmium, chromium, lead, and selenium) and energetics-related compounds (HMX, RDX, perchlorate, TNT, and the TNT biotic degradation product 4ADNT) were detected in groundwater at concentrations greater than human health screening values. Perchlorate was detected in two wells (22MWT002 and 22MWT006); however, as it was detected in the upgradient well 22MWT006 its presence may not be site-related but rather an upgradient, off-SWMU source.

Four nitroaromatic compounds were detected in the settling basin located north of Building 138. Of these four compounds, only TNT and its degradation product 4ANDT were detected at concentrations exceeding risk-based screening values.

Concentrations of arsenic and mercury in samples collected at three stream sediment locations exceeded surface soil background values. Neither organic analytes nor perchlorate were not detected in any of the stream sediment samples.

All eight RCRA metals, HMX, and RDX were detected in at least one unfiltered surface water sample, and all eight metals and perchlorate were detected in at least one filtered surface water sample. Arsenic was detected in several surface water samples, one of which was the upstream sampling location 22SW011. There is no known source of arsenic contamination at SWMU 22, and the surface water arsenic concentrations are relatively uniform across and downstream of SWMU 22. Soil, sediment, and groundwater arsenic concentrations appear to be within naturally occurring arsenic concentration ranges. However, the upstream arsenic concentration at location 22SW011 was one-fourth of the maximum on-site total arsenic concentration, suggesting that arsenic at 22SW004 might be a site-related surface water contaminant. One dissolved cadmium result exceeded the ecological screening value, but the total metals concentration from the same sample did not. No other dissolved cadmium results exceeded ecological screening values. Total chromium concentrations exceeded the human health risk-based screening criterion in 13 surface water samples. RDX concentrations exceeded the human health risk-based screening criterion at seven surface water locations

A baseline HHRA was performed to characterize the potential risks to likely human receptors under current and potential future land use scenarios for SWMU 22. The HHRA identified no chemicals of potential concern (COPCs) were identified for direct contact to surface soil and subsurface soil. RDX in soil was the only chemical identified as exceeding the screening levels for migration from soil to groundwater. RDX was not considered to be a chemical of concern (COC) for migration from soil to groundwater even though RDX was detected in groundwater because risks from exposures RDX in groundwater were within acceptable levels. COPCs for direct contact to groundwater were RDX, arsenic, cadmium, hexavalent chromium, lead, and perchlorate; COPCs for direct contact to surface water were RDX, arsenic, and cadmium; and the COPC for direct contact to sediment was arsenic. The calculated cancer risks and hazard indices for these COPCs were within acceptable risk levels. Analysis of lead in groundwater did not exceed the USEPA goal regarding lead exposures.

Similarly, the SLERA, performed to characterize the potential risks to likely ecological receptors at SWMU 22 identified no chemicals of potential concern (COPC) in in surface soil, sediment, and surface water.

The purpose of this RFI was to identify possible contaminant releases that would require further investigation or pose a threat to human health or the environment. A site that does not require further investigation and does not pose an unacceptable risk to human health and the environment may be designated as requiring No Further Action (NFA) and may be removed from further consideration. Based on the results of the human health and ecological risk assessments, NFA is recommended for SWMU 22.

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APPENDIX A

FIELD DOCUMENTATION (BORING LOG, WELL CONSTRUCTION DIAGRAMS, GROUNDWATER LEVEL MEASUREMENT FORMS, SAMPLE LOG SHEETS, AND SLUG TEST DATA)

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT - 54LT

BORING No.: 22SB001
DATE: 1/19/11
GEOLOGIST: Ellen Berkline
DRILLER: Jeremy Burchet

	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**
0'						Dense	Brown	Moist, Silty Clay, w rock pieces.	CL					
				50%/4'										
						Loose	tan	Wet, sandy, Clay/rock pieces	CL					
5				50%/2										
								Bedrock Refusal						
10														

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT-54 LT

BORING No.: 22SB002
DATE: 1/19/11
GEOLOGIST: Ellen Berklite
DRILLER: Jeremy Bawker

Depth (margin)	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0'				4'/4		Dense	Brown to tan	Moist, Sandy, Silty Clay w/organics	CL					
5				3'/3			Brown	Moist, Sandy, Silty Clay	CL					
							Rusty	Wet, Sandy, Silty Clay						
							Gray	w/rock pieces						
						Refusal at 7'								
10														

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes ____ No X ____ Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT

BORING No.: 22SB003
DATE: 1/19/11
GEOLOGIST: Ellen Berkbile
DRILLER: Jeremy Basher

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0'		90%/5		Dense	Rust	Moist Sandy, Silty Clay	CL					
	5						End of boring						
	10												

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes ______ No X Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112602362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT-54

BORING No.: 22SB004
DATE: 1/19/11
GEOLOGIST: E. Berthke
DRILLER: J. Boucher

	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**
0'						Loose	Brown	Silty Clay - Moist / wet, well graded	CL					
				80%/				Sand - Fill - Wet	SW					
				5		Dense	Tan Rust	Wet, Sandy, Silty Clay	CL					
							Gray	Hard, Fat Clay - wet	CH					
						Dense	Rust		CH					
5								Refusal at 4.5'						
10														

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes ____ No X Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT-54

BORING No.: 22SB005
DATE: 1/19/11
GEOLOGIST: E. Berklite
DRILLER: J. Bouchet

	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**
0'				Rc1/5		Dense	Rust	Moist, Sandy, silty Clay	CL					
								Refusal at 1-						
5														
10														

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes ____ No X Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT-54

BORING No.: 22SB006
DATE: 1/19/11
GEOLOGIST: E. Berklite
DRILLER: Jeremy Bucher

Depth	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
0'						Dense	Red	Moist, Sandy, Silty Clay	CL					
				80% / 3.5'			Yellow							
							White	Dry, Sandy Clay						
								Refusal at 3.5'						
5														
10														

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes ____ No X Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ~~ENVIR. FIELD SERVICES~~
DRILLING RIG: HAND AUGER

BORING No.: 22SB007
DATE: 1.21.2011
GEOLOGIST: K. SIMPSON
DRILLER: KS/KS

Depth (margin)	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
0'								GRASS						
						DENSE	BRN	MOIST, SILT F SAND	CL					
								TR CLAY						
							TAN	ROCK FRAGS.						
TD														
5														
								REFUSAL @ 4'						
								2 ATTEMPTS						
10														
								NO DPT ACCESS						
								HAND AUGER						

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): NA

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT-54

BORING No.: 22SB008
DATE: 1/19/11
GEOLOGIST: E. Berklite
DRILLER: Jeremy Boucher

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0'		40/5		Dense	Rust	Moist, Sandy Clay	CL					
					Loose	Brown	Fill - Coarse Sand	SW					
						White	Moist Sandy Clay	CL					
							Refusal at 2'						
	5												
	10												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes ____ No X Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT-54 Series

BORING No.: 22SB009
DATE: 11/19/11
GEOLOGIST: E. Berklite
DRILLER:

	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0'						Dense	Rust	Moist, Sandy, Silty Clay	CL					
				100/5				Moist						
								Wet						
							Tan/white	Moist						
							Gray	Moist						
5								Refusal at 4.5'						
10														

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes ____ No X Well I.D. #: ____

22SB010

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT-54

BORING No.: 22SB010
DATE: 1/19/11
GEOLOGIST: E. Berkite
DRILLER: J. Borcher

Depth (margin)	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
0'			~~100%~~	100%/5		Loose/L.Dense	Rust	Moist, Clayey V.Fine Sand	SC					
								clay/sand						
5								Termination of boring						
10														

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes ___ No X Well I.D. #:

22SB011

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA CRANE - SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ENVIR. FIELD SERVICES
DRILLING RIG: DPT-54

BORING No.: 22SB011
DATE: 1/19/11
GEOLOGIST: E. Berklite
DRILLER: J. Boucher

	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**
0'				70%/5		Dense	Rust	Moist, Sandy Clay	CL					
						Less Dense	tan	Moist Clayey Sand	SC					
								Refusal at 4'						
5														
10														

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes ____ No X Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: TTL
DRILLING RIG: GEOPROBE

BORING No.: 22SB012
DATE: 5-10-12
GEOLOGIST: K. SIMPSON
DRILLER: RICK MECAMEK

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
							DRAINAGE DITCH						
S1			2/2.2		SOFT	BRN	SILT & CLAY		MOIST	0	0	0	0
					↓	↓	↓ SOME GRAVEL		↓				
				—									
							TD = 2.2'						
							SAND STONE/						
							REFUSAL						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: MOVED LOCATION - SEE LOG BOOK PG 15

Drilling Area Background (ppm): 0

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: TTL
DRILLING RIG: GEOPROBE
BORING No.: 22SB013
DATE: MAY 9 2012
GEOLOGIST: K. Simpson / JF
DRILLER: R. M.[illegible]

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0-1		2.0 /			Black-Brn	Silty Sandy (F) Clay,	ML/CL	10:50	0	0	0	0
	1-2		/ 2.0			Brn-D.Brn	reworked fill, trace rocks	ML/CL	moist	↓	↓	↓	↓
							Refusal @ 2.0'						
							Bottom of boring 2.0'						

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks:

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: MICAH GROUP
DRILLING RIG: H S A

BORING No.: 22SB014
DATE: 5.9.12
GEOLOGIST: K. SIMPSON / JF
DRILLER: RICK MECARTER

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification GRASS - SOIL	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0-1	P / U	1.9 /			TAN-Brown	Sand (fine) Silt and clay	ML	16:10	0	0	0	0
	1-2	5 / 14	/ 2.0			TAN-Brown	fine [illegible] material	ML	3 sample attempts	↓	↓	↓	↓
S-2	2-3						Bottom of boring: 2.5'		1 offset location				
	3-4								refusal @ 2.5'				
	4-5								BGS				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No ____ Well I.D. #: 22MWT03

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: TTL
DRILLING RIG: GEO PROBE
BORING No.: 22SB015
DATE: 10 MAY 12
GEOLOGIST: K SIMPSON
DRILLER: RICK MIEGANER

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Sample	Sampler BZ	Borehole**	Driller BZ**
							ASPHALT						
S1			3/3		STIFF	GRAY	GRAVEL FILL		MOIST	0	0	0	0
					↓	BRN ↓	SILT WITH F. SAND TR CLAY		↓	↓	↓	↓	↓
	5												
							TD = 3'						
							REFUSAL						

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks:

Converted to Well: Yes ____ No X Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME:	NSA Crane SWMU 22	BORING No.:	22SB016
PROJECT NUMBER:	112G02362	DATE:	5.9.12
DRILLING COMPANY:	TTL	GEOLOGIST:	K. SIMPSON
DRILLING RIG:	GEO PROBE	DRILLER:	RICK MIECZAREK

(margin)	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
								GRASS/SOIL						
0						M.STIFF	BRN	SILT & F. SAND		DRY	0	0	0	0
S1							TAN	TR CLAY						
X						STIFF								
S2														
5										MOIST				
						MED. STIFF	BRN	SILT SOME CLAY						
S3								TR SAND						
								GRAVEL 1/2" Ø						
								@ 7.6'						
								TD = 8'						
								TD OF MANHOLE						
								@ 6.5' BGS ±						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: ______________________

Drilling Area Background (ppm): 0

Converted to Well: Yes ______ No X ______ Well I.D. #: ______

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: TTL
DRILLING RIG: DPT GEO PROBE 5410

BORING No.: 22SB017
DATE: 5.9.12
GEOLOGIST: K. SIMPSON
DRILLER: RICK MIECARER

	Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
								GRASS - SOIL						
0				2/2		SOFT	BRN/	SILT & F.		MOIST TO	0	0	0	0
S1							TAN	SAND TR CLAY		DRY				
						V. STIFF		SILT & CLAY						
				1.5/2										
S2				1/1				WEATHERED SAND						
5								STONE						
								TD = 5'						
								REFUSAL						
								2 TRYS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: ______

Drilling Area Background (ppm): 0

Converted to Well: Yes ____ No X Well I.D. #: ______

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: ~~TTE~~ MICAH GROUP
DRILLING RIG: CME TRACK RIG - HSA

BORING No.: 22SB018
DATE: 5.10 & 11.2012
GEOLOGIST: RS / JF
DRILLER:

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							GRASS						
						BRN	SILT W. F. SAND		MOIST	0	0	0	0
							TR ROOTS						
							SILT WITH						
							F. SAND						
							TD = 6' BGS						

S1

S2

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: HAND AUGER TO 3.5' BGS THEN USED CME RIG TO 6' BGS / SPLIT SPOON

Drilling Area Background (ppm): 0

Converted to Well: Yes ____ No X

Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: TTC
DRILLING RIG: DPT GEOPROBE

BORING No.: 22SB019
DATE: 5.10.12
GEOLOGIST: R. SIMPSON
DRILLER: R. MIECHLER

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S1			2.5/3		SOFT	BRN	SILT & CLAY		MOIST	0	0	0	0
			↓		↓	↓	↓		↓				
							TD = 3'						
							SANDSTONE						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ____ No X Well I.D. #:

Tetra Tech

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112602362
DRILLING COMPANY: Milam Group / R. Simmons
DRILLING RIG: CME 55

BORING No.: 22MWT01
DATE: May 10, 2012
GEOLOGIST: J. Ferguson
DRILLER: J. Smith

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0-1	6 / 13			V. Dense	Gray	Silty coarse LS gravel.	GP		0	0	0	0
	1-2	23 / 25				Orangy Brn	Sand (fine) silt and silty f sand	SM/ML	13:36 weathered rock				
S-2	2-3	7 / 56			V. Dense	G. Brn-Gray	Weathered mic. silty, f-g sandstone		weathered rock				
	3-4	50/1"							13:46				
S-3	4-5	A / R			Soft	Orangy Brn	micaceous sandy siltstone		13:54				
	5-6	A / R				Orangy Brn				0	0	0	0
S-4	6-7	A / R			Soft	Orangy Brn	weathered, silty f-g sandstone		14:02				
	7-8	A / R				Orangy Brn	and interbedded siltstone						
S-5	8-9	A / R			Soft	Tan-orng brn			14:06				
	9-10	A / R				Tan-orng brn							
S-6	10-11	A / R			Soft	Orange Brn	micaceous, sandy (fine) siltstone		14:10	0	0	0	0
	11-12	A / R				Orangy Brn	weathered.						
S-7	12-13	A / R			Hard	Gray	Micaceous, silty, fine-grained		14:15				
	13-14	A / R				Gray	sandstone, moist						
S-8	14-15	A / R			HARD	Gray	Micaceous, interbedded shaly		14:20				
	15-16	A / R				Gray	siltstone + f-g sandstone, moist			0	0	0	0
S-9	16-17	A / R			m. Hard - Hard	Gray							
	17-18	A / R				Gray							
S-10	18-19	A / R			M. Hard	Gray	micaceous, sandy (F), SHALY		14:25				
	19-20	A / R				Gray	siltstone, moist						
S-11	20-21	A / R			M. Hard	Gray			14:30	0	0	0	0
	21-22	A / R				Gray							
S-12	22-23	A / R			M. Hard	Gray			14:35				
	23-24	A / R				Gray							
	24-25	A / R			M. Hard	Gray			wet @ base after pulling rods				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: 16:20 5-10 ▼ = 24' BGS AR = 6" Nominal Tri Cone Roller bit. 2" Ø Sch 40 PVC screen 0.010 slot (15'-25') DSI GP2 Silica sandpack 13'-26' Bentonite Pellet seal 10'-13'

Converted to Well: Yes X No ______ Well I.D. #: 22MWT01

Tetra Tech

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112602362
DRILLING COMPANY: Micah Grp. / R. Simmons
DRILLING RIG: CME 55

BORING No.: 22MWT02
DATE: MAY 9, 2012
GEOLOGIST: J. Ferguson
DRILLER: J. Snider

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0-1	4/5	1.4		Hard	Brng-O.Brn	Sandy Clay, trace org mat	CL	12:50	0	0	0	0
	1-2	17/50	2.0			Orng Brn	micaceous, silty fine sand,	ML/CL	moist relict rck frt.				
S-2	2-3	54/5"	.45/.5		Very Dense	Grg-O.Brn	micaceous, silty fine sand		12:58 sampler	0	0	0	0
	3-4	Auger					relict rock fractur		refusal @ 2.5'				
	4-5	Auger							Auger refusal 4.5'				
S-3	5-6	A/R				Gry-O.Brn	Micaceous, silty, fine-		13:20 Air Rotary	0	0	0	0
	6-7	A/R				Gry-O.Brn	grained sandstone		4.5' -				
S-4	7-8	A/R				Gry-O.Brn	Micaceous, silty fine-		13:30	0	0	0	0
	8-9	A/R				Gry-O.Brn	grained sandstone						
S-5	9-10	A/R				Gry	Micaceous, silty fine-			0	0	0	0
	10-11	A/R				Orng Brn	med grained sandstone		13:40 TRMC HP				
S-6	11-12	A/R				Orang Brn	Micaceous silty fine-grained		14:30 Resumed drilling	0	0	0	0
	12-13	A/R			▽ 5-10-12 08:06	gray	sandstone, moist		14:44				
S-7	13-14	A/R				Dark gry	micaceous, sandy (fine) siltstone			0	0	0	0
	14-15	A/R				Dark gry			14:50				
S-8	15-16	A/R				Dark Gry	micaceous, shaly, sandy			0	0	0	0
	16-17	A/R				Dark Gry	siltstone, moist		15:02				
S-9	17-18	A/R				Dark Gry	Micaceous, Shaly, Sandy (fine)						
	18-19	A/R				Dark Gry	siltstone moist		15:16				
	19-20	A/R			▽ 5-9-12 17:06								
	20-21	A/R											

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: ▽ @ 19.2' BGS 17:06 5-9-12 ▽ @ 13.0' BGS 08:06 5-10-12
Screen 11'-21' Sandpack DSI 6B? 9'-21' Bent pellet 6'-9' BGS
2" Ø SCH 40 Screen (11'-21'), DSI Silica Sandpack (9'-21') Bent. Pellet Seal 6'-9'

Converted to Well: Yes ✓ No ______ Well I.D. #: 22MW T02

Tetra Tech

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: Mical Group / R. Simmons
DRILLING RIG: CME 55
BORING No.: 22MWT03
DATE: May 16, 2012
GEOLOGIST: J. Ferguson
DRILLER: J. Snyder

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0-1	PU				Black-Brn	Sandy (fine) silt and clay	ML/CL	DPT 5-9-2012	0	0	0	0
	1-2	SH	20			Brn	moist, trace roots	ML/CL	reworked fill				
S-2	2-3	20/50/2			Very Dense	Gry-Dr.Brn	micaceous, silty, sand,	SM	weathered 10:28	0	0	0	0
	3-4	AR					relict rock texture		fine grained sandstone				
S-3	4-5	AR				D.Brn Gry	micaceous silty fine-		sampler refusal 2.25 Auger refusal @ 3'				
	5-6	AR				Dk.Brn-Gry	grained sandstone moist		10:45				
S-4	6-7	AR				D.Brn-Gry	INTERBedded sandy (fine)		weathered, moist	0	0	0	0
	7-8	AR				D.Brn-Gry	siltstone/silty F-gr. SS		10:50				
S-5	8-9	AR				D.Brn-Gry				0	0	0	0
	9-10	AR				D.Brn-Gry			10:54				
S-6	10-11	AR			Soft	Gry-D.Brn	INTERBedded silty F-G SS		↑ moist micaceous	0	0	0	0
	11-12	AR				Gry-D.Brn	and sandy siltstone		10:58				
S-7	12-13	AR			Soft	Gry	Micaceous, silty, fine-		↑ moist				
	13-14	AR				Gry	grained sandstone		11:02				
S-8	14-15	AR			Soft	Gry			stop to wait on				
	15-16	AR				Gry	sign of H2O @ 16' BGS		11:05 H2O (0.5) - 11:20				
S-9	16-17	AR			M. Hard	Gry	Shaley, micaceous, sandy						
	17-18	AR				Gry	siltstone and interbedded		11:25				
S-10	18-19	AR			M. Hard	Gry	fine-grained sandstone						
	19-20	AR				Gry			11:30				
S-11	20-21	AR			M. Hard	Gry							
	21-22	AR				Gry			11:35				
S-12	22-23	AR			Soft	Black	Carbonaceous shale/coal		11:36				
	23-24	AR			Hard	Dark Gry	INTERbedded shaly siltstone						
S-13	24-25	AR				Dark Gry	and interbedded SS - (FG)		11:45				

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: 2" ϕ SCH 40 PVC Screen (13'-23') (0.010 slot)
DSI CP #2 Silica Sand 11'-25', Bentonite Pellet Seal 8'-11'
AR - Air Rotary

Converted to Well: Yes X No ______ Well I.D. #: 22MWT03

Tetra Tech

BORING LOG

PROJECT NAME: NSA Crane
PROJECT NUMBER: 112G02362
DRILLING COMPANY: MICAH Grp. / R. Simmons
DRILLING RIG: CME 55

BORING No.: 22MWT04
DATE: 5-11-2012
GEOLOGIST: J. Ferguson
DRILLER: J. Snyder

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0-1	12 / 50/3	0.6/0.75		Hard	Brown	Silty, clay Trace org. wet	ML/CL		0	0	0	0
	1-2					Orng Bn	weathered f-grained sandstone						
S-2	2-3	53/3"	0.25/0.25		Hard	O Bn -Gry	↓	↓	sampler refusal 2.25'	0	0	0	0
	3-4	A R							Air Rotary ↓				
S-3	4-5	A R			SOFT	Gry-O.Bn	weathered micaceous,		10:19	0	0	0	0
	5-6	A R				Gry-O.Bn	Sandy, SILTSTONE						
S-4	6-7	A R			Soft	Gry-O.Bn			10:22				
	7-8	A R				Gry-O.Bn							
S-5	8-9	A R			Soft	Gry-O.Bn			10:25				
	9-10	A R				Gry-O.Bn							
S-6	10-11	A R			Soft	Gry-Brn	Sandy (fine) siltstone		10:28 10-12.5	0	0	0	0
	11-12	A R				Gry-Brn	and claystone and coal		Coal				
S-7	12-13	A R			Soft	Dark Gry	Sandy (fine) claystone		10:32				
	13-14	A R				Dark Gry							
S-8	14-15	15:30			Hard	Dark Gry	Sandy (f), micaceous		10:36				
	15-16	5-11				Dark Gry	shaly siltstone, moist			0	0	0	0
S-9	16-17	A R			Hard	Gry	Sandy (fine) SHALY		10:40				
	17-18	A R	13:50 5-11			Gry	siltstone, moist						
S-10	18-19	A R			M. Hard	Gry	Sandy (VF-F) Shaly		10:42				
	19-20	A R				Gry	siltstone, moist						
S-11	20-21	A R			Soft	Gry			10:45	0	0	0	0
	21-22	A R		Coal		Black Gry	Coal, soft, black 21.5-		Coal 21.5'-22.5				
S-12	22-23	A R				Black -D.Gr	22.5 Dark gry claystone						
	23-24	A R			M. Hard	Gry-Dark	Sandy (f) siltstone and						
S-13	24-25	A R	11:00 5-11			Dark Gry	Claystone		10:50				

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 10:55 Bottom of Boring @ 26' BGS.
INSTALLED 2" Ø SCH 40 PVC WELL 25-15 screen
13-25 DSI 6P8 silica sandpack 10'-13' bentonite pellet seal

Drilling Area Background (ppm): 0

Converted to Well: Yes X No ____ Well I.D. #: 22MWT04

Tetra Tech

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: MICAH GRP. / R. Simmons
DRILLING RIG: CME-55
BORING No.: 22MWT05
DATE: MAY 8-9 2012
GEOLOGIST: J. Ferguson
DRILLER: J. Snider

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0-1	3/4	1.9		STIFF-	Black-Brn	Sandy (F) Clay Tr. Org. MAT	CL		0	0	0	0
	1-2	10/25	2.0			Gry-Brn	Sandy (F) Silt, moist	ML/Sm					
S-2	2-3	4/16	1.4		STIFF-	TAN-O.Brn	Micaceous Silty fine sand	Sm/ML		0	0	0	0
	3-4	50/—	1.5		Hard	TAN-O.Brn	sandy (F) Silt. moist.	Sm/ML	Sampler refusal 3.5'				
	4-5												
S-3	5-6	68/3"	.25/.25			TAN-O.Brn	Micaceous silty sand relict txt.		Auger Refusal 5.9'	0	0	0	0
Run 1 43	6-7				M. HARD	Gry-O.Brn	Broken, Fine-grained SS		5.9'-7.9'				
	7-8					Gry-O.Brn				0	0	0	0
Run 2 63	8-9					O.Brn-Gry			7.9'-12.9'				
	9-10				Soft	O.Brn-Gry	Sandy, SILTSTONE AND						
	10-11					Gry-O.Brn	CLAYSTONE, BLOCKY-						
	11-12					O.Brn-Gry	MASSIVE						
	12-13				Soft	Black	Carbonaceous SHALE			0	0	0	0
Run 3 63	13-14					Gry	MICACEOUS, SANDY (Fine)		12.9' TO 17.1'				
	14-15					Gry	siltstone, BLOCKY.						
	15-16					Gry	MASSIVE						
	16-17					Gry				0	0	0	0
	17-18	AR				CAM			AIR ROTARY 17.1'				
	18-19	AR				CAM			-19'				
							Bottom of Boring - 19.0'						

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: 2" Ø SCH 40 PVC Screen 9'-19' (0.010 SLOT)
DSI 6B#2 Silica Sandpack 7'-19'
Bentonite pellet Seal 4'-7'   AR = AIR ROTARY

Converted to Well: Yes ✓ No ____ Well I.D. #: 22MWT05

Tetra Tech

BORING LOG

PROJECT NAME: NSA Crane SWMU 22
PROJECT NUMBER: 112G02362
DRILLING COMPANY: Micah Group / R. Simmons
DRILLING RIG: CME 45

BORING No.: 22MWT06
DATE: MAY 10, 2012
GEOLOGIST: J. Ferguson
DRILLER: J. Snider

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0-1	3 / 12	1.0 / 1.25			Black-Brn	Sandy (F) Clay, trace org. mat.	CL	15:40	0	0	0	0
	1-2	57/3 / —	—			orange brown	Sandy (fine) Clay + Silt	ML/CL	moist weathered mic sandstone				
S-2	2-3	15 / 50/3	0.5 / 0.75			Gry-Or. Brn	Micaceous, Silty, F-g Sandstone		15:52 weathered rock, moist	0	0	0	0
	3-4	Auger / AR					↓ ↓		Auger refusal @ 3.5'				
S-3	4-5	A / R			Soft	Orng Brn	Sandy (F) micaceous		16:04				
	5-6	A / R				Orng Brn	siltstone, weathered		moist	0	0	0	0
S-4	6-7	A / R			Hard	Gry-O.Brn	Interbedded shaly, f-g		16:10 Rig chatters				
	7-8	A / R				Gry-O.Brn	sandstone + siltstone						
S-5	8-9	A / R			M. Hard	Gry O.Brn	↓ ↓		16:12				
	9-10	A / R				Gry-O.Brn	Micaceous, Sandy (f)						
S-6	10-11	A / R			M. Hard	TAN Brn	siltstone, moist		16:15	0	0	0	0
	11-12	A / R				TAN-Brn	↓ ↓						
S-7	12-13	A / R			M. Hard	TAN-Gry	Interbedded, micaceous, silty		16:18				
	13-14	A / R				O.Brn-Gry	sandstone and siltstone,						
S-8	14-15	A / R			M. Hard	Gry-O.Brn	trace carbonaceous streaks		16:21				
	15-16	A / R				Gry-O.Brn	↓ ↓			0	0	0	0
S-9	16-17	A / R			M. Hard	Gry O.Brn			16:24				
	17-18	A / R				Gry O.Brn	↓ ↓						
S-10	18-19	A / R			M. Hard	Gry	Shaly, Sandy (fine) siltstone		16:26				
	19-20	A / R				Gray	moist						
S-11	20-21	A / R			Soft	Gry			16:28	0	0	0	0
	21-22	A / R				Gry							
S-12	22-23	A / R			Soft	Gry			16:32				
	23-24	A / R				Gry							
S-13	24-25	A / R				Gry	↓ ↓		16:34				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks: A.R. = 6" Nominal Air Rotary - Tricone Roller bit to 26'
2" Ø SCH 40 PVC well 15'-25' (0.010 slot screen) ' 6" Tricone Roller Bit Air Rotary
GP#2 Silica Sandpack 13'-26', Bentonite pellet seal 10'-13'

Converted to Well: Yes x No ______ Well I.D. #: 22MWT06

Tetra Tech, Inc.

MONITORING WELL SHEET

WELL No.: 22-MWT01

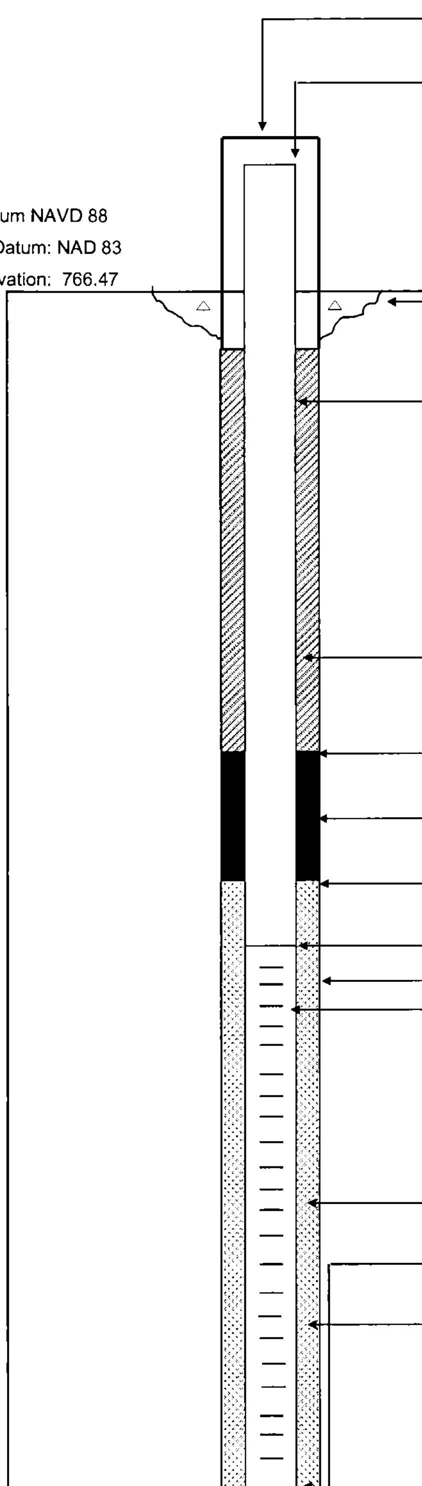
PERMIT No:

PROJECT:	NSA Crane SWMU 22	DRILLING Co.:	Micah Group / R. Simmons	BORING No.:	22-MWT01
PROJECT No.:	112G02362	DRILLER:	J. Russel	DATE COMPLETED:	05/11/12
SITE:	Lead Azide Pond	DRILLING METHOD:	H.S.A. / Air Rotary	NORTHING:	1315811.32
GEOLOGIST:	J. Ferguson	DEV. METHOD:	Surge / Submersible pump	EASTING:	3027409.14

Vertical Datum NAVD 88

Horizontal Datum: NAD 83

Ground Elevation: 766.47



Not to Scale

Elevation / Depth of Top of Riser: 768.94 / 2.77

Elevation / Height of Top of Surface Casing: 768.74 / 2.47

I.D. of Surface Casing: 6 - inch

Type of Surface Casing: Schedule 40 Steel

Type of Surface Seal: Concrete

I.D. of Riser: 2" ID, flush joint

Type of Riser: Schedule 40 PVC

Borehole Diameter: 8.25 inch

Type of Backfill: Bentonite -cement mixture

Elevation / Depth of Seal: 756.47 / 10.0

Type of Seal: Bentonite Pellet

Elevation / Depth of Top of Filter Pack: 753.47 / 13.0

Elevation / Depth of Top of Screen: 751.47 / 15.0

6" ID Air Rotary Borehole

Type of Screen: Schedule 40 PVC

Slot size/ screen length: 0.010 Slot - 10'

I.D. of Screen: 2" inside daimeter PVC

Type of Filter Pack: DSI GP#2 Silica Sand

Elevation / Depth of Bottom of Screen: 741.47 / 25.0

Elevation / Depth of Bottom of filter pack: 741.47 / 25.0

Type of Backfill Below Well: DSI GP#2 Silica Sand

Elevation / Total Depth of Borehole: 741.47 / 25.0

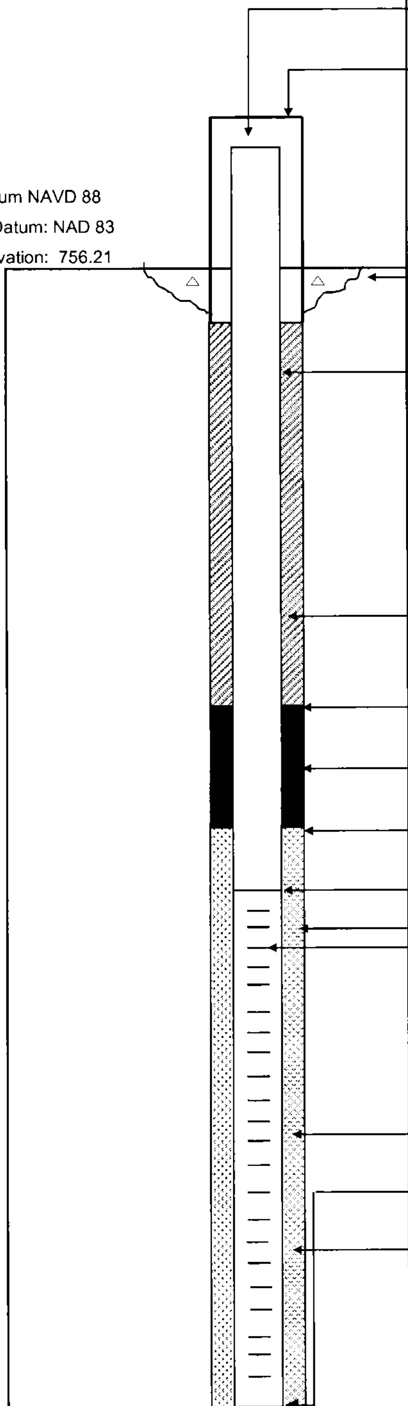
Tetra Tech, Inc.

MONITORING WELL SHEET

WELL No.: 22-MWT02
PERMIT No:

PROJECT: NSA Crane SWMU 22	DRILLING Co.: Micah Group / R. Simmons	BORING No.:	22-MWT02
PROJECT No.: 112G02362	DRILLER: J. Russel	DATE COMPLETED:	05/10/12
SITE: Lead Azide Pond	DRILLING METHOD: H.S.A. / Air Rotary	NORTHING:	1315360.00
GEOLOGIST: J. Ferguson	DEV. METHOD: Surge / Submersible pump	EASTING:	3027107.82

Vertical Datum NAVD 88
Horizontal Datum: NAD 83
Ground Elevation: 756.21



Not to Scale

Elevation / Depth of Top of Riser: 758.96 / 2.75

Elevation / Height of Top of Surface Casing: 758.78 / 2.57

I.D. of Surface Casing: 6 - inch

Type of Surface Casing: Schedule 40 Steel

Type of Surface Seal: CONCRETE

I.D. of Riser: 2" ID, flush joint

Type of Riser: Schedule 40 PVC

Borehole Diameter: 8.25 inch

Type of Backfill: Bentonite -cement mixture

Elevation / Depth of Seal: 750.21 / 6.0

Type of Seal: Bentonite Pellet

Elevation / Depth of Top of Filter Pack: 747.21 / 9.0

Elevation / Depth of Top of Screen: 745.21 / 11.0

6" ID Air Rotary Borehole

Type of Screen: Schedule 40 PVC

Slot size/ screen length: 0.010 Slot - 10'

I.D. of Screen: 2" inside daimeter PVC

Type of Filter Pack: DSI GP#2 Silica Sand

Elevation / Depth of Bottom of Screen: 735.21 / 21.0

Elevation / Depth of Bottom of filter pack: 735.21 / 21.0

Type of Backfill Below Well: DSI GP#2 Silica Sand

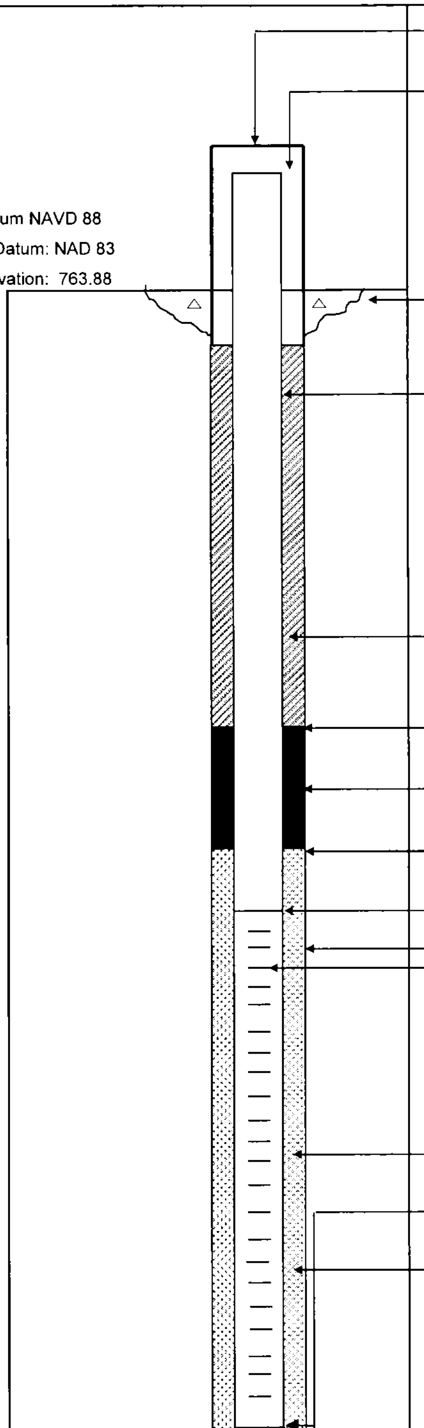
Elevation / Total Depth of Borehole: 735.21 / 21.0

Tetra Tech, Inc.

MONITORING WELL SHEET

				WELL No.:	22-MWT03
				PERMIT No:	
PROJECT:	NSA Crane SWMU 22	DRILLING Co.:	Micah Group / R. Simmons	BORING No.:	22-MWT03
PROJECT No.:	112G02362	DRILLER:	J. Russel	DATE COMPLETED:	05/11/12
SITE:	Lead Azide Pond	DRILLING METHOD:	H.S.A. / Air Rotary	NORTHING:	1315525.14
GEOLOGIST:	J. Ferguson	DEV. METHOD:	Surge / Submersible pump	EASTING:	3027497.94

Vertical Datum NAVD 88
Horizontal Datum: NAD 83
Ground Elevation: 763.88



Not to Scale

Elevation / Depth of Top of Riser:		766.64 / 2.76
Elevation / Height of Top of Surface Casing:		766.28 / 2.4
I.D. of Surface Casing:	6 - inch	
Type of Surface Casing:	Schedule 40 Steel	
Type of Surface Seal:	Concrete	
I.D. of Riser:	2" ID, flush joint	
Type of Riser:	Schedule 40 PVC	
Borehole Diameter:	8.25 inch	
Type of Backfill:	Bentonite -cement mixture	
Elevation / Depth of Seal:		755.88 / 8.0
Type of Seal:	Bentonite Pellet	
Elevation / Depth of Top of Filter Pack:		752.88 / 11.0
Elevation / Depth of Top of Screen:		750.88 / 13.0
6" ID Air Rotary Borehole		
Type of Screen:	Schedule 40 PVC	
Slot size/ screen length:	0.010 Slot - 10'	
I.D. of Screen:	DSI GP#2 Silica Sand	
Type of Filter Pack:	DSI GP#2 Silica Sand	
Elevation / Depth of Bottom of Screen:		740.88 / 23.0
Elevation / Depth of Bottom of filter pack:		738.88 / 25.0
Type of Backfill Below Well:	DSI GP#2 Silica Sand	
Elevation / Total Depth of Borehole:		738.88 / 25.0

Tetra Tech, Inc.

MONITORING WELL SHEET

WELL No.: 22-MWT04

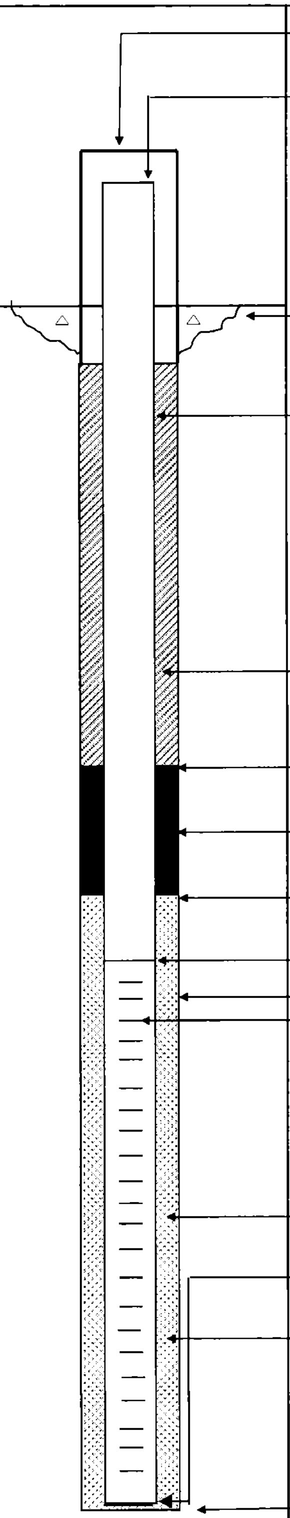
PERMIT No:

PROJECT:	NSA Crane SWMU 22	DRILLING Co.:	Micah Group / R. Simmons	BORING No.:	22-MWT04
PROJECT No.:	112G02362	DRILLER:	J. Russel	DATE COMPLETED:	05/11/12
SITE:	Lead Azide Pond	DRILLING METHOD:	H.S.A. / Air Rotary	NORTHING:	1315438.43
GEOLOGIST:	J. Ferguson	DEV. METHOD:	Surge / Submersible pump	EASTING:	3027804.94

Vertical Datum NAVD 88

Horizontal Datum: NAD 83

Ground Elevation: 759.34



Not to Scale

Elevation / Depth of Top of Riser: 761.74 / 2.4

Elevation / Height of Top of Surface Casing: 761.44 / 2.1

I.D. of Surface Casing: 6 - inch

Type of Surface Casing: Schedule 40 Steel

Type of Surface Seal: Concrete

I.D. of Riser: 2" ID, flush joint

Type of Riser: Schedule 40 PVC

Borehole Diameter: 8.25 inch

Type of Backfill: Bentonite -cement mixture

Elevation / Depth of Seal: 748.34 / 11.0

Type of Seal: Bentonite Pellet

Elevation / Depth of Top of Filter Pack: 746.34 / 13.0

Elevation / Depth of Top of Screen: 744.34 / 15.0

6" ID Air Rotary Borehole

Type of Screen: Schedule 40 PVC

Slot size/ screen length: 0.010 Slot - 10'

I.D. of Screen: 2" inside daimeter PVC

Type of Filter Pack: DSI GP#2 Silica Sand

Elevation / Depth of Bottom of Screen: 734.34 / 25.0

Elevation / Depth of Bottom of filter pack: 734.34 / 25.0

Type of Backfill Below Well: DSI GP#2 Silica Sand

Elevation / Total Depth of Borehole: 734.34 / 25.0

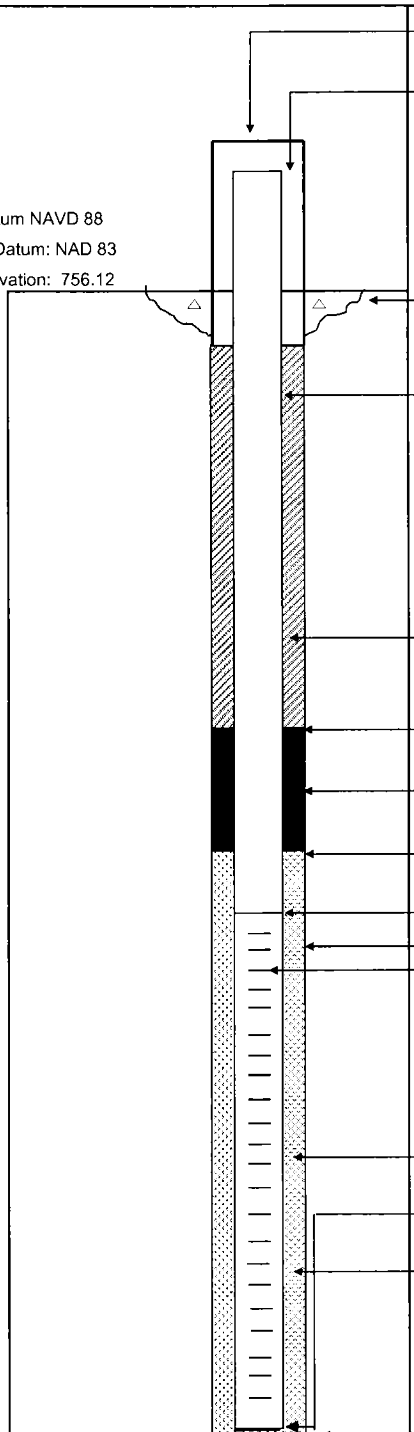
Tetra Tech, Inc.

MONITORING WELL SHEET

WELL No.:	22-MWT05
PERMIT No:	

PROJECT:	NSA Crane SWMU 22	DRILLING Co.:	Micah Group / R. Simmons	BORING No.:	22-MWT05
PROJECT No.:	112G02362	DRILLER:	J. Russel	DATE COMPLETED:	05/09/12
SITE:	Lead Azide Pond	DRILLING METHOD:	H.S.A. / Air Rotary	NORTHING:	1315271.01
GEOLOGIST:	J. Ferguson	DEV. METHOD:	Surge / Submersible pump	EASTING:	3027363.36

Vertical Datum NAVD 88
Horizontal Datum: NAD 83
Ground Elevation: 756.12



Not to Scale

Elevation / Depth of Top of Riser:		758.86 / 2.74
Elevation / Height of Top of Surface Casing:		758.67 / 2.55
I.D. of Surface Casing:	6 - inch	
Type of Surface Casing:	Schedule 40 Steel	
Type of Surface Seal:	CONCRETE	
I.D. of Riser:	2" ID, flush joint	
Type of Riser:	Schedule 40 PVC	
Borehole Diameter:	8.25 inch	
Type of Backfill:	Bentonite -cement mixture	
Elevation / Depth of Seal:		752.12 / 4.0
Type of Seal:	Bentonite Pellet	
Elevation / Depth of Top of Filter Pack:		749.12 / 7.0
Elevation / Depth of Top of Screen:		747.12 / 9.0
6" ID Air Rotary Borehole		
Type of Screen:	Schedule 40 PVC	
Slot size/ screen length:	0.010 Slot - 10'	
I.D. of Screen:	2" inside daimeter PVC	
Type of Filter Pack:	DSI GP#2 Silica Sand	
Elevation / Depth of Bottom of Screen:		737.12 / 19.0
Elevation / Depth of Bottom of filter pack:		737.12 / 19.0
Type of Backfill Below Well:	DSI GP#2 Silica Sand	
Elevation / Total Depth of Borehole:		737.12 / 19.0

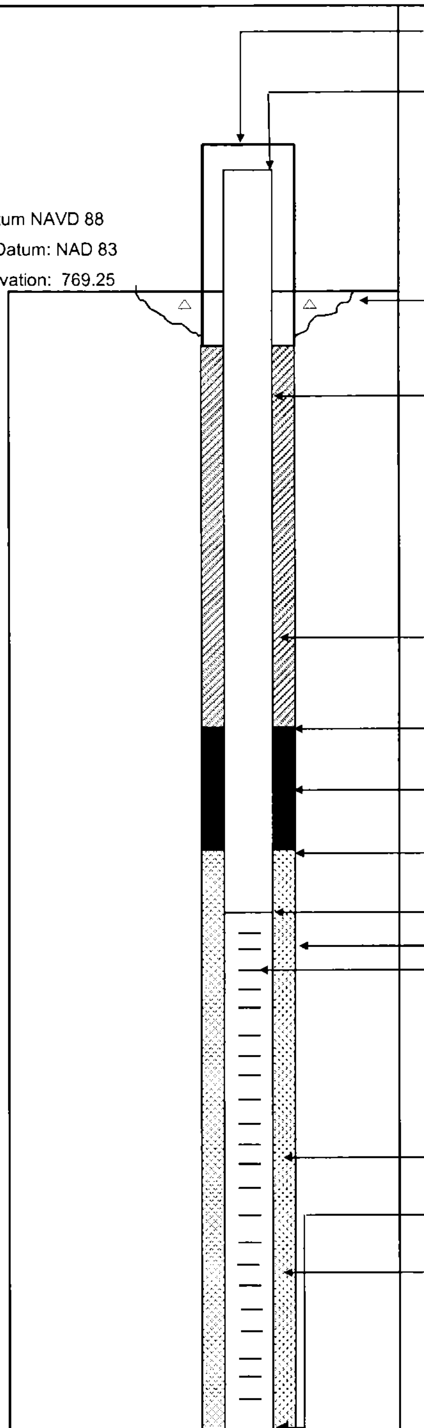
Tetra Tech, Inc.

MONITORING WELL SHEET

WELL No.: 22-MWT06
PERMIT No:

PROJECT: NSA Crane SWMU 22	DRILLING Co.: Micah Group / R. Simmons	BORING No.:	22-MWT06
PROJECT No.: 112G02362	DRILLER: J. Russel	DATE COMPLETED:	05/10/12
SITE: H.S.A. / Air Rotary	DRILLING METHOD: Hollow Stem Auger	NORTHING:	1315734.76
GEOLOGIST: J. Ferguson	DEV. METHOD: Surge / Submersible pump	EASTING:	3027588.91

Vertical Datum NAVD 88
Horizontal Datum: NAD 83
Ground Elevation: 769.25



Not to Scale

Elevation / Depth of Top of Riser: 772.00 / 2.75

Elevation / Height of Top of Surface Casing: 771.77 / 2.52

I.D. of Surface Casing: 6 - inch

Type of Surface Casing: Schedule 40 Steel

Type of Surface Seal: CONCRETE

I.D. of Riser: 2" ID, flush joint

Type of Riser: Schedule 40 PVC

Borehole Diameter: 8.25 inch

Type of Backfill: Bentonite -cement mixture

Elevation / Depth of Seal: 759.25 / 10.0

Type of Seal: Bentonite Pellet

Elevation / Depth of Top of Filter Pack: 756.25 / 13.0

Elevation / Depth of Top of Screen: 754.25 / 15.0

6" ID Air Rotary Borehole

Type of Screen: Schedule 40 PVC

Slot size/ screen length: 0.010 Slot - 10'

I.D. of Screen: 2" inside daimeter PVC

Type of Filter Pack: DSI GP#2 Silica Sand

Elevation / Depth of Bottom of Screen: 744.25 / 25.0

Elevation / Depth of Bottom of filter pack: 744.25 / 25.0

Type of Backfill Below Well: DSI GP#2 Silica Sand

Elevation / Total Depth of Borehole: 744.25 / 25.0

Page 1 of 1

MONITORING WELL DEVELOPMENT RECORD

Well: 22MWT01
Site: SWMU 22 - CRANE
Date Installed: 5-10-2012
Date Developed: 5-12-2012
Dev. Method: Surge / Pump
Pump Type: Whaler

Depth to Bottom (ft.): 27.75'
Static Water Level Before (ft.): 14.80
Static Water Level After (ft.):
Screen Length (ft.): 10'
Specific Capacity:
Casing ID (in.): 2" Ø Sch 40 PVC

Responsible Personnel: J. Ferguson
Drilling Co.: Mitchell Group / R. Simmons
Project Name: Crane
Project Number: 112G02362

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor,color,etc.)
5/12 16:23	0	Initial	14.80'	15.23	6.10	1.20	>1000	7.33-DO 84=ORP 3.13 gal purged 18.35' DW Dry after 5 gallons
16:26		5		14.18	6.19	1.25	>1000	4.33 DO 107=ORP 5gal
16:40		6.5	Dry	14.53	6.34	1.15	>1000	6.87 DO 78 orp 6gal; Recover @ 0.04'/min
5/13 10:40		Initial	16.34'					
1042		7.0	16.80	15.23	5.99	0.629	31	
1046		9.0	23.70	14.04	5.59	1.31	>1000	
1100		11.5	27.25	13.89	5.95	1.19	>1000	DRY
5/14 1625		11.5	15.75	15.17	4.72	1.38	61	
1632		13.0	20.80	14.33	5.56	1.07	>1000	
1640		15.0	23.25	14.06	5.17	1.35	>1000	
1643		16.0	26.75	—	DRY	—		

MONITORING WELL DEVELOPMENT RECORD

Well: 22MWT02
Depth to Bottom (ft.): 24.05
Responsible Personnel: J. Ferguson
Site: SWMU 22 - CRANE
Static Water Level Before (ft.): 9.24
Drilling Co.: MICAH GROUP / J. SIMMONS
Date Installed:
Static Water Level After (ft.):
Project Name: CRANE
Date Developed: MAY 12, 2012
Screen Length (ft.): 10'
Project Number: 112G02367
Dev. Method: SURGE / PUMP
Specific Capacity:
Pump Type: WHALER
Casing ID (in.): 2" Ø SCH 40

	Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	R emarks (odor,color,etc.)
5/12	13:50	0	INITIAL		17.89	4.80	1.13	>1000	295 ORP LT BRN
	13:53		5-GAL		15.78	4.25	1.17	>1000	276 ORP Pumped dry after 6 gallons
5/13	1158		5	9.31					Recovers @ 0.3 ft/min
	1200		5.5	9.70	16.59	3.94	0.694	13	
	1207		7.5	—	15.03	4.05	0.942	>1000	
	1210		8.5	19.20	14.12	4.00	1.18	>1000	
	1213		10.5	20.10	14.11	3.97	1.37	>1000	
	1220		12.0	22.00	—	DRY	—		
5/14	0918		12.0	9.38	14.87	4.04	1.47	1.7	
	0922		14.0	16.60	14.27	3.93	0.887	>1000	
	0930		17.0	20.00	14.06	3.87	1.37	>1000	
	0934		19.0	22.25	14.02	3.77	1.41	>1000	DRY
									BEST PRODUCER QA?

MONITORING WELL DEVELOPMENT RECORD

Well: 22MWT03
Site: SWMU 22
Date Installed: 5.10.12
Date Developed: 5.12.12
Dev. Method: SURGE & PUMP
Pump Type: 12 V WHALE

Depth to Bottom (ft.): 26.30
Static Water Level Before (ft.): 16.37
Static Water Level After (ft.):
Screen Length (ft.): 10'
Specific Capacity:
Casing ID (in.): 2" PVC

Responsible Personnel: K. SIMPSON
Drilling Co.: MICAH GROUP
Project Name: NSA CRANE
Project Number: 1126-02362

	Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	R emarks (odor,color,etc.)
5/12	1500	0	0	16.37	16.15	3.94	1.23	>900	GRAY, NO ODOR
	1509		6	25.00	DRY		TO PUMP		
	1516		6	23.50	15.72	3.87	1.54	>900	
	1518		8	25.00	DRY		TO PUMP		
	1523		9	23.50	15.65	3.86	1.52	>900	
5/13	1105		10.5	—	14.40	4.09	1.08	45	
	1115		12	24.90	14.31	3.81	3.81	>900	DRY
5/14	1600		12	17.10	17.90	3.86	1.41	3.2	
	1607		13.5	21.50	15.92	3.72	1.63	>1000	
	1614		15.0	25.10	15.68	3.56	1.60	>1000	
	1616		16.0	25.65	—	DRY	—		

MONITORING WELL DEVELOPMENT RECORD

Well: 22MW504 | Depth to Bottom (ft.): 27.40 | Responsible Personnel: J. Ferguson
Site: CRANE SWMU 22 | Static Water Level Before (ft.): 12.05 | Drilling Co.: Miami Group / R. Simmons
Date Installed: | Static Water Level After (ft.): | Project Name: Crane
Date Developed: 5-12-2012 | Screen Length (ft.): 10' | Project Number: 112G02362
Dev. Method: Surge / Pump | Specific Capacity:
Pump Type: Whaler | Casing ID (in.): 2" Ø Sch 40 PVC

	Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	R emarks (odor,color,etc.) 2.22=DO 121=ORP
5/12	15:47	0			16.79	5.57	0.838	333	Purged dry after 1st Vol. 2.5 gal/vol
	15:55				16.33	5.70	0.831	>1000	6.70 DO 110=ORP 3 gal
	15:58				15.77	4.98	0.837	>1000	4.38=DO 198=ORP 6 gal
	16:05		8.0		16.33	4.81	0.839	>1000	5.40 DO 206=ORP 8 gal
5/13	1220		8.0	16.12	15.16	5.07	1.08	218	
	1225		10.0	—	14.91	5.18	1.11	>1000	DARK GRAY
	1228		11.0	22.23	14.94	5.07	1.09	>1000	
	1230		12.0	—	15.11	5.01	1.06	>1000	
	1232		14.0	25.00	15.16	4.87	1.05	>1000	
5/14	1005		14.0	15.65	14.67	4.94	1.04	>1000	DARK GRAY
	1010		16.0	20.15	14.76	5.16	1.15	>1000	
	1014		19.0	24.25	14.78	5.03	1.12	>1000	
	1019		20.0	25.30	14.81	4.97	1.10	>1000	

MONITORING WELL DEVELOPMENT RECORD

Well: 22SWMU 22MWT05
Site: SWMU 22
Date Installed:
Date Developed: 5-12-2012
Dev. Method: Surge / Pump
Pump Type: Whaler

Depth to Bottom (ft.): 21.85
Static Water Level Before (ft.): 18.58
Static Water Level After (ft.):
Screen Length (ft.): 10
Specific Capacity:
Casing ID (in.): 2" PVC

Responsible Personnel: J. Ferguson
Drilling Co.: Micah Grout / R. Simmons
Project Name: Crane
Project Number: 112G02362

Date	Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	R emarks (odor,color,etc.)
5/12	14:25	0	INITIAL	18.58	18.35	4.49	0.355 mS/cm	>800	5.53 mg/L 290 ORP 0.5 gal/vol TD = 21.85
	14:40		1	15.35	17.07	3.85	0.313 mS/cm	>500	4.75 mg/L Dry after 1.5 gals 348 ORP
	14:49		2		17.22	3.87	0.377 mS/cm	>800	5.74 mg/L 336 ORP
5/13	1245		2	18.46					
	1246		2.5	18.65	14.73	3.70	0.337	272	
	1249		3.5	—	14.19	3.95	0.348	>1000	
	1251		4.0	21.40	14.36	3.81	0.328	>1000	
5/14	0947		4.0	18.44					
	0949		4.0	18.61	14.04	3.51	0.384	670	
	0952		5.0	19.08	13.78	3.73	0.324	>1000	
	0958		6.0	21.30		DRY			

MONITORING WELL DEVELOPMENT RECORD

Well: 22MWT06
Site: CRANE - SWMU 22
Date Installed:
Date Developed: 5-12 / 5-13
Dev. Method: SURGE / PUMP
Pump Type: WAMER

Depth to Bottom (ft.): 28.31
Static Water Level Before (ft.):
Static Water Level After (ft.):
Screen Length (ft.): 10'
Specific Capacity:
Casing ID (in.): 2" PVC

Responsible Personnel: D. Ferguson / R. Simpson
Drilling Co.: Micah Group / R. Simmons
Project Name: Crane - SWMU 22
Project Number: 112602362

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	R emarks (odor,color,etc.)
	0							
5/13 10:15	—	INITIAL	28.31	16.21	5.31	3.31 mS/cm	12.6	203-ORP 10.64=DO 28.31 23.34
10:25		1	25.35	16.22	4.70	0.008 mS/cm	>1000	Bailed dry after 2.5 gals 221=ORP 10.66=DO
5/14 0950		1	25.25	—	—	—	—	
0855		1.5	25.95	15.45	4.57	4.07	4.5	
0903		2.0	27.60	—	—	—	—	DRY

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: NSA CRANE
Project No.: 112G-02362
Location: SWMU 22
Personnel: K. SIMPSON
Weather Conditions: SUNNY DRY 80°F
Measuring Device: HERON
Tidally Influenced: Yes ___ No X
Remarks: V. LITTLE RAIN LAST 2 WEEKS

Well ID	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments
22MWT001	5.22.12	1605		27.95	15.34	NA		
22MWT002	↓	0740		24.05	9.19	↓		
22MWT003	↓	1601		26.30	17.45	↓		
22MWT004	↓	1558		27.90	12.62	↓		
22MWT005	5.21.12	1550		21.85	18.48	↓		
22MWT006	↓	1620		28.31	17.19	↓		

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* All measurements to the nearest 0.01 foot from the top of riser

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SS001
Sample Location: 22SS001 0002
Sampled By: KS - KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1.21.2011 Time: 0930 Method: HAND AUGER Monitor Reading (ppm): —	0 - 2'	BRN	MOIST CLAY WITH SILT & F. SAND SOME ROCK FRAG. TR ROOTS

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals ~~& pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: 22SSDUP01

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SS002
Project No.:	112G02362	Sample Location:	22SS002 0002
		Sampled By:	KS - KS
		C.O.C. No.:	

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1 . 21 . 2011 Time: 0945 Method: HAND AUGER Monitor Reading (ppm):	0 - 2'	BRN	MOIST CLAY WITH SILT & F. SAND SOME ROCK FRAGS. TR ROOTS

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals ~~& pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SS0220002
Sample Location: 22SS022
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.12.12 Time: 0930 Method: AMS PROBE Monitor Reading (ppm): 0	0-2'	BRN	DRY, SILT & F. SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~ 8 oz w/m glass, 4°C	✓	
TOC	1 8 oz w/m glass 4°C	✓	
NS/MSD COLLECTED FOR EXP, PETN, NG ONLY			
3 CONTAINERS SENT TO LAB			

OBSERVATIONS / NOTES:

USED AMS SLIDE HAMMER & PROBE

IN WORK PLAN AS SD, NO FLOW (SW)
SAMPLED 0-2' SS

MAP:

Circle if Applicable:

MS/MSD: YES

Duplicate ID No.: —

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SS025 0002
Sample Location: 22SS025
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.11.12 Time: 1210 Method: TROWEL Monitor Reading (ppm): 0	0 - 2'	BRN	MOIST TR ROOTS SILT SOME F. SAND TR ROCK FRAG.

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals + TOC	2- 8 oz w/m glass, 4°C	✓	
	3 X VOL FOR QA		

OBSERVATIONS / NOTES:

DRY STREAM BED NO SW COLLECTED, DAMP WITH A FEW SMALL WET AREAS.
IN WORK PLAN AS SD, NO FLOW (SW) SAMPLED 0-2'-SS

RAIN MONDAY PM

MAP:

IN WORK PLAN AS SD - NO SW COLLECTED AS SS (0-2')

Circle if Applicable:

MS/MSD	Duplicate ID No.:
YES	22 SS DUP 01

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0010002
Sample Location: 22SB001
Sampled By: AGB/KES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11 Time: 0930 Method: DPT Monitor Reading (ppm): —	0-2'	Brown	Moist, Silty Clay w/rock pieces

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals & pH	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Ellen Berklite

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB0010305
Project No.:	112G02362	Sample Location:	22SB001
		Sampled By:	AEB/JES
		C.O.C. No.:	

[X] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11	3-5'	tan	Wet, sandy clay w/rock pieces
Time: 0935			
Method: DPT			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals & pH	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.: 22SBDUP001

Signature(s): Ellen Berklite

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0010608
Sample Location: 22SB001
Sampled By: AEB/JES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/17/11 Time: 0940 Method: DPT Monitor Reading (ppm): —	6-8'	Refusal at 6' *	

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

NOT SAMPLED

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- ~~8 oz w/m glass, 4°C~~		
RCRA Metals & pH	1- ~~8 oz w/m glass, 4°C~~		

OBSERVATIONS / NOTES:

* Sample not collected

MAP:

Circle if Applicable:

MS/MSD: —

Duplicate ID No.: —

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB002002
Sample Location: 22SB002
Sampled By: AEB/JES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11 Time: 1020 Method: DPT Monitor Reading (ppm): —	0-2'	Brown-tan	Moist, Tan/Brown Sandy, Silty Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	2x 1- 8 oz w/m glass, 4°C	✓	
RCRA Metals & ~~pH~~	2x 1- 8 oz w/m glass, 4°C	✓	
	MS/MSD		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD: Yes

~~Duplicate ID No.:~~

Signature(s): Ellen Berklite

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB00206 07
Project No.:	112G02362	Sample Location:	22SB002
		Sampled By:	AEB/RES
		C.O.C. No.:	

[ ] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11 Time: 1030 Method: DPT Monitor Reading (ppm): —	6-7'	tan-brown	Wet, Sandy, Silty Clay with rock pieces

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C		
RCRA Metals & ~~pH~~	1- 8 oz w/m glass, 4°C		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkbite

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB0030002
Project No.:	112G02362	Sample Location:	22SB003
		Sampled By:	KS - EB
		C.O.C. No.:	

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11 Time: 1100 Method: DPT Monitor Reading (ppm): —	0-2	Rust	Sandy, Silty Clay (Moist)

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals & ~~pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB00303-05
Sample Location: 22SB003
Sampled By: AEB/KES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11 Time: 1110 Method: DPT Monitor Reading (ppm):	3-5	Rust	Moist, Sandy, Silty Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, ~~etc.~~)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals & ~~pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0040002
Sample Location: 22SB004
Sampled By: AEB/KES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11	0-2'	Brown	Well-graded Sand - Fill (Moist)
Time: 1400			
Method: DPT			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C		
RCRA Metals	1- 8 oz w/m glass, 4°C		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

K E

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB0040305
Project No.:	112G02362	Sample Location:	22SB004
		Sampled By:	AEB/KES
		C.O.C. No.:	

[ ] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1/19/11	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1410	3-5'	Gray/Rust	Hard, Fat Clay
Method: DPT			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	2X 1- 8 oz w/m glass, 4°C		
RCRA Metals & ~~pH~~	2X 1- 8 oz w/m glass, 4°C		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
yes	—

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB005002
Sample Location: 22SB005
Sampled By: AEB/KES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11 Time: 1345 Method: DPT Monitor Reading (ppm): —	~~0-3~~ 0-1	Rust	Moist, Sandy, Silty Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, ~~etc.~~)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals ~~& pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

* Refusal at 1'

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0050305
Sample Location: 22SB005
Sampled By: AEB/KES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11			NOT SAMPLED
Time:			
Method: DPT			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C		
RCRA Metals ~~& pH~~	1- 8 oz w/m glass, 4°C		

OBSERVATIONS / NOTES:

*Sample Not collected
Refusal at 1'

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB006002
Project No.:	112G02362	Sample Location:	22SB006
		Sampled By:	AEG/KES
		C.O.C. No.:	

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11	0-2'	Rust	Moist, Sandy, Silty Clay
Time: 1250			
Method: DPT			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C		
RCRA Metals ~~& pH~~	1- 8 oz w/m glass, 4°C		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berklite

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB006030~~3~~4
Project No.:	112G02362	Sample Location:	22SB006
		Sampled By:	AGB/KES
		C.O.C. No.:	

[ ] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11 Time: 1300 Method: DPT Monitor Reading (ppm): —	3-4'	White/gray	Dry, sandy clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C		
RCRA Metals ~~& pH~~	1- 8 oz w/m glass, 4°C		

OBSERVATIONS / NOTES:

*Refusal at 4'

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Ellen Berkheiser

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22	Sample ID No.: 22SB007 0002
Project No.: 112G02362	Sample Location: 22SB007 0002
	Sampled By: KS - KS
[X] Surface Soil	C.O.C. No.:
[ ] Subsurface Soil	
[] Sediment	Type of Sample:
[] Other:	[X] Low Concentration
[] QA Sample Type:	[] High Concentration

GRAB SAMPLE DATA:

Date: 1.21.2011 Time: 1310 Method: HAND AUGER Monitor Reading (ppm): —	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	0 - 2'	BRN	MOIST SILT & F. SAND TR CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals ~~[illegible]~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

NO DPT ACCESS

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [illegible signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB007
Sample Location: 22SB007 0304
Sampled By: KS - KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1.21.2011 Time: 1330 Method: HAND AUGER Monitor Reading (ppm): —	3-4'	TAN	MOIST, F SAND & SILT WITH ROCK FRAG'S TR CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals ~~& [illegible]~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

NO DPT ACCESS

REFUSAL @ 4' - 2 ATTEMPS SAME DEPTH 4'

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

22SB008 0002

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0080002
Sample Location: 22SB008
Sampled By: AEB/HES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11	0-2'	Rust	Moist, Sandy Clay
Time: 1310			
Method: DPT			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals & pH	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB009
Sample Location: 22SB009 0002
Sampled By: KS EB
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1.19.11	0 - 2	Rust	Moist, Sandy, Silty Clay
Time: 1230			
Method: DPT			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals & ~~...~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB009
Sample Location: 22SB009 C305
Sampled By: KS - EB
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth '	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1.19.11 Time: 1240 Method: DPT Monitor Reading (ppm): —	3 - 5	Wet-Moist Rust-White	sandy, silty Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals ~~& pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB100002
Project No.:	112G02362	Sample Location:	22SB10
		Sampled By:	AEB/KES
		C.O.C. No.:	

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1/19/11	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1450	0-2'	Rust	Moist, Clayey, V. Fine Sand
Method: DPT			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB100305
Sample Location: 22SB10
Sampled By: AEB/KES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1/19/11	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1500 Method: DPT Monitor Reading (ppm): —	3-5'	Rust	Clayey, V. Fine Sand

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings				
(Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals ~~& pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB110002
Sample Location: 22SB11
Sampled By: AEB/KES
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1/19/11	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1520 Method: DPT Monitor Reading (ppm): —	0-2'	Rust	Moist, sandy Clay

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB110304
Sample Location: 22SB11
Sampled By:
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11 Time: 1530 Method: DPT Monitor Reading (ppm): —	3-~~5~~4'	tan	Moist, clayey Sand

COMPOSITE SAMPLE DATA: 3-4'

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & Perchlorate	1- 8 oz w/m glass, 4°C	✓	
RCRA Metals ~~&pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

* Refusal at 4'

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [illegible]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

SAMPLED @ 1020

Sample ID No.: 22SB012 0002
Sample Location: 22SB012
Sampled By: RS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10 MAY 12 Time: RS ~~0910~~ 1020 Method: DPT Monitor Reading (ppm): 0	0 - 2'	BRN	MOIST SILT & CLAY SOME GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals + pH	1 ~~X~~ 8 oz w/m glass, 4°C	✓	
	2X VOL FOR DUP		

OBSERVATIONS / NOTES:

MOVED FROM ORIGINAL LOCATION SEE LOG BOOK #1447 PG 15

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	22FD051012-01

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0130002
Sample Location: 22SB013
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.9.12 Time: 1650 Method: DPT Monitor Reading (ppm): 0	0 - 2'	BRN	MOIST, ~~SA~~ SILT & CLAY TR F. SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~ 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

SAMPLED @ 1610

Sample ID No.: 22SB0140002
Sample Location: 22SB014
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.9.12 Time: 1610 Method: DPT Monitor Reading (ppm): 0	0-2'	BRN	DRY, FINE SAND & SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~ 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

REFUSAL @ 2.5'
3 ATEMPTS NO 3-5' SAMPLE

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB014 0203
Project No.:	112G02362	Sample Location:	22SB014
		Sampled By:	KS
		C.O.C. No.:	

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.10.12 Time: 1030 Method: ~~APP~~ CME Monitor Reading (ppm): 0	2-3'	BRN	MOIST - SANDSTONE F. SAND TR SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~X~~- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

COLLECTED USING TRACK RIG (CME) USING SPLIT SPOONS

MAP:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: NSA Crane, SWMU 22	Sample ID No.: 22SB0150002
Project No.: 112G02362	Sample Location: 22SB015
	Sampled By: KS
[X] Surface Soil	C.O.C. No.:
[ ] Subsurface Soil	
[] Sediment	Type of Sample:
[] Other:	[X] Low Concentration
[] QA Sample Type:	[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10 MAY 12 Time: 0840 Method: DPT Monitor Reading (ppm): 0	0-2'	BRN	MOIST, SILT W. F SAND TR CLAY & GRAVEL

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~ - 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

REMOVED TOP 3" OF ASPHALT/GRAVEL

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB016
Project No.:	112G02362	Sample Location:	22SB0160002
		Sampled By:	KS
[X] Surface Soil		C.O.C. No.:	
[ ] Subsurface Soil			
[] Sediment		Type of Sample:	
[] Other:		[X] Low Concentration	
[] QA Sample Type:		[] High Concentration	

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.9.12 Time: 1305 Method: DPT Monitor Reading (ppm): 0	0 - 2'	BRN/TAN	DRY SILT & F. SAND TR CLAY

COMPOSITE SAMPLE DATA:

~~Date:~~	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, ~~etc.)~~
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~- 8 oz w/m glass, 4°C	✓	
	2X VOC FOR MS/MSD		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
YES	

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB016
Sample Location: 22SB0160305
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.9.12 Time: 1315 Method: DPT Monitor Reading (ppm): 0	3 - 5'	TAN / BRN	DRY, SILT & F. SAND TR CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~4~~- 8 oz w/m glass, 4°C	✓	
	2 X VOC FOR		
	MS/MSD		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
YES	—

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0160608
Sample Location: 22SB016
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 5-9-12	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1325 Method: DPT Monitor Reading (ppm): 0	6 - 8'	BRN	MOIST SILT SOME CLAY TR SAND

COMPOSITE SAMPLE DATA:

~~Date:~~	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~ - 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

GRAVEL LAST 2"
SEWER EXCAVATION?

MAP:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0170002
Sample Location: 22SB17
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.9.12 Time: 1130 Method: DPT Monitor Reading (ppm): 0	0 - 2'	BRN	MOIST TO DRY, SILT & F. SAND TR CLAY, MORE CLAY AFTER 2.5'

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s): K-1 Sh

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0170305
Sample Location: 22SB017
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.9.12 Time: 1240 Method: DPT Monitor Reading (ppm): 0	3-5'	BRN/TAN	DRY SILT/CLAY SAND STONE @ BTM

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~ 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB018 0002
Sample Location: 22SB018
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.10.12 Time: 1120 Method: HAND AUGER Monitor Reading (ppm): 0	0-2'	BRN	MOIST, SILT WITH F. SAND, TR ROOTS

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~ 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

NEXT TO SUMP (SOUTH SIDE)
SUMP TD = 4.5' BGS
HAND AUGER REFUSAL @ 3.5'
NO TRUCK ACCESS FOR DPT
USED CME TRACK RIG FOR 2ND SAMPLE

MAP:

SEE pg 2

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SB0180406
Project No.:	112G02362	Sample Location:	22SB018
		Sampled By:	KS
		C.O.C. No.:	

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.11.12 Time: 1135 Method: ~~DPT~~ KS HSA Monitor Reading (ppm): 0	4-6'	BRN	MOIST, SILT & F. SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1 ~~2~~- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

BTM OF SUMP IS 4' BGS
USED CME TRACK RIG / SPLIT SPOON TO ACCESS LOCATION & COLLECT 4-6' SAMPLE

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Surface Soil
[ ] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SB0190002
Sample Location: 22SB019
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.10.12 Time: 1050 Method: DPT Monitor Reading (ppm): 0	0 - 2'	BRN	MOIST - SILT & CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals + PH	1 ~~4~~ 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

ADD ON LOCATION
PER TOM BRENT

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

22SB020 0002

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

 TE

Project Site Name:	SWMU 22	Sample ID No.:	22 SB 020 0002
Project No.:	112G02362	Sample Location:	22SB003
		Sampled By:	JC
		C.O.C. No.:	

[✓] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/23/13 Time: 1055 Method: Hand Auger Monitor Reading (ppm): NA	0-2ft	lt reddish brwn	silty clay (lightly little gravel moist)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

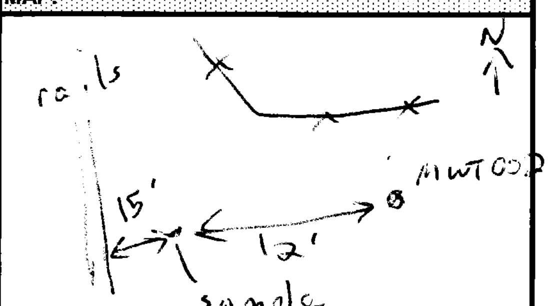
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
RDX/TNT	1-4 oz jar	✓	
Chromium (3/4)	2-4 oz jars	✓	

OBSERVATIONS / NOTES:

LOCATION 22SB003 COLLECTED 19 JAN 11
CHANGED SAMPLE ID TO
22SB020

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
	22FD01231301

Signature(s): JDC

22SB020 0203

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

TE

Project Site Name:	SWMU 22	Sample ID No.:	22 ~~SB020~~ 0203
Project No.:	112G02362	Sample Location:	22 SB003
		Sampled By:	JC
		C.O.C. No.:	

[] Surface Soil
[✓] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/23/13 Time: 1110 Method: Hand Auger Monitor Reading (ppm): NA	2-3 ft	lt reddish brwn, lt gray SS frag at bottom	silty and fine sandy clay sandstone fragments at bottom (possibly weathered rck)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
RDX/TNT	1 4 oz jar	✓	
~~chromium 3/4~~	~~2 4 oz jars~~		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.: ~~22SB020 0203 DUP~~

Signature(s): JC

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	SWMU 22	Sample ID No.:	22SS0040002
Project No.:	112G02362	Sample Location:	22SB004
		Sampled By:	JC
		C.O.C. No.:	

[✓] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/23/13 Time: 1220 Method: Hand Auger Monitor Reading (ppm): NA	0-2ft	lt reddish brown	Silty clay (lightly moist) small pockets of lt gray sand

small shallow organic layer

COMPOSITE SAMPLE DATA:

	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

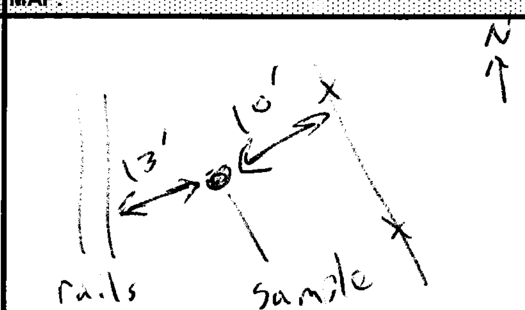
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
RDX/TNT	1 4 oz jar	✓	

OBSERVATIONS / NOTES:

* Some tire tracks (divets) in sample area, took sample in drainage and avoided tire divets

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): JC

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: SWMU 22
Project No.: 112G02362

[✓] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SS0050002
Sample Location: 22SB005
Sampled By: JC
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/23/13 Time: 1245 Method: Hand Auger Monitor Reading (ppm): NA	0 - 2ft Refusal @ 18"	lt reddish brown, lt gray SS at bottom	silty clay (lightly moist) SS pieces toward bottom

COMPOSITE SAMPLE DATA:

	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

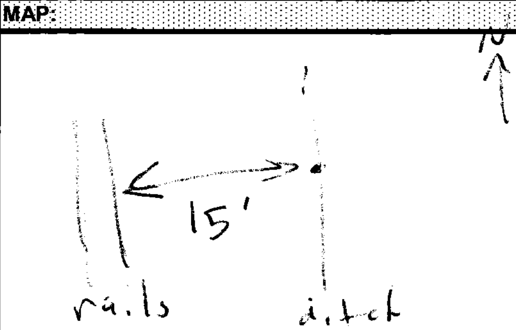
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
RDX/TNT	1 4 oz jar	✓	

OBSERVATIONS / NOTES:

* sampled in drainage way
Refusal @ 18" with sandstone pieces in auger. 3 holes attempted with 18" max depth augered

MAP:



Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): JDC

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name:	SWMU 22	Sample ID No.:	22SS0060002
Project No.:	112G02362	Sample Location:	22SB006
		Sampled By:	JC
		C.O.C. No.:	

[✓] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/23/13	0-2 ft	lt reddish-brown, lt gray SS pieces	Silty and fine sandy clay (moist), small shallow organic layer toward bottom
Time: 1310			
Method: Hand Auger			
Monitor Reading (ppm): NA			

COMPOSITE SAMPLE DATA:

	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

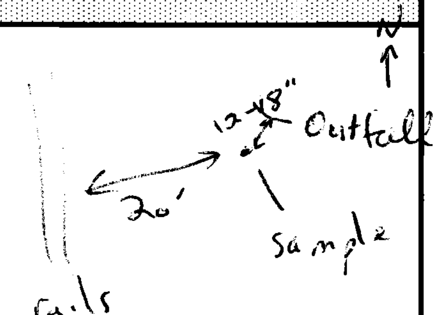
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
RDX/TNT	1 4 oz jar	✓	

OBSERVATIONS / NOTES:

* collected sample 12-18" below pipe outfall

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): JPC

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	SWMU 22	Sample ID No.:	22SS007000?
Project No.:	112G02362	Sample Location:	22SB007
		Sampled By:	JC
		C.O.C. No.:	

[✓] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/23/13 Time: 0855 Method: Hand Auger Monitor Reading (ppm): NA	0-2ft	Brown near surface, to lt reddish brown	Silty clay with gravel (moist), small shallow organic layer

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

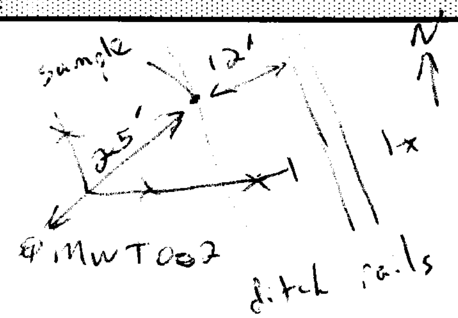
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
RDX/TNT	1 4 oz jar	✓	

OBSERVATIONS / NOTES:

* sample taken in drainage ditch
At 2ft standing water in hole encountered - no recovery below 2ft. Augered 5 holes at this location & either refusal or standing water encountered at 2ft

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.: —

Signature(s): JAC

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	SWMU 22	Sample ID No.:	22 SS008002
Project No.:	112G02362	Sample Location:	22 SB008
		Sampled By:	JC
		C.O.C. No.:	

[✓] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: ____
[] QA Sample Type: ____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/23/13 Time: 0815 Method: Hand Auger Monitor Reading (ppm): NA	0 - 2 ft	Brown near surface to lt reddish brown	silty and fine sandy clay (lightly moist)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

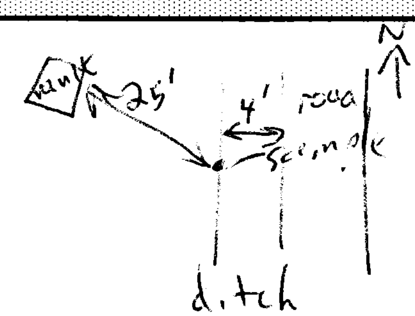
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
RDX/TNT	1 4 oz jar	✓	

OBSERVATIONS / NOTES:

* sample taken in drainage ditch

MAP:



KB138

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): JC

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 22
Project No.: 112G02362

[] Surface Soil
[] Subsurface Soil
[✓] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD0170006
Sample Location: 22SD017
Sampled By: JC
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/23/13	0 - 6"	Brown	clayey fine sand (moist) w/ pebbles
Time: 1400			
Method: ~~Hand Auger~~ grab			
Monitor Reading (ppm): NA	* could only grab sediment down to 3"		

COMPOSITE SAMPLE DATA:

	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings				
(Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
RDX/TNT	1 4 oz jar	✓	

OBSERVATIONS / NOTES:

* sample in dry part of stream bed. Upstream (150') of sample outcrop of fine sandstone underlain by shale

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): JPC

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GWT001
Sample Location: 22MWT001
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 5.22.12 Time: 1825 Method: BLADDER PUMP	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Sal ppt
	CLOUDY	5.90	0.592	18.84	140	6.20	126	~~ppt~~

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 5.22.12								
Method: BLADDER PUMP								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC SU								
Total Well Depth (TD): 27.95								
Static Water Level (WL): 15.34								
One Casing Volume(gal/L): 2.01								
Start Purge (hrs): 1615								
End Purge (hrs): 1825								
Total Purge Time (min): 130								
Total Vol. Purged (gal/L): 3.4								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓

Strike thru Parameters that are not required

OBSERVATIONS / NOTES:

SET PUMP 4' OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane
PROJECT NUMBER: 112G02362

WELL ID.: 22GWT001
DATE: 5.22.12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP +/- mV		Comments
										START PURGE
1615	15.34	100	—	—	—	—	—	—		CLOUDY, NO ODOR
1625	15.83	↓	5.00	1.32	153	8.81	19.45	177		
1635	17.70		5.29	0.992	187	8.03	18.19	168		
1645	18.20		5.41	0.703	121	7.88	18.62	160		
1655	18.55		5.59	0.507	91	7.60	19.04	155		
1705	18.77		5.65	0.487	100	8.63	19.24	153		
1715	19.03		5.68	0.479	118	9.05	19.50	150		
1725	19.28		5.73	0.501	121	7.27	19.45	141		
1735	19.59		5.77	0.537	127	6.38	19.40	136		
1745	19.84		5.86	0.546	130	6.67	19.41	128		
1755	20.18		5.94	0.553	135	7.18	19.42	122		
1805	20.37		5.94	0.570	141	6.68	19.05	121		
1815	20.62		5.94	0.586	148	6.16	18.86	121		
1820	20.84		5.90	0.590	142	6.23	18.86	124		
1825	20.95	↓	5.90	0.592	140	6.20	18.84	126		

SIGNATURE(S): [signature]

PAGE 2 OF 2

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GWT002
Sample Location: 22GWT002
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Date: 5.22.12								
Time: 1020	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Method: BLADDER PUMP	LT CLOUDY	3.93	0.940	15.83	20	5.36	352	—

PURGE DATA:

Date: 5.22.12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BLADDER PUMP								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC SCH 40								
Total Well Depth (TD): 24.05								
Static Water Level (WL): 9.19								
One Casing Volume(gal/L): 2.4								
Start Purge (hrs): 0740								
End Purge (hrs): 1020								
Total Purge Time (min): 160								
Total Vol. Purged (gal/L): 4.2								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓
		4X VOL FOR	
Strike thru Parameters that are not required		SAMPLE, MS/MSD, DUP	

OBSERVATIONS / NOTES:

SET PUMP 5' OFF BTM

Circle if Applicable:		Signature(s):
MS/MSD YES	Duplicate ID No.: 22GWDUP01	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane
PROJECT NUMBER: 112G02362
WELL ID.: 22GWT002
DATE: 5.22.12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP +/- mV		Comments
0740	9.19	115								START PURGE CLEAR, NO ODOR
0750	10.33	100	3.94	1.01	52	7.35	14.62	328		
0800	11.40	100	4.00	0.903	30	7.51	14.34	345		
0810	13.19	100	3.93	0.803	10.7	6.21	14.60	359		
0820	13.97		3.91	0.792	7.8	6.95	14.62	360		
0830	14.08		3.89	0.785	4.2	7.26	14.64	360		
0840	14.49		3.91	0.772	16	6.95	14.87	359		
0850	14.89		3.93	0.761	23	6.61	15.04	358		
0900	15.31		3.95	0.781	60	6.71	15.25	358		
0910	15.65		3.96	0.794	75	6.76	15.41	358		
0920	16.09		3.96	0.815	80	5.12	15.61	359		
0930	16.55		3.96	0.832	87	3.91	15.82	360		
0940	16.89		3.95	0.889	52	4.83	15.83	358		
0950	17.35		3.95	0.923	30	5.31	15.84	355		
1000	17.53		3.94	0.946	23	5.40	15.82	352		STOP PUMP TO CHECK RECHARGE
1010	17.32									
1020	17.68		3.93	0.940	20	5.36	15.83	352		
										START SAMPLING

SIGNATURE(S): [signature]

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Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GWT003
Sample Location: 22MWT003
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 5·23·12	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Time: 1825	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Method: BLADDER PUMP	CLEAR	3.74	1.89	18.93	9.3	3.70	350	—

PURGE DATA:

Date: 5·23·12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BLADDER PUMP								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC SU								
Total Well Depth (TD): 26.30								
Static Water Level (WL): 17.43								
One Casing Volume(gal/L): 1.5								
Start Purge (hrs): 1605								
End Purge (hrs): 1825								
Total Purge Time (min): 140								
Total Vol. Purged (gal/L): 3.7								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
~~Dissolved RCRA Metals~~	~~HNO3 - 4°C~~	~~1 - 250mL PE, field filtered~~	~~✓~~
Strike thru Parameters that are not required			

OBSERVATIONS / NOTES:

NO DISSOLVED RCRA METALS - TURB <10 NTU

SET PUMP 4' OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane
PROJECT NUMBER: 112G02362

WELL ID.: 22GWT003
DATE: 5.23.12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP +/- mV		Comments
16:05	17.43	100								START PURGE CLOUDY, NO ODOR
1615	17.50		3.65	1.82	152	9.27	20.10	373		
1625	18.08		3.63	1.81	84	5.93	20.83	373		
1635	18.59		3.66	1.81	102	4.53	19.83	376		
1645	19.02		3.68	1.83	101	4.18	19.56	372		
1655	19.39		3.69	1.88	82	3.98	19.82	363		
1705	19.64		3.70	1.90	61	4.12	19.43	360		
1715	19.99		3.71	1.91	49	5.13	19.06	358		
1725	20.23		3.72	1.90	40	4.88	19.01	354		
1735	20.48		3.73	1.90	31	4.70	18.96	352		
1745	20.70		3.75	1.92	23	4.50	19.94	351		
1755	20.89		3.75	1.94	18	4.19	18.93	350		
1805	21.02		3.74	1.92	16	3.72	18.92	350		
1815	21.21		3.73	1.90	14	3.59	18.92	351		
1820	21.27		3.73	1.89	12	3.66	18.93	351		
1825	21.33		3.74	1.89	9.3	3.70	18.93	350		

SIGNATURE(S): [signature]

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Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GW T004
Sample Location: 22MW T004
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 5.23.12	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Time: 1005	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Method: BLADDER PUMP	CLOUDY	5.10	1.22	16.32	273	2.75	167	—

PURGE DATA:

Date: 5.23.12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BLADDER PUMP								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC 54								
Total Well Depth (TD): 27.90								
Static Water Level (WL): 12.62								
One Casing Volume(gal/L): 2.5								
Start Purge (hrs): 0740								
End Purge (hrs): 1005								
Total Purge Time (min): 145								
Total Vol. Purged (gal/L): 3.8								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓
Strike thru Parameters that are not required			

OBSERVATIONS / NOTES:

SET PUMP 4' OFF BTM

Circle if Applicable:		Signature(s):
MS/MSD —	**Duplicate ID No.:** —	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane
PROJECT NUMBER: 112G02362

WELL ID.: 22GWT004
DATE: 5.23.12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP +/- mV		Comments
										START PURGE
0740	12.62	100								GRAY, NO ODOR
0750	13.36		4.61	1.15	812	6.44	16.05	201		
0800	14.38		4.63	1.16	502	6.11	16.05	203		
0810	15.40		4.66	1.16	365	5.95	16.05	205		
0820	16.52		4.73	1.16	207	6.06	16.20	196		
0830	17.90		4.85	1.16	120	6.18	16.31	190		
0840	18.30		4.99	1.17	118	5.65	16.32	177		
0850	18.70		5.10	1.18	116	5.25	16.32	162		
0900	19.05		5.15	1.19	195	5.02	16.31	155		
0910	19.38		5.23	1.20	247	4.91	16.31	148		
0920	19.89		5.23	1.21	300	4.52	16.32	149		
0930	20.45		5.23	1.22	347	4.33	16.34	149		
0940	20.86		5.19	1.22	312	4.86	16.32	155		
0950	21.28		5.14	1.22	292	5.24	16.30	160		
0955	21.42		5.10	1.22	284	2.81	16.31	163		
1000	21.58		5.10	1.22	284	2.77	16.31	166		
1005	21.72		5.10	1.22	273	2.75	16.32	167		

SIGNATURE(S):

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Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GWT005
Sample Location: 22MWT005
Sampled By: RS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Sal ppt
Date: 5.21.12								
Time: 1550								
Method: BAILER	CLOUDY	3.84	0.400	17.64	13.0	9.10	327	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 5.21.12								
Method: BAILER								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC 54								
Total Well Depth (TD): 21.85								
Static Water Level (WL): 18.49								
One Casing Volume (gal/L): 0.6								
Start Purge (hrs): —								
End Purge (hrs): —								
Total Purge Time (min): —								
Total Vol. Purged (gal/L): —								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓
Strike thru Parameters that are not required			

OBSERVATIONS / NOTES:

SAMPLED USING A BAILER, POOR WATER PRODUCER WITH SIGNIFICANT WL DRAW DOWN.
1ST BAILER WAS CLEAR, HIGHER TURBBIDITY WITH EACH ADDITIONAL BAILER.
PURGED DURING DEVELOPMENT

WL @ END OF SAMPLING = 20.35' BTOR

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature]

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22GWT006
Project No.:	112G02362	Sample Location:	22GWT006
		Sampled By:	KS
[ ] Domestic Well Data		C.O.C. No.:	
[x] Monitoring Well Data		Type of Sample:	
[ ] Other Well Type:		[X] Low Concentration	
[ ] QA Sample Type:		[ ] High Concentration	

SAMPLING DATA:

Date: 5.21.12	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Time: 1620	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Method: BAILER	cloudy	4.18	5.60	17.59	2.8	5.56	309	—

PURGE DATA:

Date: 5.21.12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BAILER								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC 5.4								
Total Well Depth (TD): 28.31								
Static Water Level (WL): 17.19								
One Casing Volume(gal/L):								
Start Purge (hrs): —								
End Purge (hrs): —								
Total Purge Time (min): —								
Total Vol. Purged (gal/L): —								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓
Strike thru Parameters that are not required			

OBSERVATIONS / NOTES:

SAMPLED USING A BAILER, POOR WATER PRODUCER WITH SIGNIFICANT WL DRAW DOWN.
1ST BAILER WAS CLEAR, HIGHER TURBIDITY WITH EACH ADDITIONAL BAILER.
PURGED DURING DEVELOPMENT

WL @ END OF SAMPLING = 20.15 BTOR

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	[signature]
—	—	

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GWT001
Sample Location: 22MWT001
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Date: 5.22.12								
Time: 1825	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Method: BLADDER PUMP	CLOUDY	5.90	0.592	18.84	140	6.20	126	—

PURGE DATA:

Date: 5.22.12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BLADDER PUMP								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC 54								
Total Well Depth (TD): 27.95								
Static Water Level (WL): 15.34								
One Casing Volume(gal/L): 2.01								
Start Purge (hrs): 1615								
End Purge (hrs): 1825								
Total Purge Time (min): 130								
Total Vol. Purged (gal/L): 3.4								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓
Strike thru Parameters that are not required			

OBSERVATIONS / NOTES:

SET PUMP 4' OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane
PROJECT NUMBER: 112G02362

WELL ID.: 22GWT001
DATE: 5.22.12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP +/- mV		Comments
1615	15.34	100								START PURGE CLOUDY, NO ODOR
1625	15.83		5.00	1.32	153	8.81	19.45	177		
1635	17.70		5.29	0.992	187	8.03	18.19	168		
1645	18.20		5.41	0.703	121	7.88	18.62	160		
1655	18.55		5.59	0.507	91	7.60	19.04	155		
1705	18.77		5.65	0.487	100	8.63	19.24	153		
1715	19.03		5.68	0.479	118	9.05	19.50	150		
1725	19.28		5.73	0.501	121	7.27	19.45	141		
1735	19.59		5.77	0.537	127	6.38	19.40	136		
1745	19.84		5.86	0.546	130	6.67	19.41	128		
1755	20.18		5.94	0.553	135	7.18	19.42	122		
1805	20.37		5.94	0.570	141	6.68	19.05	121		
1815	20.62		5.94	0.586	148	6.16	18.86	121		
1820	20.84		5.90	0.590	142	6.23	18.86	124		
1825	20.95		5.90	0.592	140	6.20	18.84	126		

SIGNATURE(S): [signature]

PAGE 2 OF 2

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GWT002
Sample Location: 22GWT002
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Date: 5.22.12								
Time: 1020	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Method: BLADDER PUMP	LT CLOUDY	3.93	0.940	15.83	20	5.36	352	—

PURGE DATA:

Date: 5.22.12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BLADDER PUMP								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC SU								
Total Well Depth (TD): 24.05								
Static Water Level (WL): 9.19								
One Casing Volume(gal/L): 2.4								
Start Purge (hrs): 0740								
End Purge (hrs): 1020								
Total Purge Time (min): 160								
Total Vol. Purged (gal/L): 4.2								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓
		4X VOL FOR	
Strike thru Parameters that are not required		SAMPLE, MS/MSD, DUP	

OBSERVATIONS / NOTES:

SET PUMP 5' OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
YES	22GWDUP01	KA Ek

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane
PROJECT NUMBER: 112G02362

WELL ID.: 22GWT002
DATE: 5.22.12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP +/- mV		Comments
										START PURGE
0740	9.19	115								CLEAR, NO ODOR
0750	10.33	100	3.94	1.01	52	7.35	14.62	328		
0800	11.40	100	4.00	0.903	30	7.51	14.34	345		
0810	13.19	100	3.93	0.803	10.7	6.21	14.60	359		
0820	13.97		3.91	0.792	7.8	6.95	14.62	360		
0830	14.08		3.89	0.785	4.2	7.26	14.64	360		
0840	14.49		3.91	0.772	16	6.95	14.87	359		
0850	14.89		3.93	0.761	23	6.61	15.04	358		
0900	15.31		3.95	0.781	60	6.71	15.25	358		
0910	15.65		3.96	0.794	75	6.76	15.41	358		
0920	16.09		3.96	0.815	80	5.12	15.61	359		
0930	16.55		3.96	0.832	87	3.91	15.82	360		
0940	16.89		3.95	0.889	52	4.83	15.83	358		
0950	17.35		3.95	0.923	30	5.31	15.84	355		
1000	17.53		3.94	0.946	23	5.40	15.82	352		STOP PUMP TO
1010	17.32									CHECK RECHARGE
1020	17.68		3.93	0.940	20	5.36	15.83	352		
										START SAMPLING

SIGNATURE(S): [signature]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GWT003
Sample Location: 22MWT003
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 5·23·12	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Time: 1825	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Method: BLADDER PUMP	CLEAR	3.74	1.89	18.93	9.3	3.70	350	—

PURGE DATA:

Date: 5·23·12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BLADDER PUMP								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC 54								
Total Well Depth (TD): 26.30								
Static Water Level (WL): 17.43								
One Casing Volume(gal/L): 1.5								
Start Purge (hrs): 1605								
End Purge (hrs): 1825								
Total Purge Time (min): 140								
Total Vol. Purged (gal/L): 3.7								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
~~Dissolved RCRA Metals~~	~~HNO3 - 4°C~~	~~1 - 250mL PE, field filtered~~	~~✓~~

Strike thru Parameters that are not required

OBSERVATIONS / NOTES:

NO DISSOLVED RCRA METALS - TURB <10 NTU

SET PUMP 4' OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane
PROJECT NUMBER: 112G02362
WELL ID.: 22GWT003
DATE: 5.23.12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP +/- mV		Comments
16:05	17.43	100								START PURGE CLOUDY, NO ODOR
1615	17.50		3.65	1.82	152	9.27	20.10	373		
1625	18.08		3.63	1.81	84	5.93	20.83	373		
1635	18.59		3.66	1.81	102	4.53	19.83	376		
1645	19.02		3.68	1.83	101	4.18	19.56	372		
1655	19.39		3.69	1.88	82	3.98	19.82	363		
1705	19.64		3.70	1.90	61	4.12	19.43	360		
1715	19.99		3.71	1.91	49	5.13	19.06	358		
1725	20.23		3.72	1.90	40	4.88	19.01	354		
1735	20.48		3.73	1.90	31	4.70	18.96	352		
1745	20.70		3.75	1.92	23	4.50	19.94	351		
1755	20.89		3.75	1.94	18	4.19	18.93	350		
1805	21.02		3.74	1.92	16	3.72	18.92	350		
1815	21.21		3.73	1.90	14	3.59	18.92	351		
1820	21.27		3.73	1.89	12	3.66	18.93	351		
1825	21.33		3.74	1.89	9.3	3.70	18.93	350		

SIGNATURE(S): [illegible]

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Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GW-T004
Sample Location: 22MW-T004
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 5-23-12	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Time: 1005	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Method: BLADDER PUMP	CLOUDY	5.10	1.22	16.32	273	2.75	167	—

PURGE DATA:

Date: 5-23-12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BLADDER PUMP								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC SU								
Total Well Depth (TD): 27.90								
Static Water Level (WL): 12.62								
One Casing Volume(gal/L): 2.5								
Start Purge (hrs): 0740								
End Purge (hrs): 1005								
Total Purge Time (min): 145								
Total Vol. Purged (gal/L): 3.8								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓

Strike thru Parameters that are not required

OBSERVATIONS / NOTES:

SET PUMP 4' OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane
PROJECT NUMBER: 112G02362

WELL ID.: 22GWT004
DATE: 5·23·12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP +/- mV		Comments
0740	12.62	100								START PURGE GRAY, NO ODOR
0750	13.36		4.61	1.15	812	6.44	16.05	201		
0800	14.38		4.63	1.16	502	6.11	16.05	203		
0810	15.40		4.66	1.16	365	5.95	16.05	205		
0820	16.52		4.73	1.16	207	6.06	16.20	196		
0830	17.90		4.85	1.16	120	6.18	16.31	190		
0840	18.30		4.99	1.17	118	5.65	16.32	177		
0850	18.70		5.10	1.18	116	5.25	16.32	162		
0900	19.05		5.15	1.19	195	5.02	16.31	155		
0910	19.38		5.23	1.20	247	4.91	16.31	148		
0920	19.89		5.23	1.21	300	4.52	16.32	149		
0930	20.45		5.23	1.22	347	4.33	16.34	149		
0940	20.86		5.19	1.22	312	4.86	16.32	155		
0950	21.28		5.14	1.22	292	5.24	16.30	160		
0955	21.42		5.10	1.22	284	2.81	16.31	163		
1000	21.58		5.10	1.22	284	2.77	16.31	166		
1005	21.72		5.10	1.22	273	2.75	16.32	167		

SIGNATURE(S): [signature]

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Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GWT005
Sample Location: 22MWT005
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Date: 5.21.12	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Time: 1550								
Method: BAILER	CLOUDY	3.84	0.400	17.64	13.0	9.10	327	—

PURGE DATA:

Date: 5.21.12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BAILER								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC SU								
Total Well Depth (TD): 21.85								
Static Water Level (WL): 18.49								
One Casing Volume(gal/L): 0.6								
Start Purge (hrs): —								
End Purge (hrs): —								
Total Purge Time (min): —								
Total Vol. Purged (gal/L): —								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓
Strike thru Parameters that are not required			

OBSERVATIONS / NOTES:

SAMPLED USING A BAILER, POOR WATER PRODUCER WITH SIGNIFICANT WL DRAW DOWN.
1ST BAILER WAS CLEAR, HIGHER TURBIDITY WITH EACH ADDITIONAL BAILER.
PURGED DURING DEVELOPMENT

WL @ END OF SAMPLING = 20.35' BTOR

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: 22GWT006
Sample Location: 22GWT006
Sampled By: KS
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 5.21.12	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal
Time: 1620	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	ppt
Method: BAILER	cloudy	4.18	5.60	17.59	2.8	5.56	309	—

PURGE DATA:

Date: 5.21.12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: BAILER								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC SU								
Total Well Depth (TD): 28.31								
Static Water Level (WL): 17.19								
One Casing Volume(gal/L):								
Start Purge (hrs): —								
End Purge (hrs): —								
Total Purge Time (min): —								
Total Vol. Purged (gal/L): —								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives plus PETN & NG	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 250mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 250mL PE, field filtered	✓
Strike thru Parameters that are not required			

OBSERVATIONS / NOTES:

SAMPLED USING A BAILER, POOR WATER PRODUCER WITH SIGNIFICANT WL DRAW DOWN.
1ST BAILER WAS CLEAR, HIGHER TURBIDITY WITH EACH ADDITIONAL BAILER.
PURGED DURING DEVELOPMENT

WL @ END OF SAMPLING = 20.15 BTOR

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	[signature]

Tetra Tech

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: SWMU 22
Project No.: 112G02362

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 22GWT005
Sample Location: 22MWT005
Sampled By: K.L.
C.O.C. No.:
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^0C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	~~Other~~ ORD
Date: 1/23/13								
Time: 1430								
Method: Bailer	v. cloudy	5.87	.305	11.87	1000+	3.10	—	422

PURGE DATA:

	Volume	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Date: 1/23/13								
Method: Bailer								
Monitor Reading (ppm): NA								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 21.80								
Static Water Level (WL): 19.67								
One Casing Volume(gal/L): 0.5								
Start Purge (hrs): 1400								
End Purge (hrs): 1430								
Total Purge Time (min): 30								
Total Vol. Purged (gal/L): 2 gal								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Chromium Speciation	1 150 mL		✓
	1 250 mL HNO_3		✓
	1 250 mL		✓

OBSERVATIONS / NOTES:

first bailer clear then very turbid.
Additional collected 22GWT005-F

Circle if Applicable:

MS/MSD

Duplicate ID No.: 22FD01231302

Signature(s):

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW001
Sample Location: 22SW001
Sampled By: AEB/TE
C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 1/20/11 Time: 1015 Depth: 4" Method: Plastic	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other Salinity(PPt)
	clear	5.95	1.51	-0.5	0.0	15.5	250	0.4

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	✓

OBSERVATIONS / NOTES:

Creek width: 10-12 feet.
Creek depth: ~4"
Flow rate: ~20-25 gpm

MAP:

Circle if Applicable:

MS/MSD
Duplicate ID No.:

Signature(s):

Ellen Berklite

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22

Project No.: 112G02362

Sample ID No.: 22SW002

Sample Location: 22SW002

Sampled By: TE - EB

C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other salinity
Date: 1/20/11 Time: 1040 Depth: 2-4" Method: Plastic Bottle	~~Brown~~ Clear	6.96	1.51	-0.23	0.8	14.42	149	0.4

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	✓

OBSERVATIONS / NOTES:

Creek width: 10-15 feet
creek depth: 2-4"
Flow rate: ~ 20-25gpm

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Ellen Berkbite

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Sample ID No.: 22SW003
Sample Location: 22SW003
Sampled By: AEB/TE
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 1/20/11 Time: 1310 Depth: 4-6" Method: Plastic bottle	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other Salinity(ppt)
	light tea	7.37	1.64	0.19	12.4	13.95	185	

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	✓

OBSERVATIONS / NOTES:

Creek width: 10-12'
Creek depth: 4-6"
Flow rate: 20-25gpm

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkelite

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW004
Sample Location: 22SW004
Sampled By: TE - EB
C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other Salinity (ppt)
Date: 1/20/11 Time: 1230 Depth: 1" Method: Plastic bottle	Brown	7.39	0.233	-0.19	643	13.82	132	0.00

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	✓

OBSERVATIONS / NOTES:

Stream Width: 1'
Stream depth: 1"
Flow rate: 100-250 mL/min
* Had to dig hole in stream bed to allow water to flow in for collection.

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Ellen Berklite

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW005
Sample Location: 22SW005
Sampled By: AEB/TE
C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 1/20/11	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	
Perchlorate	4°C	1 - 250 mL PE	
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	

OBSERVATIONS / NOTES:

* 18' from culvert/fenceline - No Flow
Sample NOT collected.

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Ellen Berklite

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW006
Sample Location: 22SW006
Sampled By: AEB/KES
C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other
Date: 1/18/11 Time: 1610 Depth: 0 - 4" Method: DIRECT FILL	Light tan	6.07	0.239	5.3	11	9.27	233	

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	✓

OBSERVATIONS / NOTES:

Flow rate: <1 gpm
Rained on and off throughout the day.
Temp (air) between 35°F-40°F.
Standing puddles when sampled.

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkbile

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW007
Sample Location: 22SW007
Sampled By: KS - EB
C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other
Date: 1/14/11 Time: 1630 Depth: 0 - 4" Method: DIRECT FILL	Light tea	6.71	0.232	5.25	2.4	6.35	207	

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	✓

OBSERVATIONS / NOTES:

Air temp: 35°-40°F throughout day. Rain intermittently. Standing puddles when sampled. Flow rate: <1gpm.

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Ellen Berkholtz

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[] Stream
[X] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Sample ID No.: 22SW008
Sample Location: 22SW008
Sampled By: KS / EB
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 1.18.11
Time: 1715
Depth:
Method:

Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	
Perchlorate	4°C	1 - 250 mL PE	
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	

OBSERVATIONS / NOTES:

*No sample collected at this location due to no water present.

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Sample ID No.: 22SW009
Sample Location: 22SW009
Sampled By: AEB/TE
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other Salinity-ppt
Date: 1/20/11								
Time: 1440								
Depth: 1-2"								
Method: Plastic bottle	Cloudy	7.44	0.523	-0.19	14.5	11.45	139	0.1

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	✓

OBSERVATIONS / NOTES:

Stream Width: 1'
stream depth: 1-2"
Flow: 1-2 gpm
* Dug hole in stream bed to allow water to flow in.

MAP:

Circle if Applicable:

~~MS/MSD~~

Duplicate ID No.: 22SWDUP01

Signature(s): Ellen Berkeley

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW010
Sample Location: 22SW010
Sampled By: AEB/TE
C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 1/20/11	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1515	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	Salinity(ppt)
Depth: 4-6" Method: plastic bottle	Light tea	7.66	0.555	0.57	25.6	13.21	23	0.1

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	2 - 1 liter amber glass	✓
Perchlorate	4°C	1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	1 - 500mL PE, field filtered	✓

OBSERVATIONS / NOTES:

Stream width: 2-3'
Stream depth: 4-6"
Flow rate: 1-2 gpm
Flow on drainage (concrete bottom)

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Ellen Berkbile

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[] Stream
[] Spring
[] Pond
[] Lake
[X] Other: DRAINAGE
[] QA Sample Type:

Sample ID No.: 22SW010
Sample Location: 22SW010
Sampled By: K S
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other
Date: 5.12.12 Time: 1100 Depth: 0 - 5" Method: DIRECT FILL	clear	7.17	0.495	18.67	6.1	3.47	1	—

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
PETN & NG	4°C	2 - 1 liter amber glass	✓
~~Explosives + PETN & NG~~	~~4°C~~	~~2 - 1 liter amber glass~~	
~~Perchlorate~~	~~4°C~~	~~1 - 250 mL PE~~	
~~Total RCRA Metals~~	~~HNO3 - 4°C~~	~~1 - 500mL PE~~	
~~Dissolved RCRA Metals (if >10 NTUs)~~	~~HNO3 - 4°C~~	~~1 - 500mL PE, field filtered~~	

OBSERVATIONS / NOTES:

SLIGHT FLOW
~ 0.5 GPM

CLEAR - SOME RUST FLOC

2ND SAMPLING EVENT
1ST 20 JAN 2011

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): [signature]

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW011
Sample Location: 22SW011
Sampled By: AEB/TE
C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other salinity (ppt)
Date: 1/20/11 Time: 1345 Depth: 6-8" Method: Plastic bottle	Clear	7.83	1.72	-0.08	4.0	14.15	150	0.5

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives	4°C	3X 2 - 1 liter amber glass	✓
Perchlorate	4°C	3X 1 - 250 mL PE	✓
Total RCRA Metals	HNO3 - 4°C	3X 1 - 500mL PE	✓
Dissolved RCRA Metals	HNO3 - 4°C	3X 1 - 500mL PE, field filtered	✓

OBSERVATIONS / NOTES:

Creek Width: 5-6'
creek depth: 6-8"
Flow rate: 15-20gpm
*Rocky creek bottom

MAP:

Circle if Applicable:

MS/MSD: yes

~~Duplicate ID No.:~~

Signature(s): Ellen Berkline

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSA CRANE SWMU 22	Sample ID No.:	22SW012
Project No.:	112G02362	Sample Location:	22SW012
		Sampled By:	Berklite/Losekamp
[X] Stream		C.O.C. No.:	2209
[] Spring			
[] Pond		Type of Sample:	
[] Lake		[] Low Concentration	
[] Other:		[] High Concentration	
[] QA Sample Type:			

SAMPLING DATA:

		Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP
Date:	4/9/2011	Cloudy	7.05	0.146	13.56	17.1	9.65	-	129
Time:	1830								
Depth:	Surface								
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	$4^{0}C$	(2) 1-liter ambers	Yes
Full Explosives	$4^{0}C$	(2) 1-liter ambers	No
RCRA Total Metals	$4^{0}C$ / HN03	(1) 500-ml plastic	No
RCRA Dissolved Metals	$4^{0}C$ / HN03	(1) 500-ml plastic	No

OBSERVATIONS / NOTES:

Flow rate = ~2 gpm.

Stream depth = 1.5 feet

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berklite

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSA CRANE SWMU 22	Sample ID No.:	22SW013
Project No.:	112G02362	Sample Location:	22SW013
		Sampled By:	Berklite/Losekamp
[X] Stream		C.O.C. No.:	2209
[] Spring			
[] Pond		Type of Sample:	
[] Lake		[] Low Concentration	
[] Other:		[] High Concentration	
[] QA Sample Type:			

SAMPLING DATA:

		Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP
Date:	4/9/2011	Clear	7.16	0.38	16.32	13	9.85	-	123
Time:	1805								
Depth:	Surface								
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	4^{0}C	(2) 1-liter ambers	Yes
Full Explosives	4^{0}C	(2) 1-liter ambers	No
RCRA Total Metals	4^{0}C / HN03	(1) 500-ml plastic	No
RCRA Dissolved Metals	4^{0}C / HN03	(1) 500-ml plastic	No

OBSERVATIONS / NOTES:

Flow rate = ~150 gpm.

Stream depth = 1.0 feet

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Ellen Berklite

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Page 1 of 1

Project Site Name:	NSA CRANE SWMU 22	Sample ID No.:	22SW014
Project No.:	112G02362	Sample Location:	22SW014
		Sampled By:	Berklite/Losekamp
[X] Stream		C.O.C. No.:	2209
[] Spring			
[] Pond		Type of Sample:	
[] Lake		[] Low Concentration	
[] Other:		[] High Concentration	
[] QA Sample Type:			

SAMPLING DATA:

		Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Date:	4/9/2011								
Time:	1815	(Visual)	(S.U.)	(mS/cm)	(^{0}C)	(NTU)	(mg/l)	(%)	
Depth:	Surface	Clear	6.93	0.261	15.26	7.47	8.65	-	123
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	4^0C	(2) 1-liter ambers	Yes
Full Explosives	4^0C	(2) 1-liter ambers	No
RCRA Total Metals	4^0C / HN03	(1) 500-ml plastic	No
RCRA Dissolved Metals	4^0C / HN03	(1) 500-ml plastic	No

OBSERVATIONS / NOTES:

Flow rate = ~75 gpm.

Stream depth = 1.0 feet

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Ellen Berklite

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSA CRANE SWMU 22	Sample ID No.:	22SW015
Project No.:	112G02362	Sample Location:	22SW015
		Sampled By:	Berklite/Losekamp
[X] Stream		C.O.C. No.:	2209
[] Spring			
[] Pond		Type of Sample:	
[] Lake		[] Low Concentration	
[] Other:		[] High Concentration	
[] QA Sample Type:			

SAMPLING DATA:

		Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP
Date:	4/9/2011								
Time:	1840								
Depth:	Surface	Clear	5.22	0.102	13.12	10.35	9.52	-	255
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	4^0C	(2) 1-liter ambers	Yes
Full Explosives	4^0C	(2) 1-liter ambers	No
RCRA Total Metals	4^0C / HN03	(1) 500-ml plastic	No
RCRA Dissolved Metals	4^0C / HN03	(1) 500-ml plastic	No

OBSERVATIONS / NOTES:

Flow rate = ~1 gpm.

Stream depth = 0.2 feet

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Ellen Berklite

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSA CRANE SWMU 22	Sample ID No.:	22SW016
Project No.:	112G02362	Sample Location:	22SW016
		Sampled By:	Berklite/Losekamp
[X] Stream		C.O.C. No.:	2209
[] Spring			
[] Pond		Type of Sample:	
[] Lake		[] Low Concentration	
[] Other:		[] High Concentration	
[] QA Sample Type:			

SAMPLING DATA:

		Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP
Date:	4/9/2011								
Time:	1900								
Depth:	Surface	Lt. Brown	6.5	0.156	14.81	17.9	10.3	-	158
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	4^{0}C	(2) 1-liter ambers	Yes
Full Explosives	4^{0}C	(2) 1-liter ambers	No
RCRA Total Metals	4^{0}C / HN03	(1) 500-ml plastic	No
RCRA Dissolved Metals	4^{0}C / HN03	(1) 500-ml plastic	No

OBSERVATIONS / NOTES:

Flow rate = ~75 gpm.

Stream depth = 0.5 feet

Seep in sandstone. Outcrop above sample location

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Allen Berklite

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSA CRANE SWMU 22	Sample ID No.:	22SW017
Project No.:	112G02362	Sample Location:	22SW017
		Sampled By:	Berklite/Losekamp
[X] Stream		C.O.C. No.:	2209
[] Spring			
[] Pond		Type of Sample:	
[] Lake		[] Low Concentration	
[] Other:		[] High Concentration	
[] QA Sample Type:			

SAMPLING DATA:

		Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP
Date:	4/9/2011								
Time:	1650								
Depth:	Surface	Clear	6.19	0	14.6	14.5	13.23	-	146
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	4^0C	(2) 1-liter ambers	Yes
Full Explosives	4^0C	(2) 1-liter ambers	No
RCRA Total Metals	4^0C / HN03	(1) 500-ml plastic	No
RCRA Dissolved Metals	4^0C / HN03	(1) 500-ml plastic	No

OBSERVATIONS / NOTES:

Flow rate = ~1 gpm.

Stream depth = 0.1 feet

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Ellen Berklite

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Sample ID No.: 22SW017
Sample Location: 22SW017
Sampled By: KS / JF
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other
Date: 5.11.12 / Time: 1515 / Depth: 0 - 6" / Method: DIRECT FILL	CLEAR	6.65	0.459	17.65	0.6	6.77	46	—

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
~~PETN & NG~~	~~4°C~~	~~2 - 1 liter amber glass~~	—
~~Explosives +~~ PETN & NG	4°C	2 - 1 liter amber glass	✓
~~Perchlorate~~	~~4°C~~	~~1 - 250 mL PE~~	—
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
~~Dissolved RCRA Metals (if >10 NTUs)~~	~~HNO3 - 4°C~~	~~1 - 500mL PE, field filtered~~	—

OBSERVATIONS / NOTES:

FLOW ~ < 0.5 gpm

2ND SAMPLING EVENT
1ST ON 9 APRIL 2011

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [signature]

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA CRANE SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW018
Sample Location: 22SW018
Sampled By: Berklite/Losekamp
C.O.C. No.: 2209

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

		Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP
Date:	4/9/2011								
Time:	1450								
Depth:	Surface	Clear	7.03	0	21.84	9.2	9.36	-	236
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	4^0C	(2) 1-liter ambers	No
Full Explosives	4^0C	(6) 1-liter ambers	Yes
RCRA Total Metals	4^0C / HN03	(3) 500-ml plastic	Yes
RCRA Dissolved Metals	4^0C / HN03	(3) 500-ml plastic	Yes

OBSERVATIONS / NOTES:

Flow rate = < 200 mL/minute.

Stream depth = 0.1 feet

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
Yes	22FD04091101

Signature(s):

Ellen Berklite

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Sample ID No.: 22SW018
Sample Location: 22SW018
Sampled By: KS
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 12 MAY 12	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
~~PETN & NG~~	~~4°C~~	~~2 - 1 liter amber glass~~	
~~Explosives + PETN & NG~~	~~4°C~~	~~2 - 1 liter amber glass~~	
~~Perchlorate~~	~~4°C~~	~~1 - 250 mL PE~~	
~~Total RCRA Metals~~	~~HNO3 - 4°C~~	~~1 - 500mL PE~~	
~~Dissolved RCRA Metals (if >10 NTUs)~~	~~HNO3 - 4°C~~	~~1 - 500mL PE, field filtered~~	

OBSERVATIONS / NOTES:

DRY NO SAMPLE

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature]

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSA CRANE SWMU 22	Sample ID No.:	22SW019
Project No.:	112G02362	Sample Location:	22SW019
		Sampled By:	Berklite/Losekamp
[X] Stream		C.O.C. No.:	2209
[] Spring			
[] Pond		Type of Sample:	
[] Lake		[] Low Concentration	
[] Other:		[] High Concentration	
[] QA Sample Type:			

SAMPLING DATA:

		Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^0C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP
Date:	4/9/2011								
Time:	1730								
Depth:	Surface	Color	7.15	0.119	12.89	11.4	11.33	-	137
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	4^0C	(2) 1-liter ambers	Yes
Full Explosives	4^0C	(2) 1-liter ambers	No
RCRA Total Metals	4^0C / HN03	(1) 500-ml plastic	No
RCRA Dissolved Metals	4^0C / HN03	(1) 500-ml plastic	No

OBSERVATIONS / NOTES:

Flow rate = ~6 gpm.

Stream depth = 0.5 feet

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Ellen Berklite

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSA CRANE SWMU 22	Sample ID No.:	22SW020
Project No.:	112G02362	Sample Location:	22SW020
		Sampled By:	Berklite/Losekamp
[X] Stream		C.O.C. No.:	2209
[] Spring			
[] Pond		Type of Sample:	
[] Lake		[] Low Concentration	
[] Other:		[] High Concentration	
[] QA Sample Type:			

SAMPLING DATA:

		Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP
Date:	4/9/2011								
Time:	1640								
Depth:	Surface	Clear	6.84	0.526	15.92	17.7	11.92	-	124
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	4^0C	(2) 1-liter ambers	Yes
Full Explosives	4^0C	(2) 1-liter ambers	No
RCRA Total Metals	4^0C / HN03	(1) 500-ml plastic	No
RCRA Dissolved Metals	4^0C / HN03	(1) 500-ml plastic	No

OBSERVATIONS / NOTES:

Flow rate = ~3 gpm.

Stream depth = 0.2 feet

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berklite

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSA CRANE SWMU 22	Sample ID No.:	22SW021
Project No.:	112G02362	Sample Location:	22SW021
		Sampled By:	Berklite/Losekamp
[X] Stream		C.O.C. No.:	2209
[] Spring			
[] Pond		Type of Sample:	
[] Lake		[] Low Concentration	
[] Other:		[] High Concentration	
[] QA Sample Type:			

SAMPLING DATA:

		Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP
Date:	4/9/2011								
Time:	1550								
Depth:	Surface	Lt. Brown	6.85	0.258	18.28	32.8	9.2	-	135
Method:	Direct fill								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Explosives (RDX / HMX)	4^0C	(2) 1-liter ambers	Yes
Full Explosives	4^0C	(2) 1-liter ambers	No
RCRA Total Metals	4^0C / HN03	(1) 500-ml plastic	No
RCRA Dissolved Metals	4^0C / HN03	(1) 500-ml plastic	No

OBSERVATIONS / NOTES:

Flow rate = ~3 gpm.

Stream depth = 0.8 feet

GPS not utilized due to limited available satellites at time of sample collection

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Ellen Berklite

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW022
Sample Location: 22SW022
Sampled By: KS
C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 12 MAY 12
Time:
Depth:
Method:

Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
~~PETN & NG~~	~~4°C~~	~~2 - 1 liter amber glass~~	
~~Explosives + PETN & NG~~	~~4°C~~	~~2 - 1 liter amber glass~~	
~~Perchlorate~~	~~4°C~~	~~1 - 250 mL PE~~	
~~Total RCRA Metals~~	~~HNO3 - 4°C~~	~~1 - 500mL PE~~	
~~Dissolved RCRA Metals (if >10 NTUs)~~	~~HNO3 - 4°C~~	~~1 - 500mL PE, field filtered~~	

OBSERVATIONS / NOTES:

DRY NO SAMPLE

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): [signature]

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SW023
Project No.:	112G02362	Sample Location:	22SW23
		Sampled By:	KS/JF
		C.O.C. No.:	

- [X] Stream
- [ ] Spring
- [ ] Pond
- [ ] Lake
- [ ] Other: ______
- [ ] QA Sample Type: ______

Type of Sample:
- [ ] Low Concentration
- [ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other
Date: 5-11-12 Time: 1435 Depth: 0-6" Method: DIRECT FILL	CLEAR	7.06	0.296	17.64	3.2	4.79	113	—

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
~~PETN & NG~~	~~4°C~~	~~2 - 1 liter amber glass~~	—
Explosives + PETN & NG + PH	4°C	2 - 1 liter amber glass	✓
~~Perchlorate~~	~~4°C~~	~~1 - 250 mL PE~~	—
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
~~Dissolved RCRA Metals (if >10 NTUs)~~	~~HNO3 - 4°C~~	~~1 - 500mL PE, field filtered~~	—

OBSERVATIONS / NOTES:

FLOW ~ < 0.5 gPM

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature]

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

Sample ID No.: 22SW024
Sample Location: 22SW024
Sampled By: KS
C.O.C. No.:

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other
Date: 5.11.12 Time: 1300 Depth: 0 - 6" Method: DIRECT FILL	CLEAR	7.29	0.942	16.90	4.9	6.53	61	—

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
~~PETN & NG~~	~~4°C~~	~~2 - 1 liter amber glass~~	—
Explosives + PETN & NG	4°C	2 - 1 liter amber glass	✓
~~Perchlorate~~	~~4°C~~	~~1 - 250 mL PE~~	—
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	✓
~~Dissolved RCRA Metals (if >10 NTUs)~~	~~HNO3 - 4°C~~	~~1 - 500mL PE, field filtered~~	—
		4X VOL FOR QA	

OBSERVATIONS / NOTES:

FLOW ~ 1 GPM

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
YES	22SWDUP01

Signature(s): [signature]

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] Stream
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Sample ID No.: 22SW025
Sample Location: 22SW025
Sampled By: KS
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 11 MAY 12	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	
Time: /								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
PETN & NG	4°C	2 - 1 liter amber glass	
Explosives + PETN & NG	4°C	2 - 1 liter amber glass	
Perchlorate	4°C	1 - 250 mL PE	
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	
Dissolved RCRA Metals (if >10 NTUs)	HNO3 - 4°C	1 - 500mL PE, field filtered	

OBSERVATIONS / NOTES:

DRY NO

MAP:

SAMPLE

Circle if Applicable:

MS/MSD **Duplicate ID No.:**

Signature(s): Kit Ela

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[X] ~~Stream~~
[] Spring
[] Pond
[] Lake
[] Other:
[] QA Sample Type:

Sample ID No.: 22SW025
Sample Location: 22SW025
Sampled By: JC
C.O.C. No.:

Type of Sample:
[X] ~~Low~~ Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other
Date: 1.23.13								
Time: 1405								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
PETN & NG	4°C	2 - 1 liter amber glass	
Explosives + PETN & NG	4°C	2 - 1 liter amber glass	
Perchlorate	4°C	1 - 250 mL PE	
Total RCRA Metals	HNO3 - 4°C	1 - 500mL PE	
Dissolved RCRA Metals (if >10 NTUs)	HNO3 - 4°C	1 - 500mL PE, field filtered	
DRY			

OBSERVATIONS / NOTES:

NO SAMPLE

MAP:

Circle if Applicable:

MS/MSD — Duplicate ID No.:

Signature(s): JJC

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22	Sample ID No.: 22SD001006
Project No.: 112G02362	Sample Location: 22SD001
	Sampled By: AEB/TE
	C.O.C. No.:

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/20/11	0-6"	Brown	Saturated, Fine-coarse sand (SW), trace silt, some fine gravel/rock fragments
Time: 1025			
Method: Stainless steel spoon			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC ~~& pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Ellen Berkebile

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD0020006
Sample Location: 22SD002
Sampled By: AEB/TE
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/20/11 Time: 1050 Method: STAINLESS STEEL TROWEL Monitor Reading (ppm): —	0-6"	Brown	Saturated Fine-Coarse Sand, trace silt, some fine gravel (rock fragments)

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC ~~& GS~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

* Rocky creek bottom

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Ellen Berkbite

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SD0030006
Project No.:	112G02362	Sample Location:	22SD003
		Sampled By:	TE - EB
		C.O.C. No.:	

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/20/11 Time: 1320 Method: Stainless Steel spoon Monitor Reading (ppm): —	0-6"	Brown	Fine-coarse sand (SW), trace silt Fine gravel (Rock fragments) Saturated

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Ellen Berklite

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SD0040006
Project No.:	112G02362	Sample Location:	22SD004
		Sampled By:	AEB/TE
		C.O.C. No.:	

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/20/11 Time: 1230 Method: Stainless steel spoon Monitor Reading (ppm): —	0-6"	Light Brown	Saturated, Silt, trace sand (SM, ML)

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC ~~&~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Ellen Berkelite

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD0050006
Sample Location: 22SD005
Sampled By: AEB/TE
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/20/11 Time: 1540 Method: Stainless steel spoon Monitor Reading (ppm): —	0-6"	Brown	Silt, trace fine sand, some organics (topsoil) ML/OL

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC ~~&~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Ellen Berkleta

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD006
Sample Location: 22SD0060006
Sampled By: TE - EB
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/13/11 Time: 1640 Method: STAINLESS STEEL TROWEL Monitor Reading (ppm): —	0-6"	tan	Saturated Silty Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC & pH	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD —
Duplicate ID No.: —

Signature(s): Ellen Bukitis

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SD006
Project No.:	112G02362	Sample Location:	22SD006~~24~~0624
		Sampled By:	TE - EB
		C.O.C. No.:	

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/13/11 Time: 1650 Method: SS TROWEL Monitor Reading (ppm): —	6-24	yellow-tan	Saturated, v.f. sandy clay w/ pieces of bedrock

COMPOSITE SAMPLE DATA: — 6 TO 24" —

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC & pH	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

6 - 24" SAMPLE

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkley

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD007
Sample Location: 22SD0070006
Sampled By: TE - EB
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/18/11 Time: 1700 Method: SS TROWEL Monitor Reading (ppm): —	0-6"	Brown	Saturated, V. Fine Sandy Clay w/ Organics

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C		
TOC & ~~pH~~	1- 8 oz w/m glass, 4°C		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkline

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD007
Sample Location: ~~22SD0624~~
Sampled By: 22SD00706024
C.O.C. No.:
TE - EB

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/18/11 Time: 1710 Method: SS TROWEL Monitor Reading (ppm): —	0-24"	Yellow-brown	Saturated, VF, Sandy Clay, with bedrock pieces

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC & ~~pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Ellen Berkelite

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD008
Sample Location: 22SD0080006
Sampled By: TE - EB
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7/18/11 Time: ~~10~~ 1720 Method: SS TROWEL Monitor Reading (ppm): —	0-6"	Brown	saturated, silty clay with organics

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC & ~~pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkline

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD008
Sample Location: 22SD0080624
Sampled By: TE - EB
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/19/11 Time: 1730 Method: SS TROWEL Monitor Reading (ppm): —	6-24"	tan/brown	Saturated, V.F. Sandy Clay with bedrock pieces

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC & ~~pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Ellen Berkbite

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD0090006
Sample Location: 22SD009
Sampled By: AEB/TE
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 1/20/11 Time: 1450 Method: Stainless Steel spoon Monitor Reading (ppm): —	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	0-6"	Brown	Saturated Silt (ML) with trace coarse sand + rock fragments

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C		
TOC ~~[illegible]~~	1- 8 oz w/m glass, 4°C		
	2 X VOC FOR QA		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

~~MS/MSD~~

Duplicate ID No.: 22SD DUP01

Signature(s): Ellen Berkbite

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD0100006
Sample Location: 22SD016
Sampled By: AEB/TE
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/20/11 Time: 1530 Method: Stainless Steel spoon Monitor Reading (ppm): —	0-6"	Brown	Saturated, Fine-med. Sand (SW) trace silt

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC ~~& pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Ellen Berkbite

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD010 0006
Sample Location: 22SD 010
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.12.12 Time: 1020 Method: TROWEL Monitor Reading (ppm): 0	0 - 6"	BRN	WET, SILT SOME F. TO CR. SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
~~Explosives +~~ PETN, NG & ~~RCRA Metals~~ + TOC	1- 8 oz w/m glass, 4°C	✓	
~~TOC & pH~~	~~1- 8 oz w/m glass, 4°C~~	—	

OBSERVATIONS / NOTES:

2ND SAMPLING EVENT
1ST 20 JAN 2011

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD011
Sample Location: 22SD0110006
Sampled By: AEB/TE
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 1/20/11 Time: 1410 Method: Stainless steel spoon Monitor Reading (ppm): —	0-6"	Brown	saturated, medium-coarse sand (SW) trace gravel, slight silt.

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives & RCRA Metals	2X 1- 8 oz w/m glass, 4°C	✓	
TOC	2X 1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD: yes

~~Duplicate ID No.:~~

Signature(s): Ellen Berkلite

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD170006
Sample Location: 22SD017
Sampled By: K S
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.11.12 Time: 1520 Method: TROWEL Monitor Reading (ppm): 0	0 - 6"	BRN	MOIST TO WET - SILT, F SAND, TR F GRAVEL

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
~~Explosives~~ PETN, NG & RCRA Metals + TOC	1- 8 oz w/m glass, 4°C	✓	
~~TOC & pH~~	~~1- 8 oz w/m glass, 4°C~~	—	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature]

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NSA Crane SWMU 22	Sample ID No.:	22SD018
Project No.:	112G02362	Sample Location:	22SD018
		Sampled By:	Berklite/Losekamp
		C.O.C. No.:	2209

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

		Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:	4/9/2011	0-6"	Grey	Sandy clay
Time:	1330			
Method:	Disp Trowel			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives (RDX / HMX)	(2) 4-oz jars		Yes
RCRA Total Metals	(2) 4-oz jars		Yes
TOC	(2) 4-oz jars		Yes

OBSERVATIONS / NOTES:

Very low flow. Less than 200 mL/min

GPS not utilized due to limited available satellites

MAP:

Circle if Applicable:

MS/MSD: Yes

Duplicate ID No.: 22FD04091102

Signature(s): Ellen Berklite

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD018 0006
Sample Location: 22SD018
Sampled By: KS
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.12.12 Time: 1000 Method: TROWEL Monitor Reading (ppm): 0	0 - 6"	BRN	DRY, SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
~~Explosives +~~ PETN, NG ~~& RCRA Metals~~ + TOC	1- 8 oz w/m glass, 4°C	✓	
~~TOC & pH~~	~~1- 8 oz w/m glass, 4°C~~	—	

OBSERVATIONS / NOTES:

CONCRETE DRAINAGE, FILLED WITH SEDIMENT.
NO SOIL - COLLECTED AS SD
SURFACE TO CONCRETE ~ 6" TOTAL MATERIAL
DRY, NO SW

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 22SD0230006
Sample Location: 22SD023
Sampled By: K S
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.11.12 Time: 1440 Method: TROWELL Monitor Reading (ppm): 0	0 - 6"	BRN	MOIST TO WET, SILT, F SAND, TR F GRAVEL

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC & pH	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Kit Eh

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NSA Crane, SWMU 22	Sample ID No.:	22SD024006
Project No.:	112G02362	Sample Location:	22SD024
		Sampled By:	KS
		C.O.C. No.:	

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.11.12 Time: 1110 Method: SS TROWEL Monitor Reading (ppm): 0	BRN 0-6"	BRN	MOIST TO WET, TR. ROOTS SILT, SOME CLAY SOME F. GRAVEL

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
TOC ~~& pH~~	1- 8 oz w/m glass, 4°C	✓	

OBSERVATIONS / NOTES:

COLLECTED BOTH SD & SW

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature]

Tetra Tech NUS, Inc.

SEDIMENT SAMPLE LOG SHEET

Project Site Name: NSA Crane, SWMU 22
Project No.: 112G02362

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

SUMP SAMPLE

Sample ID No.: 22SD0260006
Sample Location: 22SD026
Sampled By: KS/JF
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5.11.12	0-6"	DARK BRN	WET, SEDIMENT
Time: 1140			
Method: SCOOP			
Monitor Reading (ppm): 0			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Explosives + PETN, NG & RCRA Metals	1- 8 oz w/m glass, 4°C	✓	
~~TOC & pH~~	~~1- 8 oz w/m glass, 4°C~~	—	

OBSERVATIONS / NOTES:

TD OF SUMP 4' BGS
~6" OF SEDIMENT

INLET ON EAST SIDE
DRAIN ON ~~E~~ W

MAP:

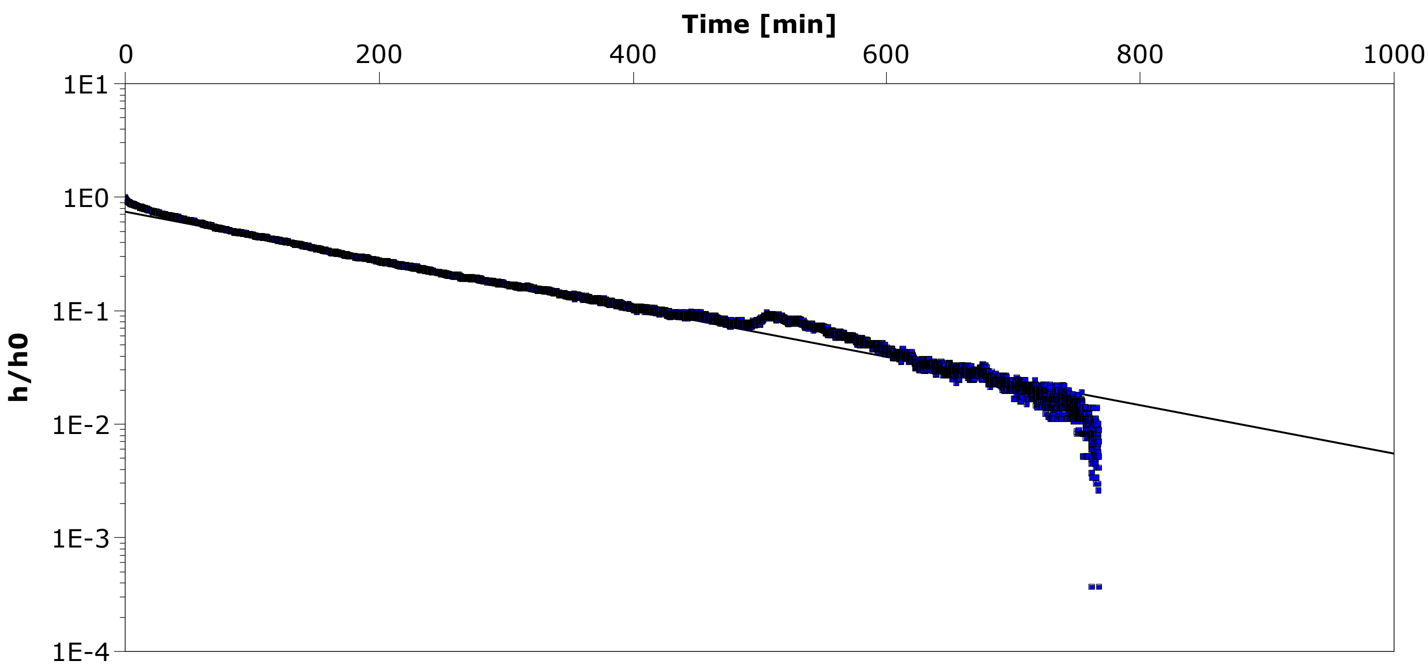
ADD ON SAMPLE
PER TOM BRENT

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech, Inc. **661 Andersen Dr, # 7** **Pittsburgh, PA**		**Slug Test Analysis Report**
		Project: SWMU 22 RFI
		Number: CTO F279
		Client: NAVFAC MW
Location: NSA Crane, IN	Slug Test: Rising Head	Test Well: 22MWT002
Test Conducted by: J. Ferguson		Test Date: 7/11/2012
Analysis Performed by: T.Evans	Bouwer & Rice	Analysis Date: 4/1/2013
Aquifer Thickness: 14.70 ft		

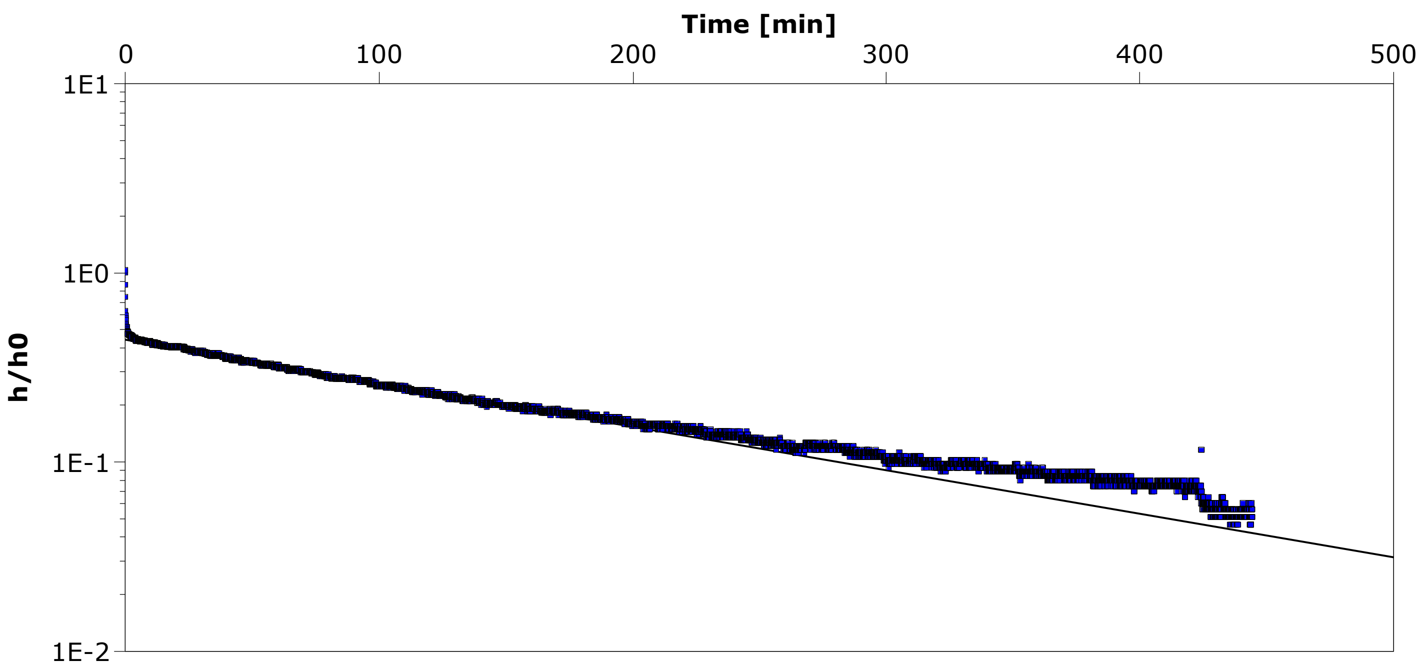


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/d]	
22MWT002	9.09×10^{-3}	

Excludes drawdown data after 485 min

Tetra Tech, Inc. 661 Andersen Dr, # 7 Pittsburgh, PA		**Slug Test Analysis Report**
		Project: SWMU 22 RFI
		Number: CTO F279
		Client: NAVFAC MW
Location: NSA Crane, IN	Slug Test: Rising Head	Test Well: 22MWT003
Test Conducted by: J. Ferguson		Test Date: 7/10/2012
Analysis Performed by: T.Evans	Bouwer & Rice	Analysis Date: 4/1/2013
Aquifer Thickness: 7.83 ft		

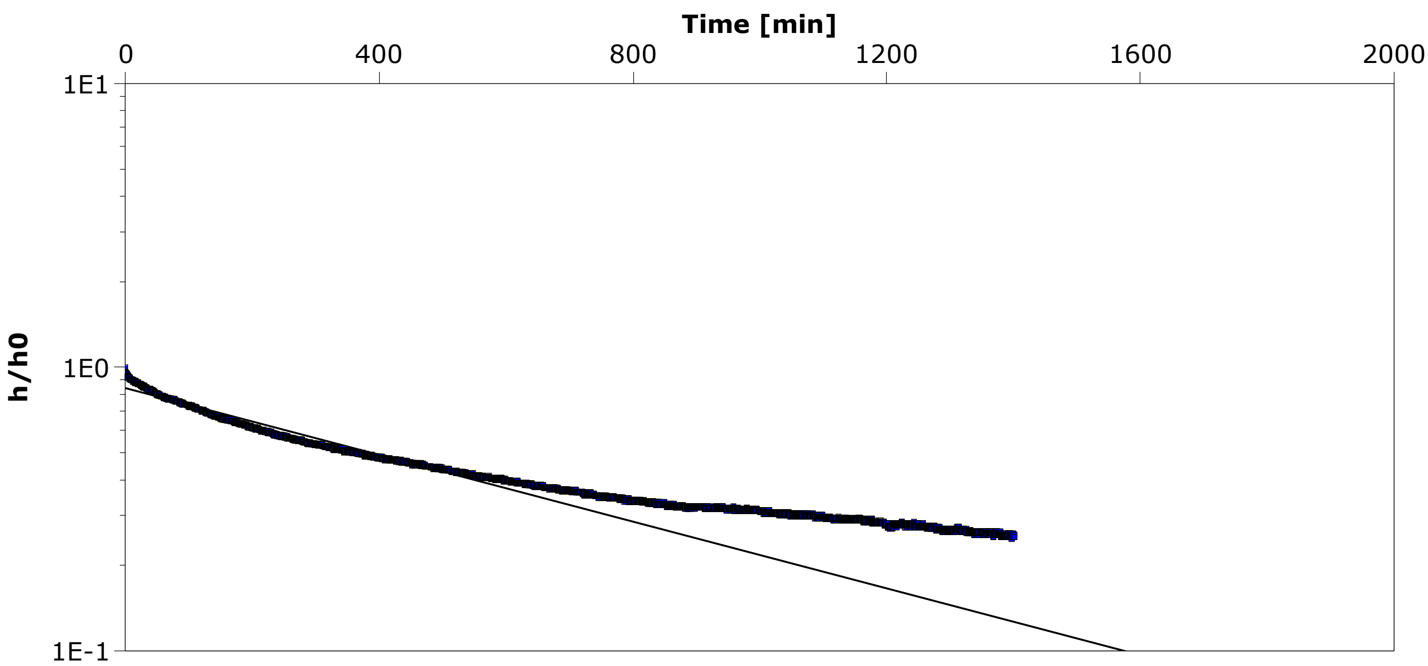


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/d]	
22MWT003	9.80×10^{-3}	

Tetra Tech, Inc. 661 Andersen Dr, # 7 Pittsburgh, PA	**Slug Test Analysis Report**
	Project: SWMU 22 RFI
	Number: CTO F279
	Client: NAVFAC MW

Location: NSA Crane, IN	Slug Test: Rising Head	Test Well: 22MWT006
Test Conducted by: J. Ferguson		Test Date: 7/11/2012
Analysis Performed by: T.Evans	Bouwer & Rice	Analysis Date: 4/1/2013
Aquifer Thickness: 14.85 ft		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/d]	
22MWT006	2.50×10^{-3}	

APPENDIX B

MISCELLANEOUS FIELD DOCUMENTATION [EQUIPMENT CALIBRATION FORMS, WORK PERMITS, FIELD TASK MODIFICATION REQUEST (FTMR) FORMS, AND SURVEY DATA]

EQUIPMENT CALIBRATION LOG

INSTRUMENT NAME/MODEL : Horiba /U-50 Series

PROJECT NAME : NSA Crane

INSTRUMENT SERIAL # : U59267X

PROJECT NUMBER : 112G02362

MANUFACTURER : Horiba

CALIBRATION DATE	INITIAL SETTINGS	STANDARDS USED	PROCEDURE	ADJUSTMENTS MADE	FINAL SETTINGS	SIGNATURE	COMMENTS
1/14/11	12.28 °C					Ellen Bleckle	
	3.92 pH	4.0 pH	Auto Cal	NONE	4.0 pH		
	152 pHmV						
	315 ORPmV						
	4.42 mS/cm	4.45 mS/cm			4.51 mS/cm		
	0.0 NTU	0.0 NTU			0.0 NTU		
	10.15 mg/L DO	~~tc.~~			11.34 mg/L DO		
	2.83 g/L TDS						
	1.6 ppt						
	0.9 σt						
1/20/11	9.24 °C		Auto Cal	NONE	4.0 pH	Ellen Bleckle	
	3.96 pH	4.0 pH					
	153 pHmV						
	332 ORPmV						
	4.43 mS/cm	4.45 mS/cm			4.55 mS/cm		
	0.0 NTU	0.0 NTU			0.0 NTU		
	12.42 mg/L DO				12.47 mg/L DO		
	2.84 g/L TDS						
	1.6 ppt						
	0.9 σt						

Instrument Rented From: FEI

DOCUMENTATION OF FIELD CALIBRATION

This attachment is to be completed daily (pre-/post-) for all direct reading instruments employed in support of the identified scope of work.

SITE NAME: SWMU 22 Former Lead Azide Pond **CTO #:** F279 **PROJECT NO.:** 112G02362

Date of Calibration	Instrument Name and Model	Instrument I.D. Number	Person Performing Calibration	Instrument Settings SU		Instrument Readings MS/CM		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre- PH Calibration	Post- PH Calibration	Pre- SC Calibration	Post- SC Calibration		AUTO CAL.
5.11.12	HORIBA U52	66422	K. SIMPSON	3.85	4.00	4.62	4.46	TURB 0 →	PH 4.0
5.12.12	↓	↓	KS	4.06	4.00	4.51	4.49	0	SC 4.45 MS/CM
5.13.12	↓	↓	KS	4.04	4.00	4.36	4.49	0	TURB 0
5.21.12	↓	↓	KS	3.99	4.00	4.55	4.48	0	LOT A3I5-05
5.22.12	↓	↓	KS	3.97	4.00	4.52	4.49	0	EXP 11/15/13
5.23.12	↓	↓	KS	3.99	4.00	4.54	4.49	0	

FIELD ENVIRONMENTAL INSTRUMENTS, INC.
www.fieldenvironmental.com

301 Brushton Avenue
Suite A
Pittsburgh PA 15221
800-393-4009 Toll Free
(412) 436-2600 Local
(412) 436-2616 Fax

	Lot #	Expiration		
Horiba Auto-Cal Solution	a315-05	11/15/2013		

Cal Standard			Reading	Acceptable Range
PH 4 @ 25^c			4.00	(3.96 - 4.04)

Cal Standard			Reading ms/cm	Acceptable Range
Conductivity			4.48	(4.31 - 4.58)

Cal Standard			Reading NTU	Acceptable Range
Turbidity		0 NTU	0.0	(-2 - +2)
		100 NTU	100.0	(95 - 105)

Dissolved Oxygen			Reading mg/L	
100% Saturation			8.91	
0% Saturation			0.00	

Cal Standard	Lot #	Expiration	Reading	Acceptable Range
PH 7 @ 25^c	a320-18	11/23/2013	7.00	(6.93 - 7.07)

Cal Standard	Lot #	Expiration	Reading	Acceptable Range
PH 10 @ 25^c	a346-10	12/13/2012	10.00	(9.9 - 10.1)

Check Standard		Temp ^{c}	Relative Reading	Acceptable Range
ORP		25.0	237.0	(+/- 15mV)

☐ ORP pin in place

*Solutions provided by LabChem (412-826-5230)

Model	U-52-2
S/N	
Sonde	66422
Barcode	U66428X
Order #	195594

Calibrated By: Terrance Collington

Date of Calibration: 5/7/2012

All calibrations performed by FEI conform to manufacturer's specifications. Please report any issues within 24 hours of receiving equipment.

All calibration solutions used are traceable to NIST. Additional documentation is available upon request.

PID

FIELD ENVIRONMENTAL INSTRUMENTS, INC.
www.fieldenvironmental.com

301 Brushton Avenue
Suite A
Pittsburgh PA 15221
800-393-4009 Toll Free
(412) 436-2600 Local
(412) 436-2616 Fax

Multi-Gas Detector Calibration Certificate

Fresh Air			Reading %	Acceptable Range
Oxygen			20.9	(20.7 - 21.2)

Cal Gas	Lot #	Expiration	Reading %	Acceptable Range
LEL	600-0050-007	08/01/12	49	(48 - 52)

Cal Gas	Lot #	Expiration	Reading %	Acceptable Range
%Vol				(18% - 22%)

Cal Gas	Lot #	Expiration	Reading ppm	Acceptable Range
H2S			10	(9 - 11)

Cal Gas	Lot #	Expiration	Reading ppm	Acceptable Range
CO			50	(48 - 52)

Cal Gas	Lot #	Expiration	Reading ppm	Acceptable Range
CO2				(4500-5500)

Cal Gas	Lot #	Expiration	Reading ppm	Acceptable Range
VOC	11-4283	04/28/13	100	(98 - 102)
PPB				(8 - 12)

Response Factor: 1.0

Model	MultiRae Plus
Lamp	10.6 eV
S/N	095-528592
Barcode	U62243X
Order #	195594

Pump Flow: 250

Calibrated By: Gene Donofrio

Date of Calibration: 05/07/12

All calibrations performed by FEI conform to manufacturer's specifications. Please report any issues within 24 hours of receiving equipment.
All calibration gas used is traceable to NIST. Additional documentation is available upon request.

EXPO PERMIT

SAFETY & BUILDING AVAILABILITY PERMIT

(FOR NON-ROUTINE REPAIR OR MAINTENANCE IN OR NEAR EXPLOSIVES OPERATIONS)

ESO 8020/11 (Rev. Jan. 2002)

FROM CAAA Safety	**AUTHORIZING CODE** CAAA
ISSUED TO Tetra Tech	**DATE** 8 May 12

PERMIT TO PERFORM THE FOLLOWING WORK

DESCRIPTION OF WORK

install tanks and drilling

Augers, general hand tools, generator (diesel)

LOCATION	**DATES**
AREA ______ **BUILDING** 138	**FROM** 5-8-12 **THROUGH** 5-15-12

APPLICABLE SAFETY PRECAUTIONS extended 5-14-12 to 6-8-12 PM

☐ **General Safety Instructions (on the reverse side) deemed adequate.**

☒ **In addition to the General Safety Instructions (on the reverse side), comply with the following:**

- Area 138 Shall be done after 1600 OR when Bldg Not in operations
- No Cell phones allowed in Area
- designated Smoking only
- generator 50ft from Bldg Refueling done off station

BUILDING AVAILABLE AND WORK APPROVED

SIGNATURE *(Supervisor)* Adam S. Redmon

SIGNATURE *(Issuing Safety Specialist)* Pam Morrison

SIGNATURE *(Person Performing Work)* [signature]

DISTRIBUTION: <u>ORIGINAL</u> **TO BUILDING SUPERVISOR,** <u>COPY</u> **TO EXPLOSIVES SAFETY OFFICE**

FLAME TOOL/HOT WORK PERMIT
NSA CRANE 11320 (REV. 12-10)

CAAA

	ITEM	FROM	TO	ISSUED TO (CIRCLE ONE)			
ESAMS CONTROL NUMBER	DATES	5-8-12	6-8-12	NAVFAC	CAAA	NSWC	OTHER
	TIME	1000	1600	NAME OF TRADE/CONTRACTOR/TENANT ACTIVITY			
[redacted]				TETRA - TECH			

TYPE OF EQUIPMENT TO BE USED (Cutting Torch, Arc, Welder, etc.) Diesel Auger, Generator, Power Washer

PURPOSE OF USE installing wells

WHERE USED (Building/Structure/Other Location) B-138 area | INSIDE/OUTSIDE (CIRCLE ONE)

INSTRUCTIONS OF THE FIRE SUPPRESSION/PREVENTION BRANCH, FIRE DEPARTMENT **(ALL CHECKED BOXES APPLY TO PERMIT)**

1 [X] READ AND BE FAMILIAR WITH THE GENERAL FIRE PREVENTION INSTRUCTION ON **[REVERSE SIDE]**, YOU SHALL ALSO COMPLY WITH THE FOLLOWING.

2 [ ] REMOVE ALL COMBUSTABLES 35 FEET, ALL FLAMMABLE MATERIAL 50 FEET, AND ALL EXPLOSIVES 100 FEET (UNLESS DISTANCE IS WAIVED BY CAAA OR NAVY SAFETY AND FIRE PREVENTION PERSONNEL, OR EXPLOSIVES ARE NOT PRESENT), FROM THE HOT WORK AREA.

3 [ ] FIRE WATCH, WITH APPROVED EXTINGUISHER AND/OR STAND-BY FIRE FIGHTING EQUIPMENT, SHALL BE PRESENT DURING AND AT LEAST 30 MINUTES AFTER WORK IS COMPLETE.

4 [ ] REFRASIL TYPE CLOTH SHALL BE USED TO PROTECT ANY EXPOSURE (NOTED IN NUMBER 2 ABOVE) THAT CAN NOT BE REMOVED THE PRESCRIBED DISTANCE.

5 [ ] PRIOR TO WORK BEING PERFORMED, PERMIT HOLDER SHALL ENSURE ALL LOCKOUT/TAGOUT PROCEDURES ARE IN PLACE.

6 [X] THE FOLLOWING SAFETY OFFICE SHALL BE CONTACTED PRIOR TO WORK BEING PERFORMED (CIRCLE ONE):

NSA X-1476 • CAAA X-3404 • NSWC X6569 or 1625 • PWD 854-3427

SIGNATURE OF PERSON DESIGNATED AS FIRE WATCH	PRINT NAME	EXT.
X-		X

REQUIRED FIRE EXTINGUISHER AT WORK SITE			OTHER FIRE PROTECTION STANDBY REQUIREMENT(S)
TYPE		SIZE	
	[ ] WATER		
ABC	[X] DRY CHEMICAL	10#	
	[ ] CO 2		

I have read, understand and will comply with the above "Instructions of the Fire Suppression/Prevention Branch, Fire Department"

SIGNATURE (Permit Holder)	PRINT NAME	EXT.	DATE
X- [illegible]	[illegible]	X [illegible]	[illegible]

HAZARDOUS AREAS ONLY

I agree that the "Instructions" of the Fire Suppression/Prevention Branch, Fire Department stated above are adequate and area is safe to work in.

SIGNATURE (Building Supervisor/Foreman/Representative)	PRINT NAME	EXT.	DATE
X- [illegible]	[illegible]	X 3033	5/8/2012

Permission is hereby granted to the Trade/Contractor/Tenant Activity named above to use specified equipment in accordance with the "Instructions" of the Suppression/Prevention Branch, Fire Department as stated above.

SIGNATURE (Fire Department/Representative)		DATE
X- [illegible]	x 1235	5-9-12

DISTRIBUTION: Original (Fire Prevention File)
Copy (Work Site)

ADDITIONAL PERMIT INSTRUCTIONS:

* Fuelling will be done off site
* No Drilling During operation of 138
* Follow Evac plan.

TETRA TECH
FIELD TASK MODIFICATION REQUEST FORM

NSA Crane Project/Installation Name	**CTO F279 112G02362** CTO & Project Number	**12May2012-01** Task Mod. Number
May 2012 SAP Addendum Modification To (e.g. Work Plan)	**SWMU 22** Site/Sample Location	**12 May 2012** Date

Activity Description: Addition of two samples: soil at location 22SB019 sampled 10 May 2012, in drainage ditch NW of building 138 and sediment at location 22SD026 sampled 11 May 2012, in settling basin NW of building 138.

Reason for Change: Both samples added as requested by NSA Crane Environmental Restoration Site Manager (Mr. Thomas Brent) for characterization of settling basin area.

Recommended Disposition: Approve additional samples and use data in NSA Crane SWMU 22 RFI report.

Field Operations Leader (Signature)

12 MAY 2012
Date

Approved Disposition: Modification Accepted

Project/Task Order Manager (Signature)

5/12/12
Date

Distribution:

Program/Project File –CTO F279
Project/Task Order Manager – Timothy Evans
Field Operations Leader – Keith Simpson

Other: ______________________

FIELD TASK MODIFICATION REQUEST FORM

Project/Installation Name SWMU 22 – Lead Azide Pond, NSA Crane, IN	CTO & Project Number CTO F279; 112G02362	Task Modification Number 002
Modification to: Sampling and Analysis Plan, RCRA Facility Investigation, SWMU 22-Lead Azide Pond	**Site Location** SWMU 22	**Date of Request** December 20, 2012

Background. Tetra Tech performed RCRA Facility Investigation (RFI) sampling at SWMU 22 in January and April 2011 and May 2012 that included the collection of surface and subsurface soil samples, surface water and sediment samples, and groundwater samples (Table 1 and Figure 1a and 1b). Analyses included energetics, metals, pH, and total organic carbon (Table 1). The distribution of constituents in the site media are illustrated on Figures 2 through 5. Water quality measurements for groundwater and surface water at SWMU 22 are summarized in Table 2a and 2b, respectively, and groundwater flow at SWMU 22 is presented on Figure 6.

Based on the human risk assessment, unacceptable risks from ingestion of groundwater contaminated with arsenic and RDX were estimated for hypothetical future residents. Table 3 summarizes the results of the risk assessment for SWMU 22 based on the data collected to date. To characterize the sources of RDX in groundwater at SWMU 22, additional activities are to be conducted. Historical discharges from the settling basin north of Building 138 may have contaminated soils along the drainages adjacent to it. These soils may be acting as secondary sources of contamination.

Purpose of FTMR. The purpose of this FTMR form is to present the supplemental RFI sampling activities to collect surface soil, surface water, sediment and groundwater samples to assess residual contamination in site media, which may be contributing to groundwater contamination in the area of 22MWT002.

Proposed Supplemental Activities. The supplemental sampling will be performed as described in this FTMR form and the approved September 2011 SAP. This FTMR form includes figures and tables and existing Standard Operating Procedure (SOP) to perform the proposed additional activities.

The approximate locations of the supplemental surface soil samples are shown on Figure 7; the supplemental sampling and analysis is presented on attached Table A-4 and described as follows:

- **Surface Soil:** Six surface soil samples will be collected in the area of Building 138 to characterize soil conditions for RDX to determine if residual contamination is present that may be acting as a source for groundwater contamination. Surface soil samples will be collected from one location (22SS003) adjacent to monitoring well 22MWT002 and from two locations (22SS004 and 22SS005) along the drainage north of well 22MWT002. One surface soil sample (22SS006) will be collected from the discharge of a corrugated metal pipe along the drainage. Two surface samples (22SS007 and 22SS007) will be collected from the drainage east of monitoring well 22MWT002 and south of the settling basin northwest of Building 138. The proposed surface soil sample locations are shown on Figure 7. The surface soil samples will be collected from 0 to 2 feet below ground surface (bgs) and in accordance with SOP-10 of the September 2011 SAP. The surface soil samples will be analyzed for RDX and TNT. (Analysis of TNT is to be performed due to detection of TNT in sediment in the settling basin north of Building 138.) In addition, the soil sample from the location of 22SS003 will also be analyzed for chromium speciation to confirm the presence of chromium as trivalent species at SWMU 22. The analysis method for the chromium speciation will be EPA Method 218.6.

- **Surface Water**: A surface water sample will be collected from location 22SD/SW025 (Figure 7). During the previous sampling events, no surface water was present. The surface water sample will be collected when sufficient water is present to collect a sample, which may be following a rain event or snow melt. The surface water sample will be collected according to SOP-05 and SOP-06 of the September 2011 SAP. The surface water sample will be analyzed for RDX and TNT.

- **Sediment**: A sediment sample will be collected from location 22SD017 to assess the sediment at that location for RDX and TNT. The sediment sample will be collected according to SOP-07 of the September 2011 SAP and analyzed for RDX and TNT.
- **Groundwater**: A groundwater sample will be collected from monitoring well 22MWT005 and analyzed for chromium speciation to confirm the presence of chromium as trivalent species at SWMU 22. Monitoring well 22MWT005 will be purged and sampled in accordance with SOP-18 and SOP-19 of the January 2011 SAP. The analysis method for the chromium speciation will be EPA Method 218.6.

Attachments to this FTMR include:

Figures
Figure 1a Sample Locations – January and April 2011 and May 2012
Figure 1b Sample Locations – January and April 2011
Figure 2 Soil Sample Results – January 2011 and May 2012
Figure 3 Surface Water Sample Results – January and April 2011 and May 2012
Figure 4 Sediment Sample Results – January 2011 and May 2012
Figure 5 Groundwater Sample Results – May 2012
Figure 6 Groundwater Potentiometric Surface Map
Figure 7 Proposed Sample Locations

Table
Table 1 Summary of Environmental Samples and Laboratory Analyses
Table 2a Groundwater Quality Data
Table 2b Surface Water Quality Data
Table 3 Summary of Receptor-Specific Human Risks and Hazards, Ecological Risks, and Recommendations
Table 4 Proposed Supplemental Sampling and Analysis

Standard Operating Procedures (SOPs)
SOP 05 – Surface Water Sampling
SOP 06 – Measurement of Water Quality Parameters
SOP 07 – Sediment Sampling
SOP 10 – Surface and Subsurface Soil Sampling
SOP 18 – Low-Flow Well Purging and Stabilization
SOP 19 – Groundwater Sampling

Reason for Change/Modification: Supplemental activities for characterization of nature and extent of constituents of concern, based on potential unacceptable risks.

Person Requesting Change/Modification:

12/20/12

Tim Evans, Project Manager / Date

Approvals:

12/20/12

Ralph Basinski, Tetra Tech Activity Coordinator / Date

Modifications to the HASP required based on this change? ☐ Yes ☒ No ☐ NA

N/A

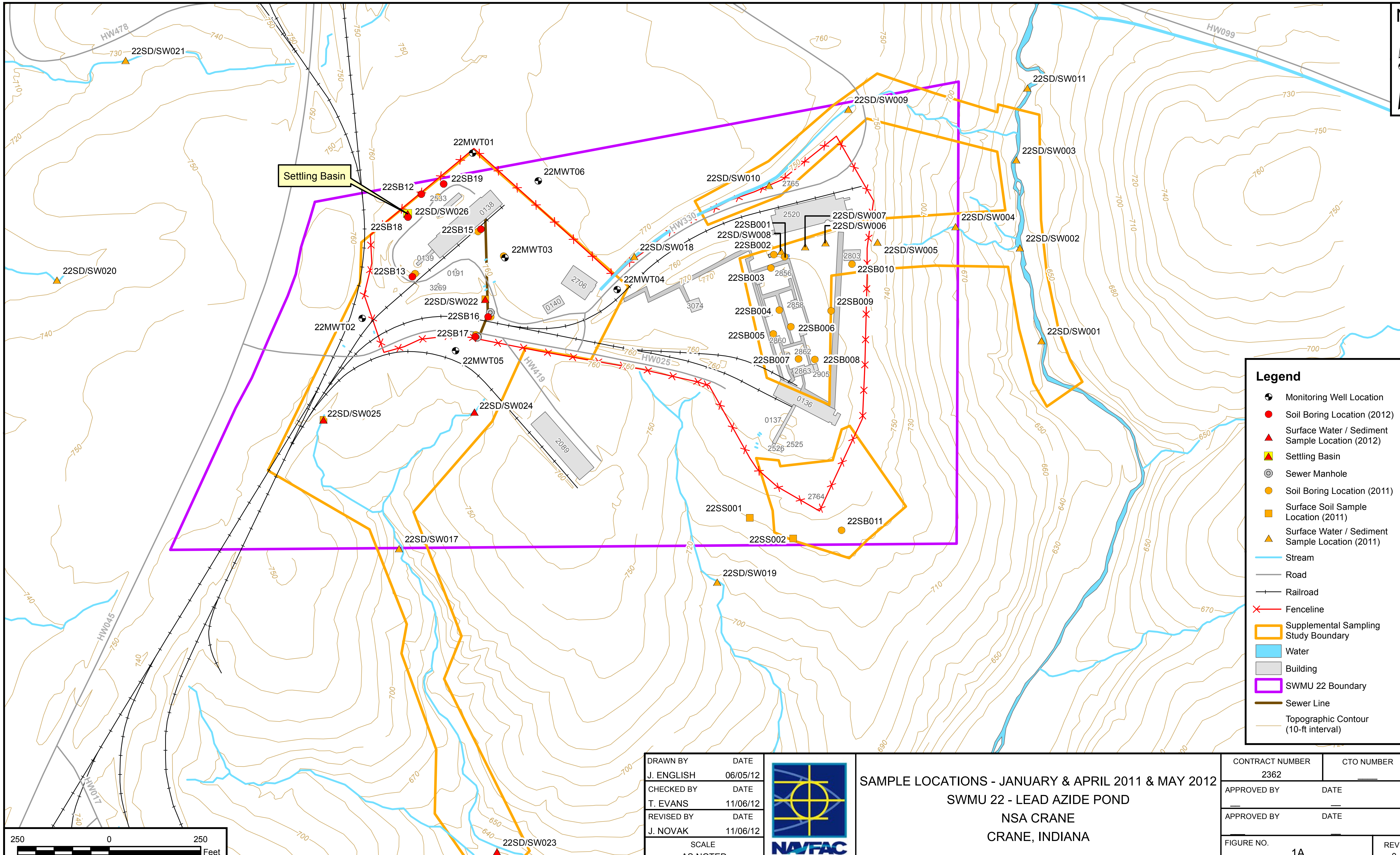
Health Safety Manager (Signature)

N/A

Date

FIGURES

PGH P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_SUPP_SURVEYED_LOCS_R1.MXD 11/06/12 JN

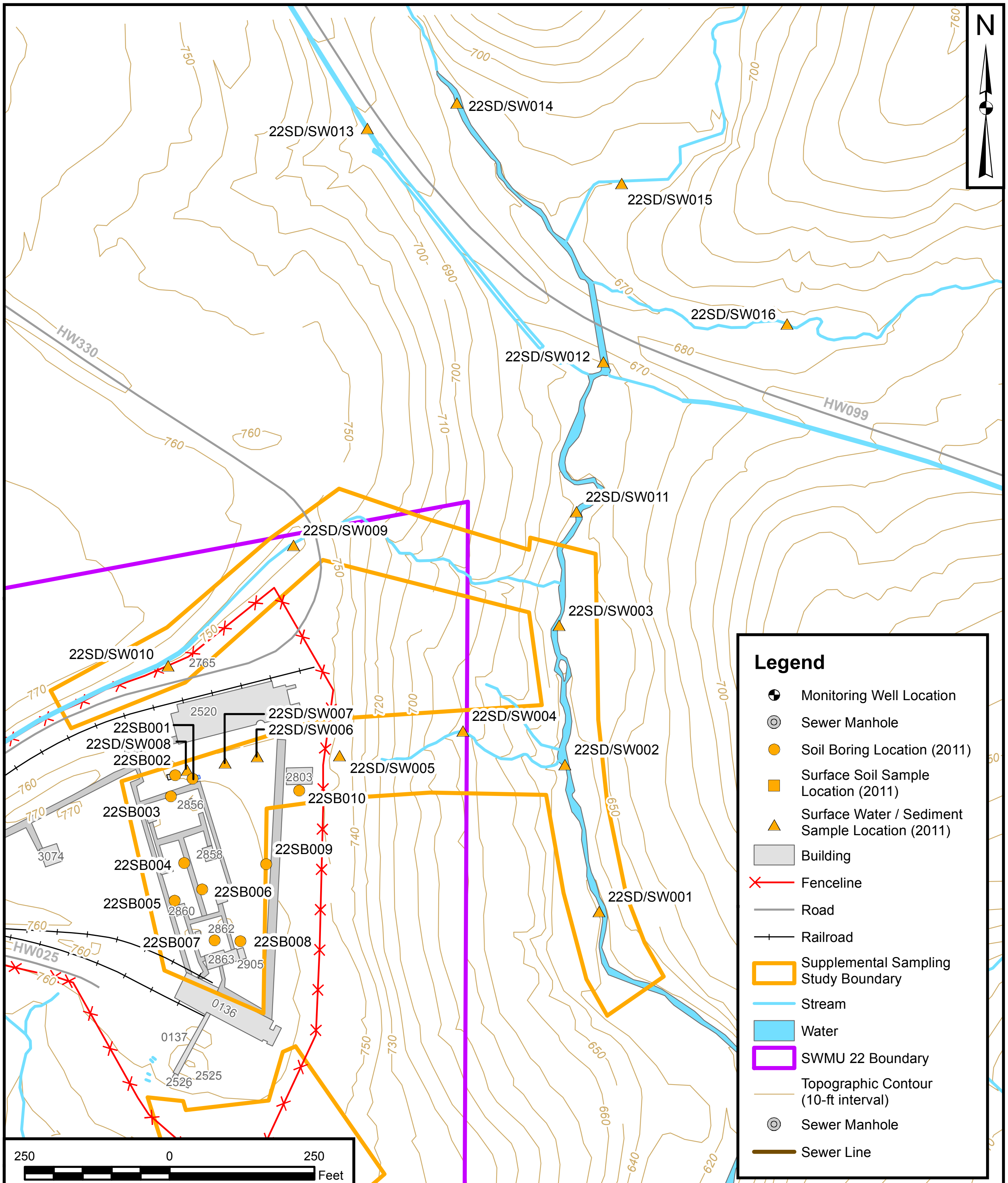


DRAWN BY	DATE	CONTRACT NUMBER	CTO NUMBER
J. ENGLISH	06/05/12	2362	___
CHECKED BY	DATE	APPROVED BY	DATE
T. EVANS	11/06/12	___	___
REVISED BY	DATE	APPROVED BY	DATE
J. NOVAK	11/06/12	___	___
SCALE		FIGURE NO.	REV
AS NOTED		1A	0

NAVFAC

SAMPLE LOCATIONS - JANUARY & APRIL 2011 & MAY 2012
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

PGH P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_SUPP_SURVEYED_LOCS_2.MXD 11/02/12 JN



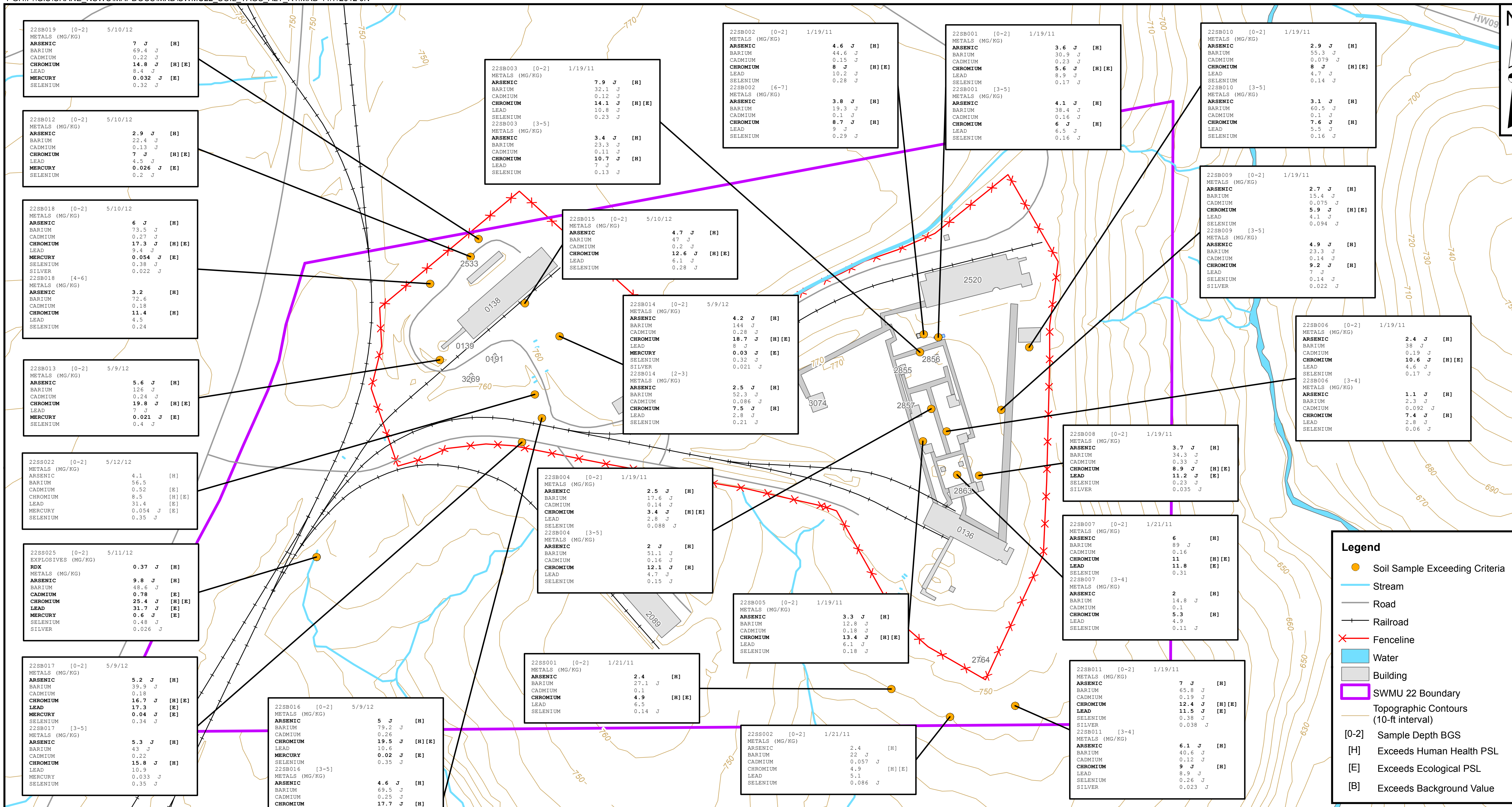
DRAWN BY J. ENGLISH	DATE 06/06/12	
CHECKED BY T. EVANS	DATE 11/02/12	
REVISED BY J. NOVAK	DATE 11/02/12	
SCALE AS NOTED		

NAVFAC

SAMPLE LOCATIONS
JANUARY & APRIL 2011
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER 2362	CTO NUMBER ___
APPROVED BY ___	DATE ___
APPROVED BY ___	DATE ___
FIGURE NO. 1B	REV 0

PGH:P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_SOIL_TAGS_ALT_R1.MXD 11/7/2012 JN



200 0 200 Feet

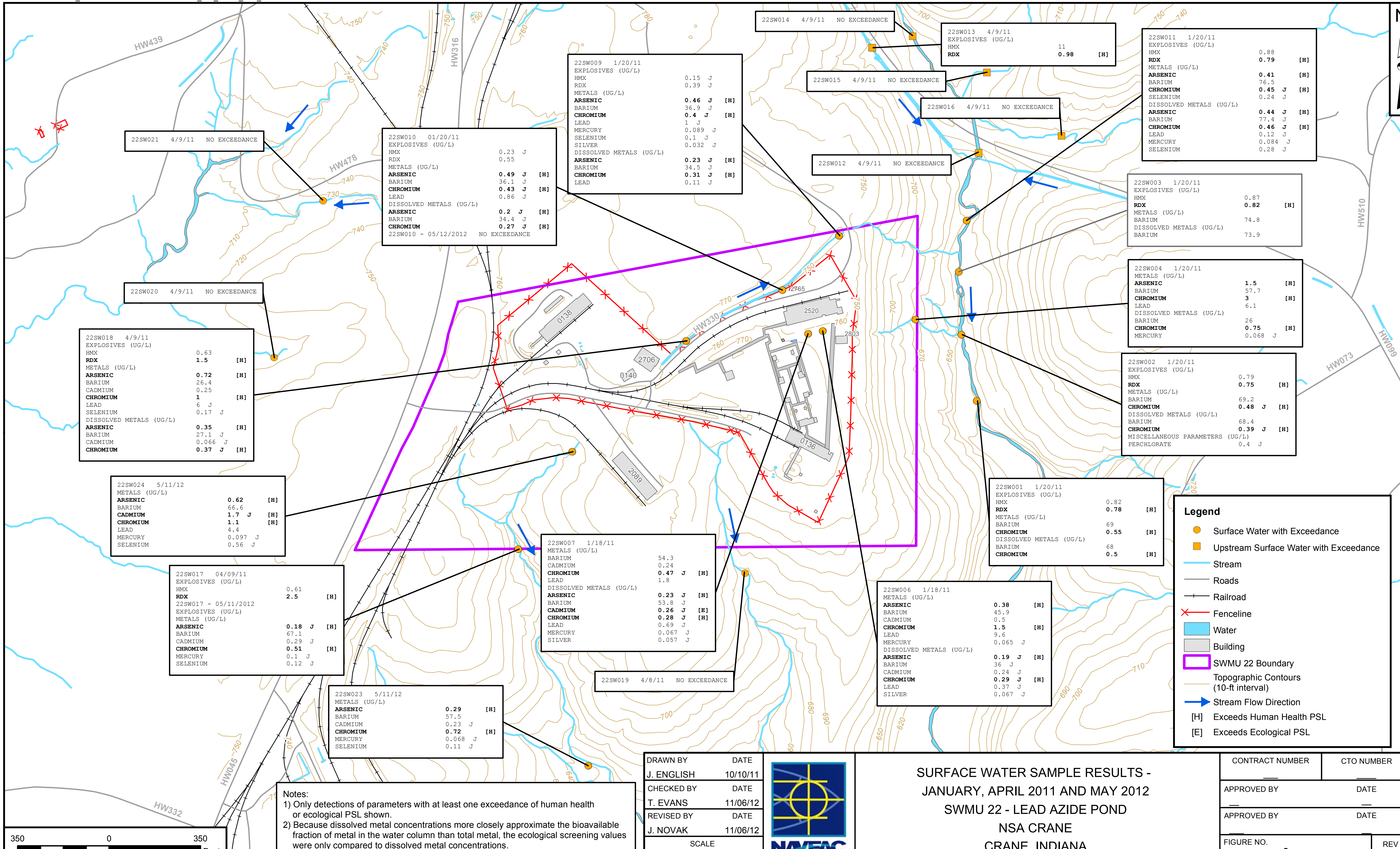
DRAWN BY	DATE
J. ENGLISH	10/10/11
CHECKED BY	DATE
T. EVANS	11/06/12
REVISED BY	DATE
J. NOVAK	11/06/12
SCALE	
AS NOTED	

NAVFAC

SOIL SAMPLE RESULTS
JANUARY 2011 AND MAY 2012
SWMU 22 - LEAD AZIDE POND
NAVAL SUPPORT ACTIVITY
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
02362	F279
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 2	REV 0

PGH:P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_SW_TAGS_ALT_R1.MXD 11/6/2012 JN



Notes:
1) Only detections of parameters with at least one exceedance of human health or ecological PSL shown.
2) Because dissolved metal concentrations more closely approximate the bioavailable fraction of metal in the water column than total metal, the ecological screening values were only compared to dissolved metal concentrations.

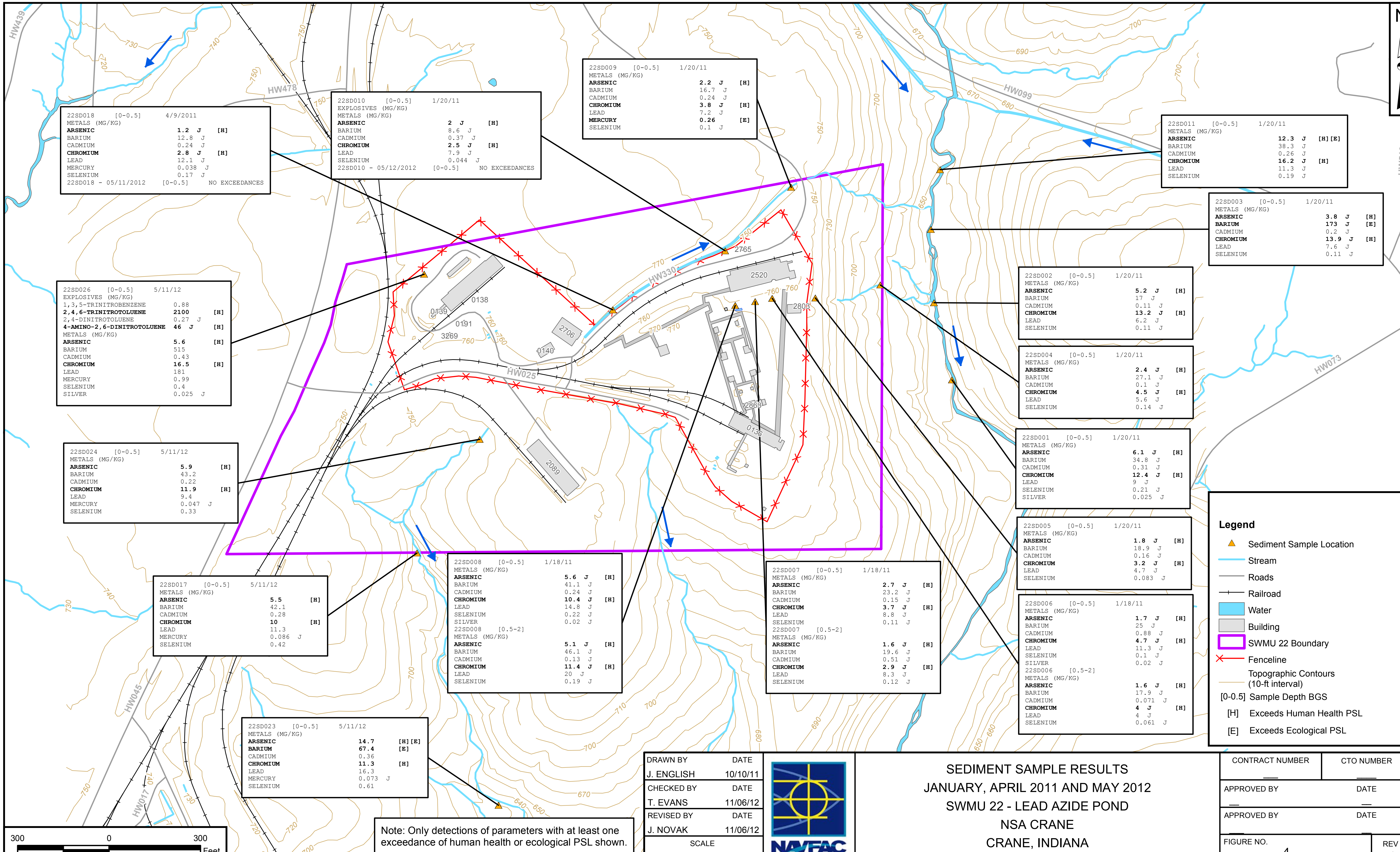
DRAWN BY	DATE
J. ENGLISH	10/10/11
CHECKED BY	DATE
T. EVANS	11/06/12
REVISED BY	DATE
J. NOVAK	11/06/12
SCALE	
AS NOTED	

NAVFAC

SURFACE WATER SAMPLE RESULTS -
JANUARY, APRIL 2011 AND MAY 2012
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 3	REV 0

PGH P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_SD_TAGS_ALT.MXD 11/06/12 JN



Note: Only detections of parameters with at least one exceedance of human health or ecological PSL shown.

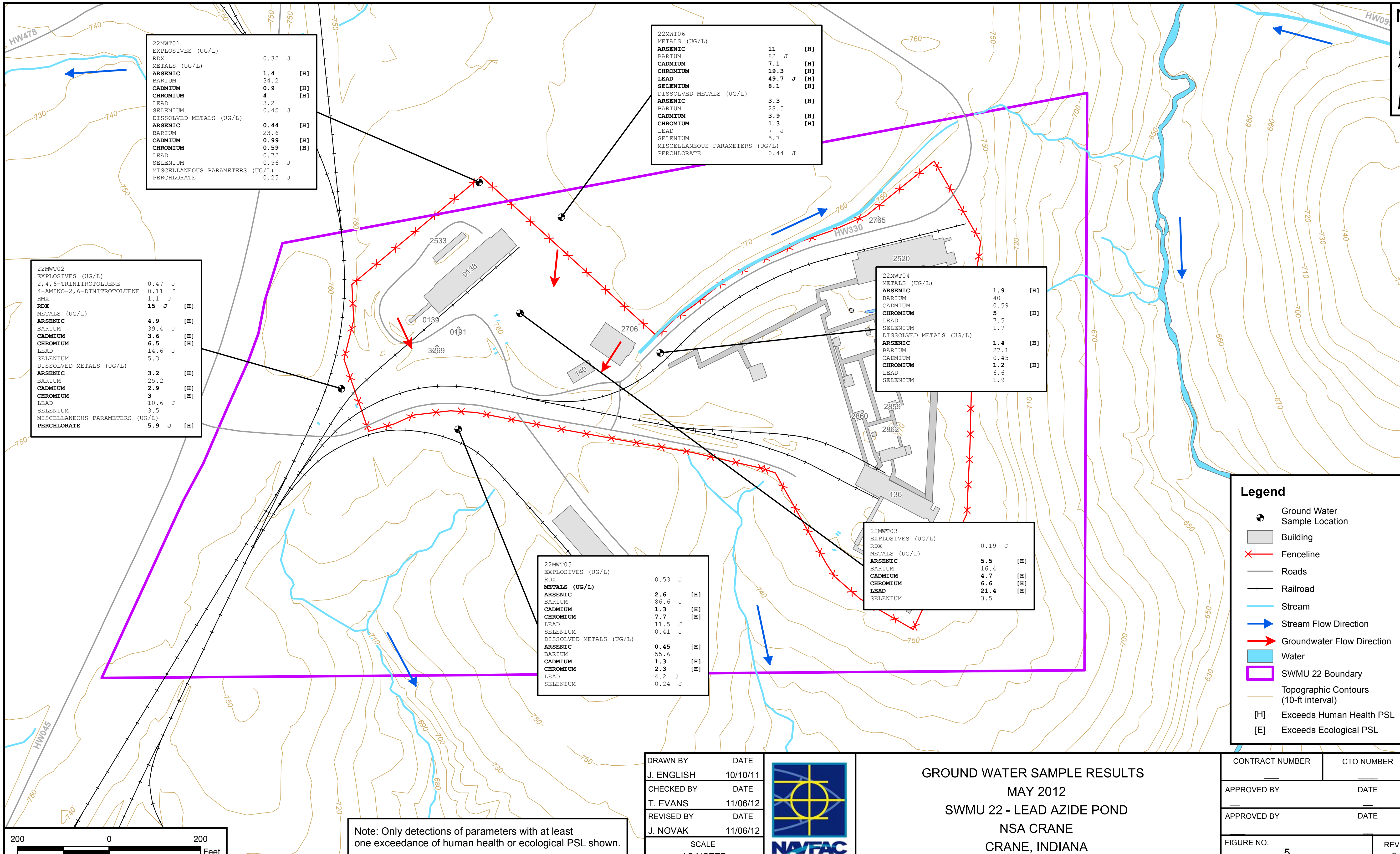
DRAWN BY	DATE
J. ENGLISH	10/10/11
CHECKED BY	DATE
T. EVANS	11/06/12
REVISED BY	DATE
J. NOVAK	11/06/12
SCALE	
AS NOTED	

NAVFAC

SEDIMENT SAMPLE RESULTS
JANUARY, APRIL 2011 AND MAY 2012
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 4	REV 0

PGH:P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_GW_TAGS_ALT_R1.MXD 11/6/2012 JN



Note: Only detections of parameters with at least one exceedance of human health or ecological PSL shown.

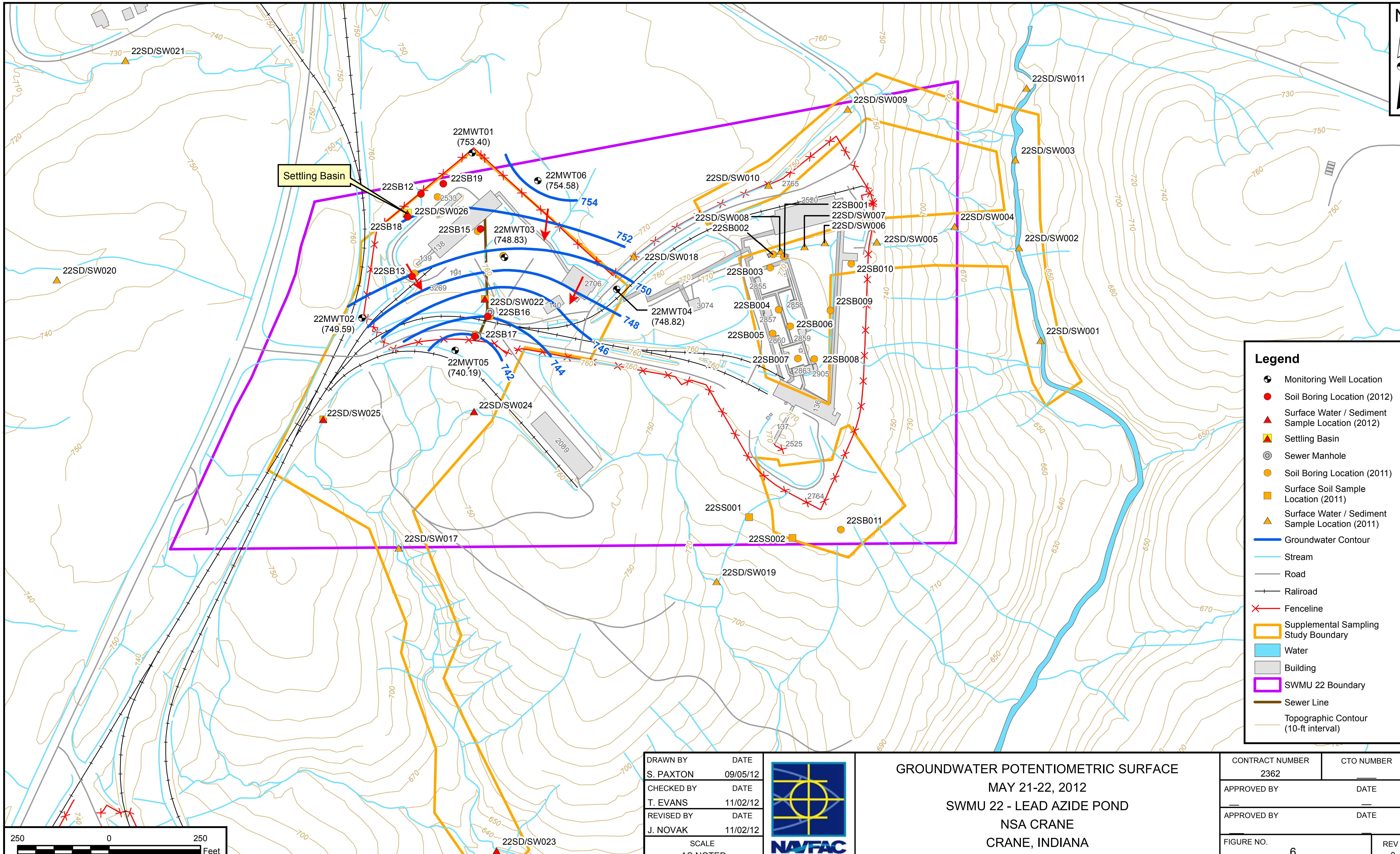
DRAWN BY	DATE
J. ENGLISH	10/10/11
CHECKED BY	DATE
T. EVANS	11/06/12
REVISED BY	DATE
J. NOVAK	11/06/12
SCALE	
AS NOTED	

NAVFAC

GROUND WATER SAMPLE RESULTS
MAY 2012
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 5	REV 0

PGH P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_POT_SURF_MAY2012.MXD 11/02/12 JN



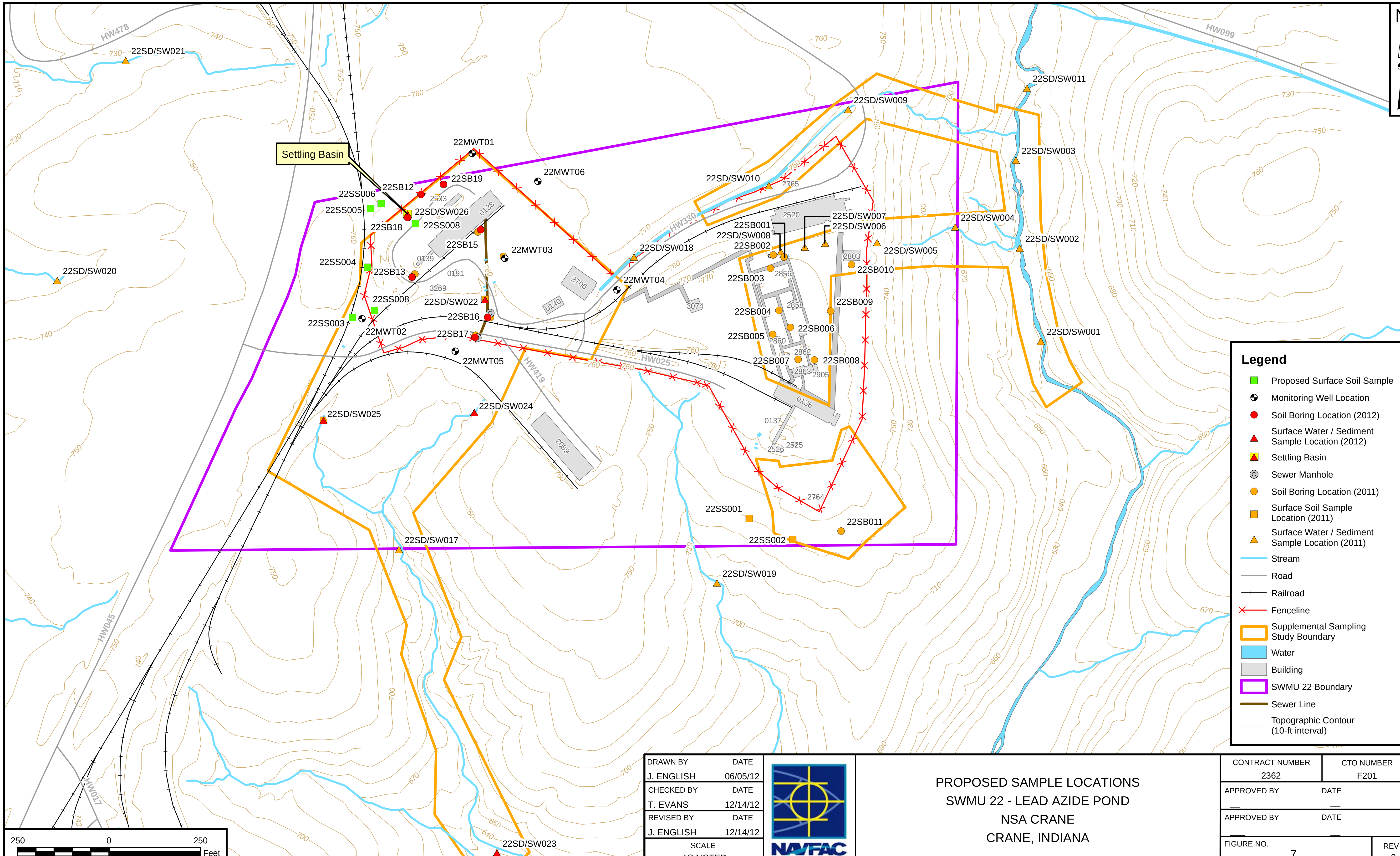
DRAWN BY	DATE
S. PAXTON	09/05/12
CHECKED BY	DATE
T. EVANS	11/02/12
REVISED BY	DATE
J. NOVAK	11/02/12
SCALE AS NOTED	

NAVFAC

GROUNDWATER POTENTIOMETRIC SURFACE
MAY 21-22, 2012
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
2362	
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 6	REV 0

PGH P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU22_SUPP_SURVEYED_PROPLOCS.MXD 12/14/12 JEE



DRAWN BY	DATE
J. ENGLISH	06/05/12
CHECKED BY	DATE
T. EVANS	12/14/12
REVISED BY	DATE
J. ENGLISH	12/14/12
SCALE	
AS NOTED	

NAVFAC

PROPOSED SAMPLE LOCATIONS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
2362	F201
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO. 7	REV 0

TABLES

TABLE 1

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSIS
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Sample Identification	Sample Type	Date Sampled	Sample Depth Interval Sampled (feet bgs)	Energetics				Metals		Miscellaneous		Comments
					Nitroaromatics / Nitramines	RDX/HMX	NG/PETN	Perchlorate	RCRA Metals	RCRA Metals (dissolved)	pH	TOC	
22SS001	22SS0010002	Surface Soil	21-Jan-11	0-2	X			X	X				Field Duplicate 22SSDUP01
22SS002	22SS0020002	Surface Soil	21-Jan-11	0-2	X			X	X				
22SS022	22SS0220002	Surface Soil	12-May-12	0-2	X		X		X			X	Listed as SD in SAP, no flow sampled as SS
22SS025	22SS0250002	Surface Soil	11-May-12	0-2	X		X		X			X	Field Duplicate 22SSDUP01. Listed as SD in SAP, no flow sampled as SS
22SB001	22SB0010002	Surface Soil	19-Jan-11	0-2	X			X	X		X		
	22SB0010305	Subsurface Soil	19-Jan-11	3-5	X			X	X		X		Field Duplicate 22SSDUP001
	22SB0010608	Subsurface Soil	NA	NA	--			--	--		--		Sample not collected due to boring refusal before sample depth
22SB002	22SB0020002	Surface Soil	19-Jan-11	0-2	X			X	X				
	22SB0020607	Subsurface Soil	19-Jan-11	6-7	X			X	X				
22SB003	22SB0030002	Surface Soil	19-Jan-11	0-2	X			X	X				
	22SB0030305	Subsurface Soil	19-Jan-11	3-5	X			X	X				
22SB004	22SB0040002	Surface Soil	19-Jan-11	0-2	X			X	X				
	22SB0040305	Subsurface Soil	19-Jan-11	3-5	X			X	X				
22SB005	22SB0050002	Surface Soil	19-Jan-11	0-2	X			X	X				
	22SB005XXXX	Subsurface Soil	NA	NA	--			--	--				Sample not collected due to boring refusal before sample depth
22SB006	22SB0060002	Surface Soil	19-Jan-11	0-2	X			X	X				
	22SB0060304	Subsurface Soil	19-Jan-11	3-4	X			X	X				
22SB007	22SB0070002	Surface Soil	21-Jan-11	0-2	X			X	X				
	22SB0070304	Subsurface Soil	21-Jan-11	3-4	X			X	X				
22SB008	22SB0080002	Surface Soil	19-Jan-11	0-2	X			X	X		X		
	22SB008XXXX	Subsurface Soil	NA	NA	--			--	--		--		Sample not collected due to boring refusal before sample depth
22SB009	22SB0090002	Surface Soil	19-Jan-11	0-2	X			X	X				
	22SB0090305	Subsurface Soil	19-Jan-11	3-5	X			X	X				
22SB010	22SB0100002	Surface Soil	19-Jan-11	0-2	X			X	X				
	22SB0100305	Subsurface Soil	19-Jan-11	3-5	X			X	X				
22SB011	22SB0110002	Surface Soil	19-Jan-11	0-2	X			X	X				
	22SB0110304	Subsurface Soil	19-Jan-11	3-4	X			X	X				
22SB012	22SB0120002	Surface Soil	10-May-12	0-2	X		X		X		X		Field Duplicate 22FD051212-01
	22SB012XXXX	Subsurface Soil	NA	NA	--		--		--		--		Sample not collected due to boring refusal before sample depth
22SB013	22SB0130002	Surface Soil	9-May-12	0-2	X		X		X				
	22SB013XXXX	Subsurface Soil	NA	NA	--		--		--				Sample not collected due to boring refusal before sample depth

TABLE 1

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSIS
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Sample Identification	Sample Type	Date Sampled	Sample Depth Interval Sampled (feet bgs)	Energetics				Metals		Miscellaneous		Comments
					Nitroaromatics / Nitramines	RDX/HMX	NG/PETN	Perchlorate	RCRA Metals	RCRA Metals (dissolved)	pH	TOC	
22SB014	22SB0140002	Surface Soil	9-May-12	0-2	X		X		X				
	22SB0140203	Subsurface Soil	10-May-12	2-3	X		X		X				
22SB015	22SB0150002	Surface Soil	10-May-12	0-2	X		X		X				
	22SB015XXXX	Subsurface Soil	NA	NA	--		--		--				Sample not collected due to boring refusal before sample depth
	22SB015XXXX	Subsurface Soil	NA	NA	--		--		--				Sample not collected due to boring refusal before sample depth
22SB016	22SB0160002	Surface Soil	9-May-12	0-2	X		X		X				
	22SB0160305	Subsurface Soil	9-May-12	3-5	X		X		X				
	22SB0160608	Subsurface Soil	9-May-12	6-8	X		X		X				
22SB017	22SB0170002	Surface Soil	9-May-12	0-2	X		X		X				
	22SB0170305	Subsurface Soil	9-May-12	3-5	X		X		X				
	22SB017XXXX	Subsurface Soil	NA	NA	--		--		--				Sample not collected due to boring refusal before sample depth
22SB018	22SB0180002	Surface Soil	10-May-12	0-2	X		X		X				
	22SB0180406	Subsurface Soil	11-May-12	4-6									
22SB019	22SB0190002	Surface Soil	10-May-12	0-2	X		X		X				Sample added due to field observations
22SD001	22SD0010006	Sediment	20-Jan-11	0-0.5	X				X			X	
22SD002	22SD0020006	Sediment	20-Jan-11	0-0.5	X				X			X	
22SD003	22SD0030006	Sediment	20-Jan-11	0-0.5	X				X			X	
22SD004	22SD0040006	Sediment	20-Jan-11	0-0.5	X				X			X	
22SD005	22SD0050006	Sediment	20-Jan-11	0-0.5	X				X			X	
22SD006	22SD0060006	Sediment	18-Jan-11	0-0.5	X				X		X	X	
	22SD0060624	Sediment	18-Jan-11	0.5-2	X				X		X	X	
22SD007	22SD0070006	Sediment	18-Jan-11	0-0.5	X				X			X	
	22SD0070624	Sediment	18-Jan-11	0.5-2	X				X			X	
22SD008	22SD0080006	Sediment	18-Jan-11	0-0.5	X				X			X	
	22SD0080624	Sediment	18-Jan-11	0.5-2	X				X			X	
22SD009	22SD0090006	Sediment	20-Jan-11	0-0.5	X				X			X	Field Duplicate 22SDDUP01
22SD010	22SD0100006	Sediment	20-Jan-11	0-0.5	X				X			X	
22SD010	22SD0100006	Sediment	12-May-12	0-0.5			X					X	
22SD011	22SD0110006	Sediment	20-Jan-11	0-0.5	X				X			X	
22SD017	22SD0170006	Sediment	11-May-12	0-0.5			X		X			X	
22SD018	22SD0180006	Sediment	9-Apr-11	0-0.5	X				X			X	Field Duplicate 22FD04091102
22SD018	22SD0180006	Sediment	12-May-12	0-0.5			X					X	
22SD022	22SD0220006	Sediment	NA	NA	--		--		--			--	Listed as SD in SAP, no flow sampled as SS, see above 22SS022
22SD023	22SD0230006	Sediment	11-May-12	0-0.5	X		X		X		X	X	
22SD024	22SD0240006	Sediment	11-May-12	0-0.5	X		X		X			X	

TABLE 1

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSIS
SWMU 22 - LEAD AZIDE POND
NSWC CRANE
CRANE, INDIANA

Sample Location	Sample Identification	Sample Type	Date Sampled	Sample Depth Interval Sampled (feet bgs)	Energetics				Metals		Miscellaneous		Comments
					Nitroaromatics / Nitramines	RDX/HMX	NG/PETN	Perchlorate	RCRA Metals	RCRA Metals (dissolved)	pH	TOC	
22SD025	22SD0250006	Sediment	NA	NA	--		--		--			--	Listed as SD in SAP, no flow sampled as SS, see above 22SS022
22SD026	22SD0260006	Sediment	11-May-12	0-0.5	X		X		X			X	Sample added due to field observations
22SW001	22SW001	Surface Water	20-Jan-11	--	X			X	X	X			
22SW002	22SW002	Surface Water	20-Jan-11	--	X			X	X	X			
22SW003	22SW003	Surface Water	20-Jan-11	--	X			X	X	X			
22SW004	22SW004	Surface Water	20-Jan-11	--	X			X	X	X			
22SW005	22SW005	Surface Water	20-Jan-11	NA	--			--	--	--			Dry, not sampled
22SW006	22SW006	Surface Water	18-Jan-11	--	X			X	X	X			
22SW007	22SW007	Surface Water	18-Jan-11	--	X			X	X	X			
22SW008	22SW008	Surface Water	18-Jan-11	--	--			--	--	--			Dry, not sampled
22SW009	22SW009	Surface Water	20-Jan-11	--	X			X	X	X			Field Duplicate 22SWDUP01
22SW010	22SW010	Surface Water	20-Jan-11	--	X			X	X	X			
22SW010	22SW010	Surface Water	12-May-12	--			X						
22SW011	22SW011	Surface Water	20-Jan-11	--	X			X	X	X			
22SW012	22SW012	Surface Water	9-Apr-11	--		X							
22SW013	22SW013	Surface Water	9-Apr-11	--		X							
22SW014	22SW014	Surface Water	9-Apr-11	--		X							
22SW015	22SW015	Surface Water	9-Apr-11	--		X							
22SW016	22SW016	Surface Water	9-Apr-11	--		X							
22SW017	22SW017	Surface Water	9-Apr-11	--		X							
22SW017	22SW017	Surface Water	11-May-12	--			X		X				
22SW018	22SW018	Surface Water	9-Apr-11	--	X				X	X			Field Duplicate 22FD04091101
22SW018	22SW018	Surface Water	12-May-12	NA			--						Dry, not sampled
22SW019	22SW019	Surface Water	9-Apr-11	--		X							
22SW020	22SW020	Surface Water	9-Apr-11	--		X							
22SW021	22SW021	Surface Water	9-Apr-11	--		X							
22SW022	22SW022	Surface Water	12-May-12	NA									Dry, not sampled
22SW023	22SW023	Surface Water	11-May-12	--	X		X		X		X		
22SW024	22SW024	Surface Water	11-May-12	--	X		X		X				Field Duplicate 22SWDUP01
22SW025	22SW025	Surface Water	11-May-12	NA									Dry, not sampled
22MWT001	22GWT001	Groundwater	22-May-12	15-25	X		X	X	X	X			
22MWT002	22GWT002	Groundwater	22-May-12	11-21	X		X	X	X	X			Field Duplicate 22GWDUP01
22MWT003	22GWT003	Groundwater	23-May-12	13-23	X		X	X	X				
22MWT004	22GWT004	Groundwater	23-May-12	15-25	X		X	X	X	X			
22MWT005	22GWT005	Groundwater	21-May-12	9-19	X		X	X	X	X			
22MWT006	22GWT006	Groundwater	21-May-12	15-25	X		X	X	X	X			

TABLE 2a

GROUNDWATER QUALITY DATA
SWMU 22 - LEAD AZIDE POND
NSA CRANE, IN

Well Number	Sample ID	Sample Date	pH	Spec Cond (mS/cm)	Temp (°C)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
22MWT001	22GWT001	5/22/2012	5.90	0.592	18.84	140	6.20	126
22MWT002	22GWT002	5/22/2012	3.93	0.940	15.83	20	5.36	352
22MWT003	22GWT003	5/23/2012	3.74	1.89	18.93	9.3	3.70	350
22MWT004	22GWT004	5/23/2012	5.10	1.22	16.32	273	2.75	167
22MWT005	22GWT005	5/21/2012	3.84	0.400	17.64	13.0	9.10	327
22MWT006	22GWT006	5/21/2012	4.18	5.60	17.59	2.8	5.56	309

Notes

DO = dissolved oxygen
mg/L = milligram per liter
mS/cm = milliSiemens per centimeter
mV = millivolts
NTU = nephelometric turbidity units
ORP = oxidation-reduction potential
Spec Cond = spoecific conductance
Temp = temperature

TABLE 2b

SURFACE WATER QUALITY DATA
SWMU 22 - LEAD AZIDE POND
NSA CRANE, IN

Location Number	Sample ID	Sample Date	pH	Spec Cond (mS/cm)	Temp (°C)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
22SW001	22SW001	1/20/2011	5.95	1.51	-0.5	0.0	15.50	250
22SW002	22SW002	1/20/2011	6.96	1.51	-0.23	0.8	14.82	189
22SW003	22SW003	1/20/2011	7.37	1.64	0.19	12.4	13.95	185
22SW004	22SW004	1/20/2011	7.39	0.233	-0.19	683	13.82	132
22SW006	22SW006	1/18/2011	6.07	0.229	5.3	11	9.27	233
22SW007	22SW007	1/18/2011	6.71	0.232	5.25	2.4	6.35	207
22SW009	22SW009	1/20/2011	7.84	0.523	-0.19	18.5	11.45	139
22SW010	22SW010	1/20/2011	7.66	0.555	0.57	25.6	13.21	23
		5/12/2012	7.17	0.495	18.67	6.1	3.47	1
22SW011	22SW011	1/20/2011	7.83	1.720	-0.08	8.0	14.15	150
22SW012	22SW012	4/9/2011	7.05	0.146	13.56	17.1	9.65	129
22SW013	22SW013	4/9/2011	7.16	0.38	16.32	13	9.85	123
22SW014	22SW014	4/9/2011	6.93	0.261	15.26	7.47	8.65	123
22SW015	22SW015	4/9/2011	5.22	0.102	13.12	10.35	9.52	255
22SW016	22SW016	4/9/2011	6.5	0.156	14.81	17.9	10.3	158
22SW017	22SW017	4/9/2011	6.19	0	14.6	14.50	13.23	146
		5/11/2012	6.65	0.459	17.65	0.6	6.77	46
22SW018	22SW018	4/9/2011	7.03	0.000	21.84	9.20	9.36	236
		5/12/2012	-- DRY --					
22SW019	22SW019	4/9/2011	7.15	0.119	12.89	11.4	11.33	137
22SW020	22SW020	4/9/2011	6.84	0.526	15.92	17.7	11.92	124
22SW021	22SW021	4/9/2011	6.85	0.258	18.28	32.80	9.2	135

TABLE 2b

SURFACE WATER QUALITY DATA
SWMU 22 - LEAD AZIDE POND
NSA CRANE, IN

Location Number	Sample ID	Sample Date	pH	Spec Cond (mS/cm)	Temp (°C)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
22SW023	22SW023	5/11/2012	7.06	0.296	17.64	3.20	4.79	113
22SW024	22SW024	5/11/2012	7.29	0.942	16.90	4.9	6.53	61

Notes
DO = dissolved oxygen
mg/L = milligram per liter
mS/cm = milliSiemens per centimeter
mV = millivolts
NTU = nephelometric turbidity units
ORP = oxidation-reduction potential
Spec Cond = spoecific conductance
Temp = temperature

TABLE 2b

SURFACE WATER QUALITY DATA
SWMU 22 - LEAD AZIDE POND
NSA CRANE, IN

Location Number	Sample ID	Sample Date	pH	Spec Cond (mS/cm)	Temp (°C)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
22SW023	22SW023	5/11/2012	7.06	0.296	17.64	3.20	4.79	113
22SW024	22SW024	5/11/2012	7.29	0.942	16.90	4.9	6.53	61

Notes
DO = dissolved oxygen
mg/L = milligram per liter
mS/cm = milliSiemens per centimeter
mV = millivolts
NTU = nephelometric turbidity units
ORP = oxidation-reduction potential
Spec Cond = spoecific conductance
Temp = temperature

TABLE 3

SUMMARY OF RECEPTOR-SPECIFIC HUMAN RISKS AND HAZARDS AND ECOLOGICAL RISKS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor Population	Environmental Media	Overall Carcinogenic Risk (Human)	Overall Hazard Index (Human)	Overall Risk (Ecological)	Critical Pathways & Chemicals of Concern
Current/Future Construction Worker (Adult)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Groundwater	7E-08	0.002	NA	NA
Current/Future Industrial Worker (Adult)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
Current/Future Trespassers (Adolescent)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Surface Water	1E-06	3E-03	NA	NA
	Sediment	3E-07	3E-03	NA	NA
Future Recreational User (Child)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Surface Water	4E-06	0.008	NA	NA
	Sediment	4E-06	0.02	NA	NA
Future Recreational User (Adult)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Surface Water	2E-06	0.003	NA	NA
	Sediment	8E-07	0.004	NA	NA

TABLE 3

SUMMARY OF RECEPTOR-SPECIFIC HUMAN RISKS AND HAZARDS AND ECOLOGICAL RISKS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor Population	Environmental Media	Overall Carcinogenic Risk (Human)	Overall Hazard Index (Human)	Overall Risk (Ecological)	Critical Pathways & Chemicals of Concern
Future Recreational User (Lifelong)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Surface Water	6E-06	NA	NA	NA
	Sediment	4E-06	NA	NA	NA
Hypothetical Resident (Child)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Groundwater	3E-04 (7E-05)(1)	3 (2)(1)	NA	Ingestion of groundwater (**arsenic**, chromium, RDX)
	Surface Water	2E-06	0.005	NA	NA
	Sediment	2E-06	0.01	NA	NA
Hypothetical Resident (Adult)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Groundwater	2E-04 (1E-04)(1)	1 (1)(1)	NA	Ingestion of groundwater (arsenic, chromium, RDX)
	Surface Water	2E-06	0.003	NA	NA
	Sediment	8E-07	0.004	NA	NA

TABLE 3

SUMMARY OF RECEPTOR-SPECIFIC HUMAN RISKS AND HAZARDS AND ECOLOGICAL RISKS
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Receptor Population	Environmental Media	Overall Carcinogenic Risk (Human)	Overall Hazard Index (Human)	Overall Risk (Ecological)	Critical Pathways & Chemicals of Concern
Hypothetical Resident (Lifelong)	Surface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Subsurface Soil	No carcinogenic COPCs	No noncarcinogenic COPCs	NA	NA
	Groundwater	5E-04 (2E-04)[1]	NA	NA	Ingestion of groundwater (**arsenic**, chromium, RDX)
	Surface Water	4E-06	NA	NA	NA
	Sediment	2E-06	NA	NA	NA
Mammals and Birds	Surface Soil	NA	NA	Acceptable	NA
Terrestrial Plants and Invertebrates	Surface Soil	NA	NA	Acceptable	NA

Notes

CMS = Corrective Measures Study
LTM = Long-Term Monitoring
LUC = Land Use Control
NFA = No further action

Shaded cells have unacceptable risk or hazard.
Bolded parameters represent significant contributor to overall risk or hazard.

(1) Chromium was evaluated in the human health risk assessment as hexavalent chromium.
Value in parenthesis is cancer risk or hazard index if chromium is evaluated as trivalent chromium

TABLE 4

SUPPLEMENTAL SAMPLING AND ANALYSIS
SWMU 22 - LEAD AZIDE POND
NAVAL SUPPORT ACTIVITY
CRANE, INDIANA

Sampling Location	ID Number	Matrix	Depth (feet or inches bgs)	Analysis	Number of Samples	Sampling SOP Reference(1)
22SS003	22SS0030002 and 22FDXXXXXX01(2)	Soil	0 - 2'	RDX, TNT Chromium (III +IV)	1 + 1 FD	SOP-10
22SS004	22SS0040002	Soil	0 - 2'	RDX, TNT	1	SOP-10
22SS005	22SS0050002	Soil	0 - 2'	RDX, TNT	1	SOP-10
22SS006	22SS0060002	Soil	0 - 2'	RDX, TNT	1	SOP-10
22SS007	22SS0070002	Soil	0 - 2'	RDX, TNT	1	SOP-10
22SS008	22SS0080002	Soil	0 - 2'	RDX, TNT	1	SOP-10
22SD017	22SW0170006	Sediment	0-6"	RDX, TNT	1	SOP-07
22SW025	22SW025 22SW025-F(3)	Surface Water	At water surface	RDX, TNT	1 + 1 FD	SOP-05, SOP-06
22MWT005	22GWT005 22GWT005-F(3)	Groundwater	NA	Chromium (III +IV)	1 + 1 FD	SOP-18, SOP-19

Notes:

(1) Sampling SOP reference from SWMU 22 RFI UFP-SAP (Tetra Tech, January 2011) and SAP Addednum (Tetra Tech, May 2012)

(2) Field duplicate (FD) locations may change in the field based on visual observations and field conditions. “XXXXXX” represents date collected.

(3) For a filtered groundawter and surface water samples, “-F” will be added to the end of the ID number (e.g. 22SW025-F).

NA - not applicable

FIELD TASK MODIFICATION REQUEST

TETRA TECH

NSA Crane Project/Installation Name	**CTO F279 112G02362** CTO & Project Number	**F279-03** Task Mod. Number
SAP, SAP Addendum, RFI, SWMU 22 Modification To (e.g. Work Plan)	**SWMU 22** Site/Sample Location	**22 Jan 2013** Date

Activity Description:
Addition of subsurface soil samples at surface soil sample locations 22SS003, 22SS005, and 22SS007 in drainage ditches west and northwest of Building 138. Samples will be collected at each location at depth interval of 2-3 feet bgs.

Reason for Change:
Samples to be collected for vertical characterization at these locations. Addition sampling has been discussed with NSA Crane Environmental Restoration Site Manager (Mr. Thomas Brent) and he concurs with the additional samples (per e-mail communication to Tetra Tech Project Manager dated 17 Jan 2013).

Recommended Disposition:
Approve collection of additional samples as described.

23 Jan 2013

Field Operations Leader (Signature) Date

Approved Disposition:
Modification Approved

22 Jan 2013

Project/Task Order Manager (Signature) Date

Distribution:

Project File:	CTO F279	Other:
Project Manager:	Tim Evans	
Field Operations Leader:	Kevin Losekamp	

SWMU 22 - LEAD AZIDE POND
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE LOCATION SURVEY DATA

HORIZONTAL DATUM: North American Datum 1983 (NAD83), INDIANA WEST ZONE, U.S. Survey Feet

VERTICAL DATUM: North American Vertical Datum 1988 (NAVD88)

Pt	N	E	Elev	Description	Sample Loc
24	1315811.05	3027409.53	766.47	GRD (Ground)	22MWT01
25	1315811.30	3027409.16	768.94	TC (Top of Casing)	
26	1315811.32	3027409.14	768.74	TP (Top of Pipe)	
40	1315359.93	3027108.33	756.21	GRD	22MWT02
41	1315359.91	3027108.00	758.96	TC	
42	1315360.00	3027107.82	758.78	TP	
34	1315524.99	3027498.48	763.88	GRD	22MWT03
35	1315524.99	3027498.00	766.64	TC	
36	1315525.14	3027497.94	766.28	TP	
17	1315438.20	3027804.87	759.34	GRD	22MWT04
18	1315438.39	3027805.24	761.74	TC	
19	1315438.43	3027804.94	761.44	TP	
9	1315271.25	3027363.21	756.12	GRD	22MWT05
10	1315270.90	3027363.25	758.86	TC	
11	1315271.01	3027363.36	758.67	TP	
20	1315735.05	3027589.02	769.25	GRD	22MWT06
21	1315734.90	3027589.01	772.00	TC	
22	1315734.76	3027588.91	771.77	TP	
14	1315411.94	3027444.98	758.19	22SD/SW22	
6	1313902.38	3027476.97	628.99	22SD/SW23	
7	1315082.32	3027002.82	742.25	22SD/SW25	
8	1315103.96	3027415.43	738.68	22SD/SW24	
27	1315698.52	3027269.96	760.10	22SB12	
30	1315473.44	3027245.14	759.42	22SB13	
32	1315603.19	3027432.90	761.96	22SB15	
12	1315363.84	3027452.06	758.72	22SB16	
16	1315309.13	3027417.35	758.17	22SB17	
29	1315636.06	3027233.00	764.15	22SB18	
23	1315726.83	3027330.95	763.16	22SB19	
28	1315645.70	3027232.57	764.76	SUMP 22SD26	
13	1315370.58	3027452.72	758.88	SAMH 1	
15	1315301.44	3027420.52	758.19	SAMH 2	
33	1315675.96	3027488.56	765.37	BLD1 138	
31	1315527.96	3027318.88	761.22	BLD1 138	
38	1315411.48	3027717.41	762.05	BLD2 2706	
39	1315456.81	3027749.35	763.08	BLD2 2706	

This survey was executed according to survey statement of work and technical specifications. I hereby certify that this survey was performed either by me or under my direct supervision and control and that all the information shown is true and correct to the best of my knowledge and belief.

Certified this 14th day of June, 2012.

Matthew L. Cooper

Matthew L. Cooper L.S.
Indiana L.S. #20200079
Bledsoe Riggert & Guerrettaz, Inc

PREPARED BY:

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APPENDIX C

DATA QUALITY REVIEW

APPENDIX C
DATA QUALITY REVIEW

This section contains a description of the data review processes used to determine whether analytical laboratory data were of acceptable technical quality for use in decision making and a summary of the associated findings. The review began with data validation, which is a comparison of data quality indicators (DQIs) against prescribed acceptance criteria. The DQIs used are measures to assess the bias and precision of the analytical calibrations and sample analyses. The output of this review was a set of alphabetic flags such as "U," "J," "R," or combinations thereof, that may have been assigned to individual results based on the validation effort. These flags were used to infer the general quality of the data and whether data quality meets the data quality objectives (DQOs) of the project. The DQOs are presented in the Sampling and Analysis Plan for SWMU 22 – Lead Azide Pond (January 2011), the addendum to that plan (May 2012), and the Field Task Modification Request (FTMR) (December 2012). Also evaluated were the measures of data completeness, sensitivity, comparability and representativeness.

Data Validation Process

In accordance with Navy requirements for this project, Tetra Tech performed a full data validation on 100 percent of analytical laboratory results. Sample data validation generally followed the guidelines presented in EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (1999) and EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (2004).

Data validation specifications require assignment of data qualifiers in response to various data deficiencies. Validation specifications also require data qualifiers be applied to results that are reported as being less than the detection limit. The flags used for data qualification are as follows:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

UR – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory may be unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies (i.e., holding times missed by a factor of two or more times the specified time limit, severe calibration non-compliances, and extremely low quality control recoveries).

R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

The preceding data qualifiers categorize data as indicative of major or minor problems. Major problems result in the rejection of data and qualification with UR or R data validation qualifiers. Minor problems result in the estimation of data, and qualification with U, J, and UJ data validation qualifiers. It is noteworthy that a U qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

When data are qualified or rejected a data qualifier code is associated with the data by Tetra Tech. The qualifier codes used for validation are as follows:

A	=	Lab Blank Contamination
B	=	Field Blank Contamination
C	=	Calibration Noncompliance (i.e., % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01	=	GC/MS Tuning Noncompliance
D	=	MS/MSD Recovery Noncompliance
E	=	LCS/LCSD Recovery Noncompliance
F	=	Lab Duplicate Imprecision
G	=	Field Duplicate Imprecision
H	=	Holding Time Exceedance
I	=	ICP Serial Dilution Noncompliance
J	=	ICP PDS Recovery Noncompliance; MSA's r < 0.995
K	=	ICP Interference - includes ICS % R Noncompliance
L	=	Instrument Calibration Range Exceedance
M	=	Sample Preservation Noncompliance
N	=	Internal Standard Noncompliance
N01	=	Internal Standard Recovery Noncompliance Dioxins
N02	=	Recovery Standard Noncompliance Dioxins

N03	=	Clean-up Standard Noncompliance Dioxins
O	=	Poor Instrument Performance (i.e., base-line drifting)
P	=	Uncertainty near detection limit (<2 x IDL for inorganics and <CRDL for organics)
Q	=	Other problems (can encompass a number of issues; i.e., chromatography, interferences, etc.)
R	=	Surrogates Recovery Noncompliance
S	=	Pesticide/PCB Resolution
T	=	% Breakdown Noncompliance for DDT and Endrin
U	=	% Difference between columns/detectors >40% for positive results determined via GC/HPLC
V	=	Non-linear calibrations; correlation coefficient r < 0.995
W	=	EMPC result
X	=	Signal to noise response drop
Y	=	Percent solids <30%
Z	=	Uncertainty at 2 sigma deviation is greater than sample activity
Z1	=	Tentatively Identified Compound considered presumptively present
Z2	=	Tentatively Identified Compound column bleed

Data Validation Outputs

After data were validated, a list was developed of non-conformities requiring data qualifier flags that are used to alert the data user to inaccurate or imprecise data. For situations in which several QC criteria were out of specification, the data validator made professional judgments and or comments on the validity of the overall data package. The reviewer then prepared a technical memorandum presenting qualification of the data, if necessary, and the rationale for making such qualifications. The net result was a data package that had been carefully reviewed for its adherence to prescribed technical requirements. Pertinent quality estimates are summarized in a more quantitative format in the following section.

Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result. Table 1 summarizes the number of results qualified for a particular data quality indicator by sample matrix. This table also shows the total number of results for comparison.

Results for chromium and lead in surface water samples from location 22SW/SD003 were rejected as explained in the Comparability section. All other data are considered acceptable for their intended purpose.

Completeness

Completeness is a measure of the number of valid samples or measurements that are available relative to the number of samples or measurements that were intended to be generated. For this project, completeness was measured on two different bases: samples collected and laboratory measurements.

- Sample completeness was a measure of the usable samples collected as compared to those intended to be collected.
- Laboratory measurement completeness was a measure of the amount of usable, valid laboratory measurements per matrix obtained for each target analyte.

Usable, valid samples (or results) were those judged, after data assessment, to represent the sampling populations and to have not been disqualified for use through data validation or additional data review. Completeness was determined using the following equation:

$$\%C = \frac{V}{T} \times 100$$

where	%C	=	percent completeness
	V	=	number of samples (or results) determined to be valid
	T	=	total number of planned samples (or results)

The percent completeness for sample collection for the SWMU 22 – Lead Azide Pond project was 100 because all samples that could be collected were collected. The laboratory percent completeness was 99.5 because all data except the two rejected results described in the Comparability section are considered acceptable for use for their intended purpose.

Sensitivity

Analytical sensitivity was generally satisfactory to meet DQOs presented in the Sampling and Analysis Plan for SWMU 22 – Lead Azide Pond (December 2010), the addendum to that plan (May 2012), and the December 2012 FTMR. It was known at the start of the project, however, that the laboratory could not meet the screening level limits for several analytes. The laboratory reported the nondetected results down the limit of detection (LOD) in order to meet the Project Screening Levels (PSLs) for as many analytes as possible. The reported surface soil, subsurface soil, and sediment nondetected values for the explosive compounds that had PSL exceedances on Worksheet No. 15 from the SWMU 22 – Lead Azide Pond QAPP were all reported at the LOD from the QAPP. The reported surface and ground water nondetected values for the explosive compounds that had PSL exceedances on Worksheet No. 15 from the SWMU 22 – Lead Azide Pond QAPP were all reported at the LOD from the QAPP, except for two surface water samples which required two-fold dilutions due to sample matrix interferences. Only nondetected arsenic, mercury, and silver results reported for surface water samples exceeded PSLs from Worksheet No. 15 from the SWMU 22 – Lead Azide Pond QAPP. All reported nondetected metals results for ground water, surface soil, subsurface soil, and sediment samples were less than the PSLs from Worksheet No. 15 from the SWMU 22 – Lead Azide Pond QAPP. The number of PSL exceedances are not considered excessive and should not have an adverse impact on the quality of the data.

The following are reasons other than the laboratory LOD that can cause a nondetected result to exceed the screening level limits.

1. Laboratory or field blank contamination can cause the LOD to be raised to exceed screening level limits.
2. Percent moisture in soil samples can cause the adjusted LOD to exceed screening level limits.
3. Sample dilution due to concentrations greater than the calibration range of the instrument or due to matrix interference can raise the LOD to above the screening level limits.

The significance, if any, of PSLs exceedances by non-detect values is discussed in the risk assessment.

Laboratory Accuracy

Accuracy in the laboratory is measured through the comparison of a laboratory control sample (LCS) result to a known or calculated value and is expressed as a percent recovery (%R). Surrogates and internal standards assess accuracy in organic methods. LCSs assess the accuracy of laboratory operations with minimal sample matrix effects. Surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement for organic analyses. Internal standards, added after preparation, are for sample quantitation. Laboratory accuracy is determined by comparing calculated percent recoveries to accuracy control limits specified by the laboratory using the appropriate analytical method.

Percent recovery is calculated using the following equation:

$$\%R = \frac{Ss - So}{S} \times 100$$

where	%R	=	percent recovery
	Ss	=	result of spiked sample

So	=	result of non-spiked sample
S	=	concentration of spiked amount.

Tables 1 thru 5 presents the soil and aqueous results that were qualified because of blank contamination, matrix spike, sample preservation or ICP serial dilution noncompliances. The noncompliances in general do not show any directional bias trends within the data sets. Overall, the laboratory accuracy was acceptable and the amount of data qualified is not considered excessive. There were no quality control deficiencies noted for field accuracy, however, the agreement between the total chromium results for sample 22GWT005 and its field duplicate collected in January 2013 were notable and are described in the next section.

Laboratory and Field Precision

Precision is a measure of the degree to which two or more measurements are in agreement and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions.

Precision for chemical parameters is expressed as a Relative Percent Difference (RPD), which is defined as the ratio of the difference to the mean for the two values being evaluated. RPDs, typically expressed as percentages, are used to evaluate both field and laboratory duplicate precision and are calculated as follows:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where	RPD	=	relative percent difference
	V1, V2	=	two results obtained by analyzing duplicate samples

The precision estimates obtained from duplicate field samples encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, subsampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

Laboratory duplicate imprecision did not result in any qualification of the data. Tables 1 thru 5 presents the aqueous and soil results qualified because of field duplicate imprecision for arsenic, barium, cadmium, chromium, lead, selenium, and total organic carbon. The precision noncompliances occur mostly in the soil and sediment samples and in general do not show any trends within the data sets. Lack of soil homogeneity is the likely cause of field precision noncompliances. Overall, the laboratory precision was acceptable and the amount of data qualified is not considered excessive.

One sample, 22GWT005, exhibited a high degree of imprecision for the total chromium results in the original (90.8 µg/L total chromium) and corresponding duplicate (19.8 µg/L total chromium) samples. The hexavalent chromium results for the original and duplicate samples and for all other samples were consistently less than the 10 µg/L limit of detection. The 90.8 µg/L total chromium result was double checked by the laboratory by analyzing a serial dilution of that sample. The serial dilution result (99 µg/L) was within 10 percent of the originally reported 90.8 µg/L. A sampling error could not be found. The sample collection log for these samples confirms that turbidity (i.e., suspended solids) was higher than normal at this sampling location. These are indications that groundwater was heterogeneous at this sampling location.

Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., among sampling points and among sampling events). Comparability was achieved by using standardized sampling and analysis methods, as well as standardized data reporting formats. Comparability of laboratory measurements was achieved primarily through the use and documentation of standard sampling and analytical methods. Results were reported in units that ensured comparability with previous data.

Comparability of laboratory measurements was assessed primarily through the use of QC samples and through adherence to the Sampling and Analysis Plan for SWMU 22 – Lead Azide Pond (December 2010) and the addendum to that plan (May 2012). In addition, dissolved and total metal concentrations were compared for water samples to verify whether dissolved metal concentrations were less than total metal concentrations, as they should be. Allowances were made for uncertainties in the measured metals concentrations, especially at concentrations near detection limits. Such uncertainties may indicate a discrepancy but the discrepancy is caused by natural variations in the measured values and does not represent an error. For dissolved metal concentrations at least 5 times the LOD, dissolved metal concentrations no more than 20 percent greater than the total metal concentrations were not reviewed. At lower concentrations a 50 percent deviation was allowed. If both results were less than detection limits, no mathematical comparison was made. Otherwise, additional review was applied to the data to determine why the dissolved metal concentrations exceeded the total metal concentrations.

For each metal in each sample, dissolved metal concentrations were less than total metal concentrations except for one sample. That sample, from location 22SW/SD003, had chromium (0.92 µg/L) and lead (2.2 µg/L) concentrations in the dissolved portion of the sample that exceeded by a significant margin the chromium (0.43) and lead (0.11 µg/L) concentrations in the total metal portion. Causes of this type of discrepancy often are associated with sample contamination or confusion of the dissolved and total metal portions of the sample during sampling or analysis. After detailed review of the data and the sample collection and analysis records, an error was not evident but the reported results represent a physical impossibility. Therefore, although the data validation process identified no laboratory errors, the data were rejected. Other metals in this sample were not affected and the results for those metals were not rejected.

The effect on the project of rejecting these two metal results in the filtered and unfiltered samples was negligible. Neither the total nor the dissolved metal concentrations would change the outcome of the risk assessment because they fall within the middle of the observed concentration ranges for these metals or they do not exceed screening criteria. The remaining data are sufficient to assess the nature and extent of contamination.

Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site.

The Sampling and Analysis Plan for SWMU 22 – Lead Azide Pond (December 2010), the addendum to that plan (May 2012), and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. It is believed that all reported data are adequately representative of site conditions and intended populations. Based on groundwater elevations and site configuration, wells T01 and T06 are considered to represent groundwater conditions upgrdient of, and unaffected by, SWMU 22 operations. All other SWMU 22 wells are considered to represent groundwater that is potentially affected by SWMU 22 operations.

Samples 22SS0200002 and 22SS0200203 were mislabeled on the chain of custody that accompanied the samples to the laboratory. Sample 22SS0200002 was mislabeled as 22SS0030002 and 22SS0200203 was mislabeled as 22SS0030203. The error was detected and corrected in the Tt database for SMWU 22. In addition, sample 22SB0200002 was incorrectly labeled as 22SS0200002 and this error was later corrected where necessary, including the Tt database for SWMU 22.

Given the disparity in results for total chromium between sample 22GWT005 and its field duplicate, the representativeness of a single sample collected at that location is questionable. The filtered version of this sample had no detectable chromium at 1.5 µg/L, indicating that all of the detectable chromium was in suspended solids. The fact that the original and duplicate sample results are in significant disagreement indicates that the well needs to be purged longer before collecting a sample or that samples from this well are likely to exhibit a significant degree of random fluctuations in total chromium results. A sample was collected from the same location in April 2013 for total and hexavalent chromium. No issues were identified with the April 2013 sample.

TABLE C-1

COMPLETE ANALYTICAL RESULTS DATA SET FOR SOIL
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SB001		22SB002		22SB003	
SAMPLE ID	22SB0010002	22SB0010305	22SB0020002	22SB0020607	22SB0030002	22SB0030305
SAMPLE DATE	20110119	20110119	20110119	20110119	20110119	20110119
SAMPLE CODE	NORMAL	ORIG	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	SO	SO	SO	SO	SO	SO
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	SS	SB	SS	SB	SS	SB
TOP DEPTH	0	3	0	6	0	3
BOTTOM DEPTH	2	5	2	7	2	5
EXPLOSIVES (MG/KG)						
1,3,5-Trinitrobenzene	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-Dinitrobenzene	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-Trinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-Amino-4,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-Nitrotoluene	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-Nitrotoluene	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-Amino-2,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-Nitrotoluene	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Nitrobenzene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Nitroglycerin	NA	NA	NA	NA	NA	NA
PETN	NA	NA	NA	NA	NA	NA
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Tetryl	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)						
Arsenic	3.6 J	4.1 J	4.6 J	3.8 J	7.9 J	3.4 J
Barium	30.9 J	38.4 J	44.6 J	19.3 J	32.1 J	23.3 J
Cadmium	0.23 J	0.16 J	0.15 J	0.1 J	0.12 J	0.11 J
Chromium	5.6 J	6 J	8 J	8.7 J	14.1 J	10.7 J
Lead	8.9 J	6.5 J	10.2 J	9 J	10.8 J	7 J
Mercury	0.04 U	0.044 U	0.026 U	0.032 U	0.046 U	0.04 U
Selenium	0.17 J	0.16 J	0.28 J	0.29 J	0.23 J	0.13 J
Silver	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ
MISCELLANEOUS PARAMETERS (%)						
Percent Moisture	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)						
Perchlorate	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Hexavalent Chromium						
Total Organic Carbon	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (S.U.)						
pH	7.3	7.9	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mV)						
Oxidation Reduction Potential	NA	NA	NA	NA	NA	NA

TABLE C-1

COMPLETE ANALYTICAL RESULTS DATA SET FOR SOIL
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SB004		22SB005	22SB006		22SB007	
SAMPLE ID	22SB0040002	22SB0040305	22SB0050002	22SB0060002	22SB0060304	22SB0070002	22SB0070304
SAMPLE DATE	20110119	20110119	20110119	20110119	20110119	20110121	20110121
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	SO	SO	SO	SO	SO	SO	SO
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	SS	SB	SS	SS	SB	SS	SB
TOP DEPTH	0	3	0	0	3	0	3
BOTTOM DEPTH	2	5	2	2	4	2	4
EXPLOSIVES (MG/KG)							
1,3,5-Trinitrobenzene	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-Dinitrobenzene	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-Trinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-Amino-4,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-Nitrotoluene	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-Nitrotoluene	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-Amino-2,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-Nitrotoluene	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Nitrobenzene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Nitroglycerin	NA	NA	NA	NA	NA	NA	NA
PETN	NA	NA	NA	NA	NA	NA	NA
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Tetryl	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)							
Arsenic	2.5 J	2 J	3.3 J	2.4 J	1.1 J	6	2
Barium	17.6 J	51.1 J	12.8 J	38 J	2.3 J	89 J	14.8 J
Cadmium	0.14 J	0.16 J	0.18 J	0.19 J	0.092 J	0.16	0.1
Chromium	3.4 J	12.1 J	13.4 J	10.6 J	7.4 J	11	5.3
Lead	2.8 J	4.7 J	6.1 J	4.6 J	2.8 J	11.8	4.9
Mercury	0.02 U	0.086 U	0.028 U	0.021 U	0.025 U	0.079 U	0.046 U
Selenium	0.088 J	0.15 J	0.18 J	0.17 J	0.06 J	0.31	0.11 J
Silver	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 U	0.04 U
MISCELLANEOUS PARAMETERS (%)							
Percent Moisture	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/							
Perchlorate	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Hexavalent Chromium							
Total Organic Carbon	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (S.U.							
pH	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mV)							
Oxidation Reduction Potential	NA	NA	NA	NA	NA	NA	NA

TABLE C-1

COMPLETE ANALYTICAL RESULTS DATA SET FOR SOIL
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SB008	22SB009		22SB010		22SB011	
SAMPLE ID	22SB0080002	22SB0090002	22SB0090305	22SB0100002	22SB0100305	22SB0110002	22SB0110304
SAMPLE DATE	20110119	20110119	20110119	20110119	20110119	20110119	20110119
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	SO	SO	SO	SO	SO	SO	SO
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	SS	SS	SB	SS	SB	SS	SB
TOP DEPTH	0	0	3	0	3	0	3
BOTTOM DEPTH	2	2	5	2	5	2	4
EXPLOSIVES (MG/KG)							
1,3,5-Trinitrobenzene	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-Dinitrobenzene	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-Trinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-Amino-4,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-Nitrotoluene	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-Nitrotoluene	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-Amino-2,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-Nitrotoluene	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Nitrobenzene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Nitroglycerin	NA	NA	NA	NA	NA	NA	NA
PETN	NA	NA	NA	NA	NA	NA	NA
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Tetryl	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)							
Arsenic	3.7 J	2.7 J	4.9 J	2.9 J	3.1 J	7 J	6.1 J
Barium	34.3 J	15.4 J	23.3 J	55.3 J	60.5 J	65.8 J	40.6 J
Cadmium	0.33 J	0.075 J	0.14 J	0.079 J	0.1 J	0.19 J	0.12 J
Chromium	8.9 J	5.9 J	9.2 J	8 J	7.6 J	12.4 J	9 J
Lead	11.2 J	4.1 J	7 J	4.7 J	5.5 J	11.5 J	8.9 J
Mercury	0.035 U	0.042 U	0.04 U	0.031 U	0.025 U	0.038 U	0.067 U
Selenium	0.23 J	0.094 J	0.14 J	0.14 J	0.16 J	0.38 J	0.26 J
Silver	0.035 J	0.04 UJ	0.022 J	0.04 UJ	0.04 UJ	0.038 J	0.023 J
MISCELLANEOUS PARAMETERS (%)							
Percent Moisture	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/							
Perchlorate	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Hexavalent Chromium							
Total Organic Carbon	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (S.U.							
pH	8.2	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mV)							
Oxidation Reduction Potential	NA	NA	NA	NA	NA	NA	NA

TABLE C-1

COMPLETE ANALYTICAL RESULTS DATA SET FOR SOIL
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SB012	22SB013	22SB014		22SB015
SAMPLE ID	22SB0120002	22SB0130002	22SB0140002	22SB0140203	22SB0150002
SAMPLE DATE	20120510	20120509	20120509	20120510	20120510
SAMPLE CODE	ORIG	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	SO	SO	SO	SO	SO
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	SS	SS	SS	SB	SS
TOP DEPTH	0	0	0	2	0
BOTTOM DEPTH	2	2	2	3	2
EXPLOSIVES (MG/KG)					
1,3,5-Trinitrobenzene	0.158 UJ	0.158 UJ	0.158 UJ	0.158 UJ	0.158 UJ
1,3-Dinitrobenzene	0.126 UJ	0.126 UJ	0.126 UJ	0.126 UJ	0.126 UJ
2,4,6-Trinitrotoluene	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ
2,4-Dinitrotoluene	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ
2,6-Dinitrotoluene	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ
2-Amino-4,6-Dinitrotoluene	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ
2-Nitrotoluene	0.132 UJ	0.132 UJ	0.132 UJ	0.132 UJ	0.132 UJ
3-Nitrotoluene	0.142 UJ	0.142 UJ	0.142 UJ	0.142 UJ	0.142 UJ
4-Amino-2,6-Dinitrotoluene	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ
4-Nitrotoluene	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
HMX	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
Nitrobenzene	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ
Nitroglycerin	0.17 UJ	0.17 UJ	0.17 UJ	0.17 UJ	0.17 UJ
PETN	1.158 UJ	1.158 UJ	1.158 UJ	1.158 UJ	1.158 UJ
RDX	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
Tetryl	0.182 UJ	0.182 UJ	0.182 UJ	0.182 UJ	0.182 UJ
METALS (MG/KG)					
Arsenic	2.9 J	5.6 J	4.2 J	2.5 J	4.7 J
Barium	22.4 J	126 J	144 J	52.3 J	47 J
Cadmium	0.13 J	0.24 J	0.28 J	0.086 J	0.2 J
Chromium	7 J	19.8 J	18.7 J	7.5 J	12.6 J
Lead	4.5 J	7 J	8 J	2.8 J	6.1 J
Mercury	0.026 J	0.021 J	0.03 J	0.04 U	0.04 U
Selenium	0.2 J	0.4 J	0.32 J	0.21 J	0.28 J
Silver	0.04 UJ	0.04 UJ	0.021 J	0.04 UJ	0.04 UJ
MISCELLANEOUS PARAMETERS (%)					
Percent Moisture	16	13	18.9	8.1	14.3
MISCELLANEOUS PARAMETERS (MG/					
Perchlorate	NA	NA	NA	NA	NA
Hexavalent Chromium					
Total Organic Carbon	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (S.U.					
pH	7.7	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mV)					
Oxidation Reduction Potential	NA	NA	NA	NA	NA

TABLE C-1

COMPLETE ANALYTICAL RESULTS DATA SET FOR SOIL
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SB016			22SB017		22SB018	
SAMPLE ID	**22SB0160002**	**22SB0160305**	**22SB0160608**	**22SB0170002**	**22SB0170305**	**22SB0180002**	**22SB0180406**
SAMPLE DATE	**20120509**	**20120509**	**20120509**	**20120509**	**20120509**	**20120510**	**20120511**
SAMPLE CODE	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**
MATRIX	**SO**	**SO**	**SO**	**SO**	**SO**	**SO**	**SO**
SAMPLE TYPE	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**
SUBMATRIX	**SS**	**SB**	**SB**	**SS**	**SB**	**SS**	**SB**
TOP DEPTH	**0**	**3**	**6**	**0**	**3**	**0**	**4**
BOTTOM DEPTH	**2**	**5**	**8**	**2**	**5**	**2**	**6**
EXPLOSIVES (MG/KG)							
1,3,5-Trinitrobenzene	0.158 UJ	0.158 UJ	0.158 UJ	0.158 UJ	0.158 UJ	0.158 UJ	0.158 U
1,3-Dinitrobenzene	0.126 UJ	0.126 UJ	0.126 UJ	0.126 UJ	0.126 UJ	0.126 UJ	0.126 U
2,4,6-Trinitrotoluene	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 U
2,4-Dinitrotoluene	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 U
2,6-Dinitrotoluene	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 U
2-Amino-4,6-Dinitrotoluene	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 U
2-Nitrotoluene	0.132 UJ	0.132 UJ	0.132 UJ	0.132 UJ	0.132 UJ	0.132 UJ	0.132 U
3-Nitrotoluene	0.142 UJ	0.142 UJ	0.142 UJ	0.142 UJ	0.142 UJ	0.142 UJ	0.142 U
4-Amino-2,6-Dinitrotoluene	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 U
4-Nitrotoluene	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 U
HMX	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 U
Nitrobenzene	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 U
Nitroglycerin	0.17 UJ	0.17 UJ	0.17 UJ	0.17 UJ	0.17 UJ	0.17 UJ	0.17 U
PETN	1.158 UJ	1.158 UJ	1.158 UJ	1.158 UJ	1.158 UJ	1.158 UJ	1.158 U
RDX	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 U
Tetryl	0.182 UJ	0.182 UJ	0.182 UJ	0.182 UJ	0.182 UJ	0.182 UJ	0.182 U
METALS (MG/KG)							
Arsenic	5 J	4.6 J	3.4 J	5.2 J	5.3 J	6 J	3.2
Barium	79.2 J	69.5 J	54 J	39.9 J	43 J	73.5 J	72.6
Cadmium	0.26	0.25 J	0.19 J	0.18	0.22	0.27 J	0.18
Chromium	19.5 J	17.7 J	8.7 J	16.7 J	15.8 J	17.3 J	11.4
Lead	10.6	10.6 J	8.7 J	17.3	10.9	9.4 J	4.5
Mercury	0.02 J	0.021 J	0.027 J	0.04 J	0.033 J	0.054 J	0.04 U
Selenium	0.35 J	0.46 J	0.29 J	0.34 J	0.35 J	0.38 J	0.24
Silver	0.04 U	0.04 UJ	0.04 UJ	0.04 U	0.04 U	0.022 J	0.04 U
MISCELLANEOUS PARAMETERS (%)							
Percent Moisture	9.1	13.4	15	12.2	9.4	16.3	15
MISCELLANEOUS PARAMETERS (MG/							
Perchlorate	NA	NA	NA	NA	NA	NA	NA
Hexavalent Chromium							
Total Organic Carbon	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (S.U.							
pH	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mV)							
Oxidation Reduction Potential	NA	NA	NA	NA	NA	NA	NA

TABLE C-1

COMPLETE ANALYTICAL RESULTS DATA SET FOR SOIL
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SB019	22SB020		22SS001	22SS002	22SS004	22SS005
SAMPLE ID	22SB0190002	22SB0200002	22SB0200203	22SS0010002	22SS0020002	22SS0040002	22SS0050002
SAMPLE DATE	20120510	20130123	20130123	20110121	20110121	20130123	20130123
SAMPLE CODE	NORMAL	NORMAL	NORMAL	ORIG	NORMAL	NORMAL	NORMAL
MATRIX	SO	SO	SO	SO	SO	SO	SO
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	SS	SS	SS	SS	SS	SS	SS
TOP DEPTH	0	0	2	0	0	0	0
BOTTOM DEPTH	2	2	3	2	2	2	2
EXPLOSIVES (MG/KG)							
1,3,5-Trinitrobenzene	0.158 UJ	NA	NA	0.158 U	0.158 U	NA	NA
1,3-Dinitrobenzene	0.126 UJ	NA	NA	0.126 U	0.126 U	NA	NA
2,4,6-Trinitrotoluene	0.166 UJ	0.2 U	0.2 U	0.166 U	0.166 U	0.2 U	0.2 U
2,4-Dinitrotoluene	0.166 UJ	NA	NA	0.166 U	0.166 U	NA	NA
2,6-Dinitrotoluene	0.166 UJ	NA	NA	0.166 U	0.166 U	NA	NA
2-Amino-4,6-Dinitrotoluene	0.15 UJ	NA	NA	0.15 U	0.15 U	NA	NA
2-Nitrotoluene	0.132 UJ	NA	NA	0.132 U	0.132 U	NA	NA
3-Nitrotoluene	0.142 UJ	NA	NA	0.142 U	0.142 U	NA	NA
4-Amino-2,6-Dinitrotoluene	0.15 UJ	NA	NA	0.15 U	0.15 U	NA	NA
4-Nitrotoluene	0.16 UJ	NA	NA	0.16 U	0.16 U	NA	NA
HMX	0.16 UJ	NA	NA	0.16 U	0.16 U	NA	NA
Nitrobenzene	0.15 UJ	NA	NA	0.15 U	0.15 U	NA	NA
Nitroglycerin	0.17 UJ	NA	NA	NA	NA	NA	NA
PETN	1.158 UJ	NA	NA	NA	NA	NA	NA
RDX	0.16 UJ	0.2 U	0.2 U	0.16 U	0.16 U	0.2 U	0.2 U
Tetryl	0.182 UJ	NA	NA	0.182 U	0.182 U	NA	NA
METALS (MG/KG)							
Arsenic	7 J	NA	NA	2.4	2.4	NA	NA
Barium	69.4 J	NA	NA	27.1 J	22 J	NA	NA
Cadmium	0.22 J	NA	NA	0.1	0.057 J	NA	NA
Chromium	14.8 J	NA	16.5	4.9	4.9	NA	NA
Lead	8.4 J	NA	NA	6.5	5.1	NA	NA
Mercury	0.032 J	NA	NA	0.068 U	0.056 U	NA	NA
Selenium	0.32 J	NA	NA	0.14 J	0.086 J	NA	NA
Silver	0.04 UJ	NA	NA	0.04 U	0.04 U	NA	NA
MISCELLANEOUS PARAMETERS (%)							
Percent Moisture	15.4	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/							
Perchlorate	NA	NA	NA	0.004 U	0.004 U	NA	NA
Hexavalent Chromium		NA	1.31				
Total Organic Carbon	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (S.U.							
pH	NA	NA	5.36	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mV)							
Oxidation Reduction Potential	NA	NA	605	NA	NA	NA	NA

TABLE C-1

COMPLETE ANALYTICAL RESULTS DATA SET FOR SOIL
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SS006	22SS007	22SS008	22SS022	22SS025
SAMPLE ID	22SS0060002	22SS0070002	22SS0080002	22SS0220002	22SS0250002
SAMPLE DATE	20130123	20130123	20130123	20120512	20120511
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	ORIG
MATRIX	SO	SO	SO	SO	SO
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	SS	SS	SS	SS	SS
TOP DEPTH	0	0	0	0	0
BOTTOM DEPTH	2	2	2	2	2
EXPLOSIVES (MG/KG)					
1,3,5-Trinitrobenzene	NA	NA	NA	0.158 U	0.158 U
1,3-Dinitrobenzene	NA	NA	NA	0.126 U	0.126 U
2,4,6-Trinitrotoluene	0.2 U	0.2 U	0.2 U	0.166 U	0.166 U
2,4-Dinitrotoluene	NA	NA	NA	0.166 U	0.166 U
2,6-Dinitrotoluene	NA	NA	NA	0.166 U	0.166 U
2-Amino-4,6-Dinitrotoluene	NA	NA	NA	0.15 U	0.15 U
2-Nitrotoluene	NA	NA	NA	0.132 U	0.132 U
3-Nitrotoluene	NA	NA	NA	0.142 U	0.142 U
4-Amino-2,6-Dinitrotoluene	NA	NA	NA	0.15 U	0.15 U
4-Nitrotoluene	NA	NA	NA	0.16 U	0.16 U
HMX	NA	NA	NA	0.16 U	0.16 U
Nitrobenzene	NA	NA	NA	0.15 U	0.15 U
Nitroglycerin	NA	NA	NA	0.17 U	0.17 U
PETN	NA	NA	NA	1.158 U	1.158 U
RDX	0.2 U	0.2 U	0.2 U	0.16 U	0.37 J
Tetryl	NA	NA	NA	0.182 U	0.182 U
METALS (MG/KG)					
Arsenic	NA	NA	NA	4.1	9.8 J
Barium	NA	NA	NA	56.5	48.6 J
Cadmium	NA	NA	NA	0.52	0.78
Chromium	NA	NA	NA	8.5	25.4 J
Lead	NA	NA	NA	31.4	31.7 J
Mercury	NA	NA	NA	0.054 J	0.6 J
Selenium	NA	NA	NA	0.35 J	0.48 J
Silver	NA	NA	NA	0.04 U	0.026 J
MISCELLANEOUS PARAMETERS (%)					
Percent Moisture	NA	NA	NA	14.9	22.8
MISCELLANEOUS PARAMETERS (MG/					
Perchlorate	NA	NA	NA	NA	NA
Hexavalent Chromium					
Total Organic Carbon	NA	NA	NA	11000	4100
MISCELLANEOUS PARAMETERS (S.U.					
pH	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mV)					
Oxidation Reduction Potential	NA	NA	NA	NA	NA

TABLE C-2

COMPLETEANALYTICAL RESULTS DATA SET FOR GROUNDWATER
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA
PAGE 1 OF 1

LOCATION	**22MWT01**	**22MWT02**	**22MWT03**	**22MWT04**	**22MWT05**	**22MWT05**	**22MWT05**	**22MWT06**
SAMPLE ID	**22GWT001**	**22GWT002**	**22GWT003**	**22GWT004**	**22GWT005**	**22GWT005_20130123**	**22GWT005_20130416**	**22GWT006**
SAMPLE DATE	**20120522**	**20120522**	**20120523**	**20120523**	**20120521**	**20130123**	**20130416**	**20120521**
SAMPLE CODE	**NORMAL**	**ORIG**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**
MATRIX	**GW**	**GW**	**GW**	**GW**	**GW**	**GW**	**GW**	**GW**
SAMPLE TYPE	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**	**NORMAL**
SUBMATRIX	**SIDE GRADIENT GW**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**UPGRADIENT GW**
TOP DEPTH	**-9999**	**-9999**	**-9999**	**-9999**	**-9999**	**-9999**	**-9999**	**-9999**
BOTTOM DEPTH	**-9999**	**-9999**	**-9999**	**-9999**	**-9999**	**-9999**	**-9999**	**-9999**
DISSOLVED METALS (UG/L)								
Arsenic	0.44	3.2	NA	1.4	0.45	NA	NA	3.3
Barium	23.6	25.2	NA	27.1	55.6	NA	NA	28.5
Cadmium	0.99	2.9	NA	0.45	1.3	NA	NA	3.9
Chromium	0.59	3	NA	1.2	2.3	1.5 U	NA	1.3
Hexavalent Chromium	NA	NA	NA	NA	NA	10 U	0.034	
Lead	0.72	10.6 J	NA	6.6	4.2 J	NA	NA	7 J
Mercury	0.12 U	0.12 U	NA	0.12 U	0.18 U	NA	NA	0.12 U
Selenium	0.56 J	3.5	NA	1.9	0.24 J	NA	NA	5.7
Silver	0.06 U	0.06 U	NA	0.06 U	0.06 U	NA	NA	0.06 U
EXPLOSIVES (UG/L)								
1,3,5-Trinitrobenzene	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	NA	NA	0.26 UJ
1,3-Dinitrobenzene	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ	NA	NA	0.262 UJ
2,4,6-Trinitrotoluene	0.266 UJ	0.47 J	0.266 UJ	0.266 UJ	0.266 UJ	NA	NA	0.266 UJ
2,4-Dinitrotoluene	0.25 UJ	0.25 UJ	0.25 UJ	0.25 UJ	0.25 UJ	NA	NA	0.25 UJ
2,6-Dinitrotoluene	0.25 UJ	0.25 UJ	0.25 UJ	0.25 UJ	0.25 UJ	NA	NA	0.25 UJ
2-Amino-4,6-Dinitrotoluene	0.25 UJ	0.25 UJ	0.25 UJ	0.25 UJ	0.25 UJ	NA	NA	0.25 UJ
2-Nitrotoluene	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	NA	NA	0.252 UJ
3-Nitrotoluene	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	NA	NA	0.266 UJ
4-Amino-2,6-Dinitrotoluene	0.2 UJ	0.11 J	0.2 UJ	0.2 UJ	0.2 UJ	NA	NA	0.2 UJ
4-Nitrotoluene	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	NA	NA	0.266 UJ
HMX	0.23 UJ	1.1 J	0.23 UJ	0.23 UJ	0.23 UJ	NA	NA	0.23 UJ
Nitrobenzene	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	NA	NA	0.252 UJ
Nitroglycerin	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	NA	NA	0.26 UJ
PETN	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ	NA	NA	1.214 UJ
RDX	0.32 J	15 J	0.19 J	0.246 UJ	0.53 J	NA	NA	0.246 UJ
Tetryl	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	NA	NA	0.266 UJ
METALS (UG/L)								
Arsenic	1.4	4.9	5.5	1.9	2.6	NA	NA	11
Barium	34.2	39.4 J	16.4	40	86.6 J	NA	NA	82 J
Cadmium	0.9	3.6	4.7	0.59	1.3	NA	NA	7.1
Chromium	4	6.5	6.6	5	7.7	90.8 J	NA	19.3
Hexavalent Chromium	NA	NA	NA	NA	NA	NA	NA	
Lead	3.2	14.6 J	21.4	7.5	11.5 J	NA	NA	49.7 J
Mercury	0.18 U	0.12 U	0.14 U	0.19 U	0.29 U	NA	NA	0.14 U
Selenium	0.45 J	5.3	3.5	1.7	0.41 J	NA	NA	8.1
Silver	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	NA	NA	0.06 U
MISCELLANEOUS PARAMETERS (UG/L)								
Perchlorate	0.25 J	5.9 J	0.4 UJ	0.4 UJ	0.4 UJ	NA	NA	0.44 J

TABLE C-3

COMPLETE ANALYTICAL RESULTS DATA SET FOR SETTLING BASIN AND STREAM SEDIMENTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA
PAGE 1 OF 3

LOCATION	22SD/SW001	22SD/SW002	22SD/SW003	22SD/SW004	22SD/SW005	22SD/SW006	
SAMPLE ID	22SD0010006	22SD0020006	22SD0030006	22SD0040006	22SD0050006	22SD0060006	22SD0060624
SAMPLE DATE	20110120	20110120	20110120	20110120	20110120	20110118	20110118
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	SD	SD	SD	SD	SD	SD	SD
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	SD	SD	SD	SD	SD	SD	SD
TOP DEPTH	0	0	0	0	0	0	0.5
BOTTOM DEPTH	0.5	0.5	0.5	0.5	0.5	0.5	2
EXPLOSIVES (MG/KG)							
1,3,5-Trinitrobenzene	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-Dinitrobenzene	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-Trinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-Amino-4,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-Nitrotoluene	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-Nitrotoluene	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-Amino-2,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-Nitrotoluene	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Nitrobenzene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Nitroglycerin	NA	NA	NA	NA	NA	NA	NA
PETN	NA	NA	NA	NA	NA	NA	NA
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Tetryl	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)							
Arsenic	6.1 J	5.2 J	3.8 J	2.4 J	1.8 J	1.7 J	1.6 J
Barium	34.8 J	17 J	173 J	27.1 J	18.9 J	25 J	17.9 J
Cadmium	0.31 J	0.11 J	0.2 J	0.1 J	0.16 J	0.88 J	0.071 J
Chromium	12.4 J	13.2 J	13.9 J	4.5 J	3.2 J	4.7 J	4 J
Lead	9 J	6.2 J	7.6 J	5.6 J	4.7 J	11.3 J	4 J
Mercury	0.03 U	0.033 U	0.037 U	0.054 U	0.045 U	0.041 U	0.04 U
Selenium	0.21 J	0.11 J	0.11 J	0.14 J	0.083 J	0.1 J	0.061 J
Silver	0.025 J	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.02 J	0.04 UJ
MISCELLANEOUS PARAMETERS (%)							
Percent Moisture	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)							
Total Organic Carbon	11000	1200	2900	13000	31000	10000	2000
MISCELLANEOUS PARAMETERS (S.U.)							
pH	NA	NA	NA	NA	NA	6.6	7.3

TABLE C-3

COMPLETE ANALYTICAL RESULTS DATA SET FOR SETTLING BASIN AND STREAM SEDIMENTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SD/SW007		22SD/SW008		22SD/SW009	22SD/SW010	
SAMPLE ID	22SD0070006	22SD0070624	22SD0080006	22SD0080624	22SD0090006	22SD0100006	22SD0100006_2012
SAMPLE DATE	20110118	20110118	20110118	20110118	20110120	20110120	20120512
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	ORIG	NORMAL	NORMAL
MATRIX	SD	SD	SD	SD	SD	SD	SD
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	SD	SD	SD	SD	SD	SD	SD
TOP DEPTH	0	0.5	0	0.5	0	0	0
BOTTOM DEPTH	0.5	2	0.5	2	0.5	0.5	0.5
EXPLOSIVES (MG/KG)							
1,3,5-Trinitrobenzene	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U	NA
1,3-Dinitrobenzene	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U	NA
2,4,6-Trinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	NA
2,4-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	NA
2,6-Dinitrotoluene	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U	NA
2-Amino-4,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	NA
2-Nitrotoluene	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U	NA
3-Nitrotoluene	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U	NA
4-Amino-2,6-Dinitrotoluene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	NA
4-Nitrotoluene	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	NA
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	NA
Nitrobenzene	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	NA
Nitroglycerin	NA	NA	NA	NA	NA	NA	0.17 U
PETN	NA	NA	NA	NA	NA	NA	1.158 U
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	NA
Tetryl	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U	NA
METALS (MG/KG)							
Arsenic	2.7 J	1.6 J	5.6 J	5.1 J	2.2 J	2 J	NA
Barium	23.2 J	19.6 J	41.1 J	46.1 J	16.7 J	8.6 J	NA
Cadmium	0.15 J	0.51 J	0.24 J	0.13 J	0.24 J	0.37 J	NA
Chromium	3.7 J	2.9 J	10.4 J	11.4 J	3.8 J	2.5 J	NA
Lead	8.8 J	8.3 J	14.8 J	20 J	7.2 J	7.9 J	NA
Mercury	0.034 U	0.039 U	0.045 U	0.056 U	0.26	0.051 U	NA
Selenium	0.11 J	0.12 J	0.22 J	0.19 J	0.1 J	0.044 J	NA
Silver	0.04 UJ	0.04 UJ	0.02 J	0.04 UJ	0.04 UJ	0.04 UJ	NA
MISCELLANEOUS PARAMETERS (%)							
Percent Moisture	NA	NA	NA	NA	NA	NA	44.1
MISCELLANEOUS PARAMETERS (MG/							
Total Organic Carbon	8300	5500	18000	2100	18000	8800	29000
MISCELLANEOUS PARAMETERS (S.U.							
pH	NA	NA	NA	NA	NA	NA	NA

TABLE C-3

COMPLETE ANALYTICAL RESULTS DATA SET FOR SETTLING BASIN AND STREAM SEDIMENTS
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SD/SW011	22SD/SW017	22SD/SW018		22SD/SW023	22SD/SW024	22SD/SW026
SAMPLE ID	22SD0110006	22SD0170006	22SD0180006	22SD0180006_2012	22SD0230006	22SD0240006	22SD0260006
SAMPLE DATE	20110120	20120511	20110409	20120512	20120511	20120511	20120511
SAMPLE CODE	NORMAL	NORMAL	ORIG	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	SD	SD	SD	SD	SD	SD	SD
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	UPSTREAM SD	SD	SD	SD	SD	SD	SD
TOP DEPTH	0	0	0	0	0	0	0
BOTTOM DEPTH	0.5	0.5	0.5	0.5	0.5	0.5	0.5
EXPLOSIVES (MG/KG)							
1,3,5-Trinitrobenzene	0.158 U	NA	0.158 U	NA	0.158 U	0.158 U	0.88
1,3-Dinitrobenzene	0.126 U	NA	0.126 U	NA	0.126 U	0.126 U	0.126 U
2,4,6-Trinitrotoluene	0.166 U	NA	0.166 U	NA	0.166 U	0.166 U	2100
2,4-Dinitrotoluene	0.166 U	NA	0.166 U	NA	0.166 U	0.166 U	0.27 J
2,6-Dinitrotoluene	0.166 U	NA	0.166 U	NA	0.166 U	0.166 U	0.166 U
2-Amino-4,6-Dinitrotoluene	0.15 U	NA	0.15 U	NA	0.15 U	0.15 U	0.15 U
2-Nitrotoluene	0.132 U	NA	0.132 U	NA	0.132 U	0.132 U	0.132 U
3-Nitrotoluene	0.142 U	NA	0.142 U	NA	0.142 U	0.142 U	0.142 U
4-Amino-2,6-Dinitrotoluene	0.15 U	NA	0.15 U	NA	0.15 U	0.15 U	46 J
4-Nitrotoluene	0.16 U	NA	0.16 U	NA	0.16 U	0.16 U	0.16 U
HMX	0.16 U	NA	0.16 U	NA	0.16 U	0.16 U	0.16 U
Nitrobenzene	0.15 U	NA	0.15 U	NA	0.15 U	0.15 U	0.15 U
Nitroglycerin	NA	0.17 U	NA	0.17 U	0.17 U	0.17 U	0.17 U
PETN	NA	1.158 U	NA	1.158 U	1.158 U	1.158 U	1.158 U
RDX	0.16 U	NA	0.16 U	NA	0.16 U	0.16 U	0.16 U
Tetryl	0.182 U	NA	0.182 U	NA	0.182 U	0.182 U	0.182 U
METALS (MG/KG)							
Arsenic	12.3 J	5.5	1.2 J	NA	14.7	5.9	5.6
Barium	38.3 J	42.1	12.8 J	NA	67.4	43.2	515
Cadmium	0.26 J	0.28	0.24 J	NA	0.36	0.22	0.43
Chromium	16.2 J	10	2.8 J	NA	11.3	11.9	16.5
Lead	11.3 J	11.3	12.1 J	NA	16.3	9.4	181
Mercury	0.049 U	0.086 J	0.038 J	NA	0.073 J	0.047 J	0.99
Selenium	0.19 J	0.42	0.17 J	NA	0.61	0.33	0.4
Silver	0.04 UJ	0.04 U	0.04 UJ	NA	0.04 U	0.04 U	0.025 J
MISCELLANEOUS PARAMETERS (%)							
Percent Moisture	NA	31.1	NA	21.4	25.7	21.6	19.3
MISCELLANEOUS PARAMETERS (MG/							
Total Organic Carbon	2800	670	6900 J	39000	14000	6400	NA
MISCELLANEOUS PARAMETERS (S.U.							
pH	NA	NA	NA	NA	6.1	NA	NA

TABLE C-4

COMPLETE ANALYTICAL RESULTS DATA SET FOR SURFACE WATER
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SD/SW001	22SD/SW002	22SD/SW003	22SD/SW004	22SD/SW006	22SD/SW007	22SD/SW009
SAMPLE ID	22SW001	22SW002	22SW003	22SW004	22SW006	22SW007	22SW009
SAMPLE DATE	20110120	20110120	20110120	20110120	20110118	20110118	20110120
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	ORIG
MATRIX	SW	SW	SW	SW	SW	SW	SW
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	NA	NA	NA	NA	NA	NA	NA
TOP DEPTH	-9999	-9999	-9999	-9999	-9999	-9999	-9999
BOTTOM DEPTH	-9999	-9999	-9999	-9999	-9999	-9999	-9999
DISSOLVED METALS (UG/L)							
ARSENIC	0.18 U	0.18 U	0.18 U	0.18 U	0.19 J	0.23 J	0.23 J
Barium	68	68.4	73.9	26	36 J	53.8 J	34.5 J
Cadmium	0.04 U	0.04 U	0.04 U	0.04 U	0.24 J	0.26 J	0.04 U
Chromium	0.5	0.39 J	0.92	0.75	0.29 J	0.28 J	0.31 J
Lead	0.22 U	0.22 U	2.2	0.22 U	0.37 J	0.69 J	0.11 J
Mercury	0.12 U	0.12 U	0.12 U	0.068 J	0.12 U	0.067 J	0.12 U
Selenium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 UJ	0.2 UJ
Silver	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.067 J	0.057 J	0.06 UJ
EXPLOSIVES (UG/L)							
1,3,5-Trinitrobenzene	0.26 U	0.26 U	0.26 U	0.26 U	0.52 U	0.52 U	0.26 U
1,3-Dinitrobenzene	0.262 U	0.262 U	0.262 U	0.262 U	0.52 U	0.52 U	0.262 U
2,4,6-Trinitrotoluene	0.266 U	0.266 U	0.266 U	0.266 U	0.52 U	0.52 U	0.266 U
2,4-Dinitrotoluene	0.25 U	0.25 U	0.25 U	0.25 U	0.52 U	0.52 U	0.25 U
2,6-Dinitrotoluene	0.25 U	0.25 U	0.25 U	0.25 U	0.52 U	0.52 U	0.25 U
2-Amino-4,6-Dinitrotoluene	0.25 U	0.25 U	0.25 U	0.25 U	0.52 U	0.52 U	0.25 U
2-Nitrotoluene	0.252 U	0.252 U	0.252 U	0.252 U	0.52 U	0.52 U	0.252 U
3-Nitrotoluene	0.266 U	0.266 U	0.266 U	0.266 U	0.52 U	0.52 U	0.266 U
4-Amino-2,6-Dinitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	0.4 U	0.2 U
4-Nitrotoluene	0.266 U	0.266 U	0.266 U	0.266 U	0.52 U	0.52 U	0.266 U
HMX	0.82	0.79	0.87	0.23 U	0.48 U	0.48 U	0.15 J
Nitrobenzene	0.252 U	0.252 U	0.252 U	0.252 U	0.52 U	0.52 U	0.252 U
Nitroglycerin	NA	NA	NA	NA	NA	NA	NA
PETN	NA	NA	NA	NA	NA	NA	NA
RDX	0.78	0.75	0.82	0.246 U	0.48 U	0.48 U	0.39 J
Tetryl	0.266 U	0.266 U	0.266 U	0.266 U	0.52 U	0.52 U	0.266 U
METALS (UG/L)							
Arsenic	0.18 U	0.18 U	0.18 U	1.5	0.38	0.18 U	0.46 J
Barium	69	69.2	74.8	57.7	45.9	54.3	36.9 J
Cadmium	0.04 U	0.04 U	0.04 U	0.04 U	0.5	0.24	0.073 U
Chromium	0.55	0.48 J	0.43 J	3	1.5	0.47 J	0.4 J
Lead	0.22 U	0.22 U	0.11 J	6.1	9.6	1.8	1 J
Mercury	0.12 U	0.12 U	0.12 U	0.12 U	0.065 J	0.12 U	0.089 J
Selenium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.1 J
Silver	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.032 J
MISCELLANEOUS PARAMETERS (S.U.)							
pH	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/L)							
Perchlorate	0.4 U	0.4 J	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U

TABLE C-4

COMPLETE ANALYTICAL RESULTS DATA SET FOR SURFACE WATER
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SD/SW010		22SD/SW011	22SD/SW012	22SD/SW013	22SD/SW014	22SD/SW015	22SD/SW016
SAMPLE ID	22SW010	22SW010_2012051	22SW011	22SW012	22SW013	22SW014	22SW015	22SW016
SAMPLE DATE	20110120	20120512	20110120	20110409	20110409	20110409	20110409	20110409
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	SW	SW	UPSTREAM SW	UPSTREAM SW	UPSTREAM SW	UPSTREAM SW	UPSTREAM SW	UPSTREAM SW
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	NA	NA	NA	NA	NA	NA	NA	NA
TOP DEPTH	-9999	-9999	-9999	-9999	-9999	-9999	-9999	-9999
BOTTOM DEPTH	-9999	-9999	-9999	-9999	-9999	-9999	-9999	-9999
DISSOLVED METALS (UG/L)								
ARSENIC	0.2 J	NA	0.44 J	NA	NA	NA	NA	NA
Barium	34.4 J	NA	77.4 J	NA	NA	NA	NA	NA
Cadmium	0.043 U	NA	0.04 UJ	NA	NA	NA	NA	NA
Chromium	0.27 J	NA	0.46 J	NA	NA	NA	NA	NA
Lead	0.22 UJ	NA	0.12 J	NA	NA	NA	NA	NA
Mercury	0.12 U	NA	0.084 J	NA	NA	NA	NA	NA
Selenium	0.2 UJ	NA	0.28 J	NA	NA	NA	NA	NA
Silver	0.06 UJ	NA	0.06 UJ	NA	NA	NA	NA	NA
EXPLOSIVES (UG/L)								
1,3,5-Trinitrobenzene	0.26 U	NA	0.26 U	NA	NA	NA	NA	NA
1,3-Dinitrobenzene	0.262 U	NA	0.262 U	NA	NA	NA	NA	NA
2,4,6-Trinitrotoluene	0.266 U	NA	0.266 U	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	0.25 U	NA	0.25 U	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	0.25 U	NA	0.25 U	NA	NA	NA	NA	NA
2-Amino-4,6-Dinitrotoluene	0.25 U	NA	0.25 U	NA	NA	NA	NA	NA
2-Nitrotoluene	0.252 U	NA	0.252 U	NA	NA	NA	NA	NA
3-Nitrotoluene	0.266 U	NA	0.266 U	NA	NA	NA	NA	NA
4-Amino-2,6-Dinitrotoluene	0.2 U	NA	0.2 U	NA	NA	NA	NA	NA
4-Nitrotoluene	0.266 U	NA	0.266 U	NA	NA	NA	NA	NA
HMX	0.23 J	NA	0.88	0.23 U	11	0.23 U	0.23 U	0.23 U
Nitrobenzene	0.252 U	NA	0.252 U	NA	NA	NA	NA	NA
Nitroglycerin	NA	0.26 U	NA	NA	NA	NA	NA	NA
PETN	NA	1.214 U	NA	NA	NA	NA	NA	NA
RDX	0.55	NA	0.79	0.246 U	0.98	0.246 U	0.246 U	0.246 U
Tetryl	0.266 U	NA	0.266 U	NA	NA	NA	NA	NA
METALS (UG/L)								
Arsenic	0.49 J	NA	0.41	NA	NA	NA	NA	NA
Barium	36.1 J	NA	76.5	NA	NA	NA	NA	NA
Cadmium	0.083 U	NA	0.04 U	NA	NA	NA	NA	NA
Chromium	0.43 J	NA	0.45 J	NA	NA	NA	NA	NA
Lead	0.86 J	NA	0.22 U	NA	NA	NA	NA	NA
Mercury	0.12 U	NA	0.12 U	NA	NA	NA	NA	NA
Selenium	0.2 UJ	NA	0.24 J	NA	NA	NA	NA	NA
Silver	0.06 UJ	NA	0.06 UJ	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (S.U								
pH	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/								
Perchlorate	0.4 U	NA	0.4 U	NA	NA	NA	NA	NA

TABLE C-4

COMPLETE ANALYTICAL RESULTS DATA SET FOR SURFACE WATER
SWMU22 – LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

LOCATION	22SD/SW017		22SD/SW018	22SD/SW019	22SD/SW020	22SD/SW021	22SD/SW023	22SD/SW024
SAMPLE ID	22SW017	22SW017_2012051	22SW018	22SW019	22SW020	22SW021	22SW023	22SW024
SAMPLE DATE	20110409	20120511	20110409	20110409	20110409	20110409	20120511	20120511
SAMPLE CODE	NORMAL	NORMAL	ORIG	NORMAL	NORMAL	NORMAL	NORMAL	ORIG
MATRIX	SW	SW	SW	SW	SW	SW	SW	SW
SAMPLE TYPE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX	NA	NA	NA	NA	NA	NA	NA	NA
TOP DEPTH	-9999	-9999	-9999	-9999	-9999	-9999	-9999	-9999
BOTTOM DEPTH	-9999	-9999	-9999	-9999	-9999	-9999	-9999	-9999
DISSOLVED METALS (UG/L)								
ARSENIC	NA	NA	0.35	NA	NA	NA	NA	NA
Barium	NA	NA	27.1 J	NA	NA	NA	NA	NA
Cadmium	NA	NA	0.066 J	NA	NA	NA	NA	NA
Chromium	NA	NA	0.37 J	NA	NA	NA	NA	NA
Lead	NA	NA	0.22 U	NA	NA	NA	NA	NA
Mercury	NA	NA	0.12 U	NA	NA	NA	NA	NA
Selenium	NA	NA	0.2 UJ	NA	NA	NA	NA	NA
Silver	NA	NA	0.06 U	NA	NA	NA	NA	NA
EXPLOSIVES (UG/L)								
1,3,5-Trinitrobenzene	NA	NA	0.26 U	NA	NA	NA	0.26 U	0.26 U
1,3-Dinitrobenzene	NA	NA	0.262 U	NA	NA	NA	0.262 U	0.262 U
2,4,6-Trinitrotoluene	NA	NA	0.266 U	NA	NA	NA	0.266 U	0.266 U
2,4-Dinitrotoluene	NA	NA	0.25 U	NA	NA	NA	0.25 U	0.25 U
2,6-Dinitrotoluene	NA	NA	0.25 U	NA	NA	NA	0.25 U	0.25 U
2-Amino-4,6-Dinitrotoluene	NA	NA	0.25 U	NA	NA	NA	0.25 U	0.25 U
2-Nitrotoluene	NA	NA	0.252 U	NA	NA	NA	0.252 U	0.252 U
3-Nitrotoluene	NA	NA	0.266 U	NA	NA	NA	0.266 U	0.266 U
4-Amino-2,6-Dinitrotoluene	NA	NA	0.2 U	NA	NA	NA	0.2 U	0.2 U
4-Nitrotoluene	NA	NA	0.266 U	NA	NA	NA	0.266 U	0.266 U
HMX	0.61	NA	0.63	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U
Nitrobenzene	NA	NA	0.252 U	NA	NA	NA	0.252 U	0.252 U
Nitroglycerin	NA	0.26 U	NA	NA	NA	NA	0.26 U	0.26 U
PETN	NA	1.214 U	NA	NA	NA	NA	1.214 U	1.214 U
RDX	2.5	NA	1.5	0.246 U	0.246 U	0.246 U	0.246 U	0.246 U
Tetryl	NA	NA	0.266 U	NA	NA	NA	0.266 U	0.266 U
METALS (UG/L)								
Arsenic	NA	0.18 J	0.72	NA	NA	NA	0.29	0.62
Barium	NA	67.1	26.4	NA	NA	NA	57.5	66.6
Cadmium	NA	0.29 J	0.25	NA	NA	NA	0.23 J	1.7 J
Chromium	NA	0.51	1	NA	NA	NA	0.72	1.1
Lead	NA	0.22 U	6 J	NA	NA	NA	0.22 U	4.4
Mercury	NA	0.1 J	0.12 U	NA	NA	NA	0.068 J	0.097 J
Selenium	NA	0.12 J	0.17 J	NA	NA	NA	0.11 J	0.56 J
Silver	NA	0.06 U	0.06 U	NA	NA	NA	0.19 U	0.06 U
MISCELLANEOUS PARAMETERS (S.U.								
pH	NA	NA	NA	NA	NA	NA	6.3	NA
MISCELLANEOUS PARAMETERS (UG/								
Perchlorate	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX D

ANALYTICAL DATA - FULL TABLES

GROUNDWATER

LOCATION SAMPLE ID SAMPLE DATE	22MWT01 22GWT001 5/22/2012	22MWT02 22GWT002 5/22/2012	22MWT02 22GWT002-D 5/22/2012	22MWT03 22GWT003 5/23/2012	22MWT04 22GWT004 5/23/2012
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
1,3-DINITROBENZENE	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ
2,4,6-TRINITROTOLUENE	0.266 UJ	0.47 J	0.49 J	0.266 UJ	0.266 UJ
2,4-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	0.250 UJ
2,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	0.250 UJ
2-AMINO-4,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	0.250 UJ
2-NITROTOLUENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ
3-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ
4-AMINO-2,6-DINITROTOLUENE	0.2 UJ	0.11 J	0.11 J	0.2 UJ	0.2 UJ
4-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ
HMX	0.230 UJ	1.1 J	1.2 J	0.230 UJ	0.230 UJ
NITROBENZENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ
NITROGLYCERIN	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
PETN	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ
RDX	0.32 J	15 J	15 J	0.19 J	0.246 UJ
TETRYL	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ
METALS (UG/L)					
ARSENIC	1.4	4.9	4.8	5.5	1.9
BARIUM	34.2	39.4 J	36.7 J	16.4	40
CADMIUM	0.9	3.6	3.6	4.7	0.59
CHROMIUM	4	6.5	5.6	6.6	5
LEAD	3.2	14.6 J	14.7 J	21.4	7.5
MERCURY	0.18 U	0.12 U	0.2 U	0.14 U	0.19 U
SELENIUM	0.45 J	5.3	5.1	3.5	1.7
SILVER	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
DISSOLVED METALS (UG/L)					
ARSENIC	0.44	3.2	3.1	--	1.4
BARIUM	23.6	25.2	24.6	--	27.1
CADMIUM	0.99	2.9	2.7	--	0.45
CHROMIUM	0.59	3	2.8	--	1.2
LEAD	0.72	10.6 J	9.9 J	--	6.6
MERCURY	0.12 U	0.12 U	0.12 U	--	0.12 U
SELENIUM	0.56 J	3.5	3.3	--	1.9
SILVER	0.06 U	0.06 U	0.06 U	--	0.06 U
MISCELLANEOUS PARAMETERS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--

GROUNDWATER

LOCATION SAMPLE ID SAMPLE DATE	22MWT01 22GWT001 5/22/2012	22MWT02 22GWT002 5/22/2012	22MWT02 22GWT002-D 5/22/2012	22MWT03 22GWT003 5/23/2012	22MWT04 22GWT004 5/23/2012
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--
PERCHLORATE (UG/L)	0.25 J	5.9 J	6.1 J	0.4 UJ	0.4 UJ
FILTERED MISCELLANEOUS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--

GROUNDWATER Footnotes:

-- = The chemical was not analyzed or no value was available.

Data Qualifiers:

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GROUNDWATER

LOCATION	22MWT01	22MWT02	22MWT02	22MWT03	22MWT05
SAMPLE ID	22GWT001	22GWT002	22GWT002-D	22GWT003	22GWT005
SAMPLE DATE	5/22/2012	5/22/2012	5/22/2012	5/23/2012	5/21/2012
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
1,3-DINITROBENZENE	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ
2,4,6-TRINITROTOLUENE	0.266 UJ	0.47 J	0.49 J	0.266 UJ	0.266 UJ
2,4-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	0.25 UJ
2,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	0.25 UJ
2-AMINO-4,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	0.25 UJ
2-NITROTOLUENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ
3-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ
4-AMINO-2,6-DINITROTOLUENE	0.2 UJ	0.11 J	0.11 J	0.2 UJ	0.20 UJ
4-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ
HMX	0.230 UJ	1.1 J	1.2 J	0.230 UJ	0.23 UJ
NITROBENZENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ
NITROGLYCERIN	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
PETN	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ
RDX	0.32 J	15 J	15 J	0.19 J	0.53 J
TETRYL	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ
METALS (UG/L)					
ARSENIC	1.4	4.9	4.8	5.5	2.6
BARIUM	34.2	39.4 J	36.7 J	16.4	86.6 J
CADMIUM	0.9	3.6	3.6	4.7	1.3
CHROMIUM	4	6.5	5.6	6.6	7.7
LEAD	3.2	14.6 J	14.7 J	21.4	11.5 J
MERCURY	0.18 U	0.12 U	0.2 U	0.14 U	0.29 U
SELENIUM	0.45 J	5.3	5.1	3.5	0.41 J
SILVER	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
DISSOLVED METALS (UG/L)					
ARSENIC	0.44	3.2	3.1	--	0.45
BARIUM	23.6	25.2	24.6	--	55.6
CADMIUM	0.99	2.9	2.7	--	1.3
CHROMIUM	0.59	3	2.8	--	2.3
LEAD	0.72	10.6 J	9.9 J	--	4.2 J
MERCURY	0.12 U	0.12 U	0.12 U	--	0.18 U
SELENIUM	0.56 J	3.5	3.3	--	0.24 J
SILVER	0.06 U	0.06 U	0.06 U	--	0.06 U
MISCELLANEOUS PARAMETERS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--

GROUNDWATER

LOCATION	22MWT01	22MWT02	22MWT02	22MWT03	22MWT05
SAMPLE ID	22GWT001	22GWT002	22GWT002-D	22GWT003	22GWT005
SAMPLE DATE	5/22/2012	5/22/2012	5/22/2012	5/23/2012	5/21/2012
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--
PERCHLORATE (UG/L)	0.25 J	5.9 J	6.1 J	0.4 UJ	0.40 UJ
FILTERED MISCELLANEOUS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--

GROUNDWATER Footnotes:

-- = The chemical was not analyzed or no value was available.

Data Qualifiers:

Blank (i.e., no qualifier) = the chemical was detected.

J = The chemical was detected but the concentration reported is an estimated value.

U = The chemical was not detected.

UJ = The chemical was not detected but the value reported is estimated.

GROUNDWATER

LOCATION SAMPLE ID SAMPLE DATE	22MWT01 22GWT001 5/22/2012	22MWT02 22GWT002 5/22/2012	22MWT02 22GWT002-D 5/22/2012	22MWT03 22GWT003 5/23/2012	22MWT05 22GWT005_20130123 1/23/2013
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	--
1,3-DINITROBENZENE	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ	--
2,4,6-TRINITROTOLUENE	0.266 UJ	0.47 J	0.49 J	0.266 UJ	--
2,4-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	--
2,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	--
2-AMINO-4,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	--
2-NITROTOLUENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	--
3-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	--
4-AMINO-2,6-DINITROTOLUENE	0.2 UJ	0.11 J	0.11 J	0.2 UJ	--
4-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	--
HMX	0.230 UJ	1.1 J	1.2 J	0.230 UJ	--
NITROBENZENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	--
NITROGLYCERIN	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	--
PETN	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ	--
RDX	0.32 J	15 J	15 J	0.19 J	--
TETRYL	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	--
METALS (UG/L)					
ARSENIC	1.4	4.9	4.8	5.5	--
BARIUM	34.2	39.4 J	36.7 J	16.4	--
CADMIUM	0.9	3.6	3.6	4.7	--
CHROMIUM	4	6.5	5.6	6.6	90.8 J
LEAD	3.2	14.6 J	14.7 J	21.4	--
MERCURY	0.18 U	0.12 U	0.2 U	0.14 U	--
SELENIUM	0.45 J	5.3	5.1	3.5	--
SILVER	0.06 U	0.06 U	0.06 U	0.06 U	--
DISSOLVED METALS (UG/L)					
ARSENIC	0.44	3.2	3.1	--	--
BARIUM	23.6	25.2	24.6	--	--
CADMIUM	0.99	2.9	2.7	--	--
CHROMIUM	0.59	3	2.8	--	1.5 U
LEAD	0.72	10.6 J	9.9 J	--	--
MERCURY	0.12 U	0.12 U	0.12 U	--	--
SELENIUM	0.56 J	3.5	3.3	--	--
SILVER	0.06 U	0.06 U	0.06 U	--	--
MISCELLANEOUS PARAMETERS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	0.01 U
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	641
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	3.46

GROUNDWATER

LOCATION SAMPLE ID SAMPLE DATE	22MWT01 22GWT001 5/22/2012	22MWT02 22GWT002 5/22/2012	22MWT02 22GWT002-D 5/22/2012	22MWT03 22GWT003 5/23/2012	22MWT05 22GWT005_20130123 1/23/2013
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--
PERCHLORATE (UG/L)	0.25 J	5.9 J	6.1 J	0.4 UJ	--
FILTERED MISCELLANEOUS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	0.01 U
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	635
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	3.46
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--

GROUNDWATER Footnotes:

-- = The chemical was not analyzed or no value was available.

Data Qualifiers:

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J = The chemical was detected but the concentration reported is an estimated value.

U = The chemical was not detected.

UJ = The chemical was not detected but the value reported is estimated.

GROUNDWATER

LOCATION	22MWT01	22MWT02	22MWT02	22MWT03	22MWT05
SAMPLE ID	22GWT001	22GWT002	22GWT002-D	22GWT003	22GWT005_20130123-D
SAMPLE DATE	5/22/2012	5/22/2012	5/22/2012	5/23/2012	1/23/2013
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	--
1,3-DINITROBENZENE	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ	--
2,4,6-TRINITROTOLUENE	0.266 UJ	0.47 J	0.49 J	0.266 UJ	--
2,4-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	--
2,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	--
2-AMINO-4,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	--
2-NITROTOLUENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	--
3-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	--
4-AMINO-2,6-DINITROTOLUENE	0.2 UJ	0.11 J	0.11 J	0.2 UJ	--
4-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	--
HMX	0.230 UJ	1.1 J	1.2 J	0.230 UJ	--
NITROBENZENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	--
NITROGLYCERIN	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	--
PETN	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ	--
RDX	0.32 J	15 J	15 J	0.19 J	--
TETRYL	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	--
METALS (UG/L)					
ARSENIC	1.4	4.9	4.8	5.5	--
BARIUM	34.2	39.4 J	36.7 J	16.4	--
CADMIUM	0.9	3.6	3.6	4.7	--
CHROMIUM	4	6.5	5.6	6.6	19.8 J
LEAD	3.2	14.6 J	14.7 J	21.4	--
MERCURY	0.18 U	0.12 U	0.2 U	0.14 U	--
SELENIUM	0.45 J	5.3	5.1	3.5	--
SILVER	0.06 U	0.06 U	0.06 U	0.06 U	--
DISSOLVED METALS (UG/L)					
ARSENIC	0.44	3.2	3.1	--	--
BARIUM	23.6	25.2	24.6	--	--
CADMIUM	0.99	2.9	2.7	--	--
CHROMIUM	0.59	3	2.8	--	1.6 U
LEAD	0.72	10.6 J	9.9 J	--	--
MERCURY	0.12 U	0.12 U	0.12 U	--	--
SELENIUM	0.56 J	3.5	3.3	--	--
SILVER	0.06 U	0.06 U	0.06 U	--	--
MISCELLANEOUS PARAMETERS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	0.01 U
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	662
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	3.52

GROUNDWATER

LOCATION SAMPLE ID SAMPLE DATE	22MWT01 22GWT001 5/22/2012	22MWT02 22GWT002 5/22/2012	22MWT02 22GWT002-D 5/22/2012	22MWT03 22GWT003 5/23/2012	22MWT05 22GWT005_20130123-D 1/23/2013
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--
PERCHLORATE (UG/L)	0.25 J	5.9 J	6.1 J	0.4 UJ	--
FILTERED MISCELLANEOUS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	0.01 U
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	639
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	3.48
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--

GROUNDWATER Footnotes:

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GROUNDWATER

LOCATION	22MWT01	22MWT02	22MWT02	22MWT03	22MWT05
SAMPLE ID	22GWT001	22GWT002	22GWT002-D	22GWT003	22GWT005_20130416
SAMPLE DATE	5/22/2012	5/22/2012	5/22/2012	5/23/2012	4/16/2013
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	--
1,3-DINITROBENZENE	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ	--
2,4,6-TRINITROTOLUENE	0.266 UJ	0.47 J	0.49 J	0.266 UJ	--
2,4-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	--
2,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	--
2-AMINO-4,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	--
2-NITROTOLUENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	--
3-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	--
4-AMINO-2,6-DINITROTOLUENE	0.2 UJ	0.11 J	0.11 J	0.2 UJ	--
4-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	--
HMX	0.230 UJ	1.1 J	1.2 J	0.230 UJ	--
NITROBENZENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	--
NITROGLYCERIN	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	--
PETN	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ	--
RDX	0.32 J	15 J	15 J	0.19 J	--
TETRYL	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	--
METALS (UG/L)					
ARSENIC	1.4	4.9	4.8	5.5	--
BARIUM	34.2	39.4 J	36.7 J	16.4	--
CADMIUM	0.9	3.6	3.6	4.7	--
CHROMIUM	4	6.5	5.6	6.6	1 U
LEAD	3.2	14.6 J	14.7 J	21.4	--
MERCURY	0.18 U	0.12 U	0.2 U	0.14 U	--
SELENIUM	0.45 J	5.3	5.1	3.5	--
SILVER	0.06 U	0.06 U	0.06 U	0.06 U	--
DISSOLVED METALS (UG/L)					
ARSENIC	0.44	3.2	3.1	--	--
BARIUM	23.6	25.2	24.6	--	--
CADMIUM	0.99	2.9	2.7	--	--
CHROMIUM	0.59	3	2.8	--	1 U
LEAD	0.72	10.6 J	9.9 J	--	--
MERCURY	0.12 U	0.12 U	0.12 U	--	--
SELENIUM	0.56 J	3.5	3.3	--	--
SILVER	0.06 U	0.06 U	0.06 U	--	--
MISCELLANEOUS PARAMETERS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	623
TURBIDITY (NTU)	--	--	--	--	1.8
PH (S.U.)	--	--	--	--	3.79

GROUNDWATER

LOCATION	22MWT01	22MWT02	22MWT02	22MWT03	22MWT05
SAMPLE ID	**22GWT001**	**22GWT002**	**22GWT002-D**	**22GWT003**	**22GWT005_20130416**
SAMPLE DATE	**5/22/2012**	**5/22/2012**	**5/22/2012**	**5/23/2012**	**4/16/2013**
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	0.046
PERCHLORATE (UG/L)	0.25 J	5.9 J	6.1 J	0.4 UJ	--
FILTERED MISCELLANEOUS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	616
TURBIDITY (NTU)	--	--	--	--	1 U
PH (S.U.)	--	--	--	--	3.61
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	0.034

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GROUNDWATER

LOCATION SAMPLE ID SAMPLE DATE	22MWT01 22GWT001 5/22/2012	22MWT02 22GWT002 5/22/2012	22MWT02 22GWT002-D 5/22/2012	22MWT03 22GWT003 5/23/2012	22MWT06 22GWT006 5/21/2012
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
1,3-DINITROBENZENE	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ	0.262 UJ
2,4,6-TRINITROTOLUENE	0.266 UJ	0.47 J	0.49 J	0.266 UJ	0.266 UJ
2,4-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	0.25 UJ
2,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	0.25 UJ
2-AMINO-4,6-DINITROTOLUENE	0.250 UJ	0.25 UJ	0.25 UJ	0.250 UJ	0.25 UJ
2-NITROTOLUENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ
3-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ
4-AMINO-2,6-DINITROTOLUENE	0.2 UJ	0.11 J	0.11 J	0.2 UJ	0.20 UJ
4-NITROTOLUENE	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ
HMX	0.230 UJ	1.1 J	1.2 J	0.230 UJ	0.23 UJ
NITROBENZENE	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ	0.252 UJ
NITROGLYCERIN	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
PETN	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ	1.214 UJ
RDX	0.32 J	15 J	15 J	0.19 J	0.246 UJ
TETRYL	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ	0.266 UJ
METALS (UG/L)					
ARSENIC	1.4	4.9	4.8	5.5	11
BARIUM	34.2	39.4 J	36.7 J	16.4	82 J
CADMIUM	0.9	3.6	3.6	4.7	7.1
CHROMIUM	4	6.5	5.6	6.6	19.3
LEAD	3.2	14.6 J	14.7 J	21.4	49.7 J
MERCURY	0.18 U	0.12 U	0.2 U	0.14 U	0.14 U
SELENIUM	0.45 J	5.3	5.1	3.5	8.1
SILVER	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
DISSOLVED METALS (UG/L)					
ARSENIC	0.44	3.2	3.1	--	3.3
BARIUM	23.6	25.2	24.6	--	28.5
CADMIUM	0.99	2.9	2.7	--	3.9
CHROMIUM	0.59	3	2.8	--	1.3
LEAD	0.72	10.6 J	9.9 J	--	7 J
MERCURY	0.12 U	0.12 U	0.12 U	--	0.12 U
SELENIUM	0.56 J	3.5	3.3	--	5.7
SILVER	0.06 U	0.06 U	0.06 U	--	0.06 U
MISCELLANEOUS PARAMETERS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--

GROUNDWATER

LOCATION	22MWT01	22MWT02	22MWT02	22MWT03	22MWT06
SAMPLE ID	22GWT001	22GWT002	22GWT002-D	22GWT003	22GWT006
SAMPLE DATE	5/22/2012	5/22/2012	5/22/2012	5/23/2012	5/21/2012
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--
PERCHLORATE (UG/L)	0.25 J	5.9 J	6.1 J	0.4 UJ	0.44 J
FILTERED MISCELLANEOUS					
HEXAVALENT CHROMIUM (MG/L)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
TURBIDITY (NTU)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--
HEXAVALENT CHROMIUM (UG/L)	--	--	--	--	--

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SEDIMENT

LOCATION SAMPLE ID SAMPLE DATE	22SD/SW001 22SD0010006 1/20/2011	22SD/SW002 22SD0020006 1/20/2011	22SD/SW003 22SD0030006 1/20/2011	22SD/SW004 22SD0040006 1/20/2011	22SD/SW005 22SD0050006 1/20/2011
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-DINITROBENZENE	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-NITROTOLUENE	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-NITROTOLUENE	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-NITROTOLUENE	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
NITROBENZENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
TETRYL	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)					
ARSENIC	6.1 J	5.2 J	3.8 J	2.4 J	1.8 J
BARIUM	34.8 J	17 J	173 J	27.1 J	18.9 J
CADMIUM	0.31 J	0.11 J	0.2 J	0.1 J	0.16 J
CHROMIUM	12.4 J	13.2 J	13.9 J	4.5 J	3.2 J
LEAD	9 J	6.2 J	7.6 J	5.6 J	4.7 J
MERCURY	0.03 U	0.033 U	0.037 U	0.054 U	0.045 U
SELENIUM	0.21 J	0.11 J	0.11 J	0.14 J	0.083 J
SILVER	0.025 J	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	--	--	--	--
TOTAL ORGANIC CARBON (MG/KG)	11000	1200	2900	13000	31000
PH (S.U.)	--	--	--	--	--

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SEDIMENT

LOCATION SAMPLE ID SAMPLE DATE	22SD/SW006 22SD0060006 1/18/2011	22SD/SW006 22SD0060624 1/18/2011	22SD/SW007 22SD0070006 1/18/2011	22SD/SW007 22SD0070624 1/18/2011	22SD/SW008 22SD0080006 1/18/2011
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-DINITROBENZENE	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-NITROTOLUENE	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-NITROTOLUENE	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-NITROTOLUENE	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
NITROBENZENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
TETRYL	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)					
ARSENIC	1.7 J	1.6 J	2.7 J	1.6 J	5.6 J
BARIUM	25 J	17.9 J	23.2 J	19.6 J	41.1 J
CADMIUM	0.88 J	0.071 J	0.15 J	0.51 J	0.24 J
CHROMIUM	4.7 J	4 J	3.7 J	2.9 J	10.4 J
LEAD	11.3 J	4 J	8.8 J	8.3 J	14.8 J
MERCURY	0.041 U	0.04 U	0.034 U	0.039 U	0.045 U
SELENIUM	0.1 J	0.061 J	0.11 J	0.12 J	0.22 J
SILVER	0.02 J	0.04 UJ	0.04 UJ	0.04 UJ	0.02 J
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	--	--	--	--
TOTAL ORGANIC CARBON (MG/KG)	10000	2000	8300	5500	18000
PH (S.U.)	6.6	7.3	--	--	--

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SEDIMENT

LOCATION SAMPLE ID SAMPLE DATE	22SD/SW008 22SD0080624 1/18/2011	22SD/SW009 22SD0090006 1/20/2011	22SD/SW009 22SD0090006-D 1/20/2011	22SD/SW010 22SD0100006 1/20/2011	22SD/SW010 22SD0100006_20120512 5/12/2012
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	0.158 U	0.158 U	0.158 U	--
1,3-DINITROBENZENE	0.126 U	0.126 U	0.126 U	0.126 U	--
2,4,6-TRINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	--
2,4-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	--
2,6-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	--
2-AMINO-4,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	--
2-NITROTOLUENE	0.132 U	0.132 U	0.132 U	0.132 U	--
3-NITROTOLUENE	0.142 U	0.142 U	0.142 U	0.142 U	--
4-AMINO-2,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	--
4-NITROTOLUENE	0.16 U	0.16 U	0.16 U	0.16 U	--
HMX	0.16 U	0.16 U	0.16 U	0.16 U	--
NITROBENZENE	0.15 U	0.15 U	0.15 U	0.15 U	--
NITROGLYCERIN	--	--	--	--	0.17 U
PETN	--	--	--	--	1.158 U
RDX	0.16 U	0.16 U	0.16 U	0.16 U	--
TETRYL	0.182 U	0.182 U	0.182 U	0.182 U	--
METALS (MG/KG)					
ARSENIC	5.1 J	2.2 J	5.2 J	2 J	--
BARIUM	46.1 J	16.7 J	35.1 J	8.6 J	--
CADMIUM	0.13 J	0.24 J	1.5 J	0.37 J	--
CHROMIUM	11.4 J	3.8 J	38.6 J	2.5 J	--
LEAD	20 J	7.2 J	53 J	7.9 J	--
MERCURY	0.056 U	0.26	0.052 U	0.051 U	--
SELENIUM	0.19 J	0.1 J	0.14 J	0.044 J	--
SILVER	0.04 UJ	0.04 UJ	0.073 U	0.04 UJ	--
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	--	--	--	44.1
TOTAL ORGANIC CARBON (MG/KG)	2100	18000	22000	8800	29000
PH (S.U.)	--	--	--	--	--

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SEDIMENT

LOCATION SAMPLE ID SAMPLE DATE	22SD/SW011 22SD0110006 1/20/2011	22SD/SW017 22SD0170006 5/11/2012	22SD/SW017 22SD0170006_20130123 1/23/2013	22SD/SW018 22SD0180006 4/9/2011	22SD/SW018 22SD0180006-D 4/9/2011
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	--	--	0.158 U	0.158 U
1,3-DINITROBENZENE	0.126 U	--	--	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	0.166 U	--	0.2 U	0.166 U	0.166 U
2,4-DINITROTOLUENE	0.166 U	--	--	0.166 U	0.166 U
2,6-DINITROTOLUENE	0.166 U	--	--	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	0.15 U	--	--	0.15 U	0.15 U
2-NITROTOLUENE	0.132 U	--	--	0.132 U	0.132 U
3-NITROTOLUENE	0.142 U	--	--	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	0.15 U	--	--	0.15 U	0.15 U
4-NITROTOLUENE	0.16 U	--	--	0.16 U	0.16 U
HMX	0.16 U	--	--	0.16 U	0.16 U
NITROBENZENE	0.15 U	--	--	0.15 U	0.15 U
NITROGLYCERIN	--	0.17 U	--	--	--
PETN	--	1.158 U	--	--	--
RDX	0.16 U	--	0.2 U	0.16 U	0.16 U
TETRYL	0.182 U	--	--	0.182 U	0.182 U
METALS (MG/KG)					
ARSENIC	12.3 J	5.5	--	1.2 J	1.5 J
BARIUM	38.3 J	42.1	--	12.8 J	18.5 J
CADMIUM	0.26 J	0.28	--	0.24 J	0.15 J
CHROMIUM	16.2 J	10	--	2.8 J	5 J
LEAD	11.3 J	11.3	--	12.1 J	10.3 J
MERCURY	0.049 U	0.086 J	--	0.038 J	0.04 U
SELENIUM	0.19 J	0.42	--	0.17 J	0.15 J
SILVER	0.04 UJ	0.04 U	--	0.04 UJ	0.04 UJ
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	31.1	--	--	--
TOTAL ORGANIC CARBON (MG/KG)	2800	670	--	6900 J	13000 J
PH (S.U.)	--	--	--	--	--

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Data Qualifiers:

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R = The value is rejected.

SEDIMENT

LOCATION SAMPLE ID SAMPLE DATE	22SD/SW018 22SD0180006_20120512 5/12/2012	22SD/SW023 22SD0230006 5/11/2012	22SD/SW024 22SD0240006 5/11/2012	22SD/SW026 22SD0260006 5/11/2012
EXPLOSIVES (MG/KG)				
1,3,5-TRINITROBENZENE	--	0.158 U	0.158 U	0.88
1,3-DINITROBENZENE	--	0.126 U	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	--	0.166 U	0.166 U	2100
2,4-DINITROTOLUENE	--	0.166 U	0.166 U	0.27 J
2,6-DINITROTOLUENE	--	0.166 U	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	--	0.15 U	0.15 U	0.15 U
2-NITROTOLUENE	--	0.132 U	0.132 U	0.132 U
3-NITROTOLUENE	--	0.142 U	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	--	0.15 U	0.15 U	46 J
4-NITROTOLUENE	--	0.16 U	0.16 U	0.16 U
HMX	--	0.16 U	0.16 U	0.16 U
NITROBENZENE	--	0.15 U	0.15 U	0.15 U
NITROGLYCERIN	0.17 U	0.17 U	0.17 U	0.17 U
PETN	1.158 U	1.158 U	1.158 U	1.158 U
RDX	--	0.16 U	0.16 U	0.16 U
TETRYL	--	0.182 U	0.182 U	0.182 U
METALS (MG/KG)				
ARSENIC	--	14.7	5.9	5.6
BARIUM	--	67.4	43.2	515
CADMIUM	--	0.36	0.22	0.43
CHROMIUM	--	11.3	11.9	16.5
LEAD	--	16.3	9.4	181
MERCURY	--	0.073 J	0.047 J	0.99
SELENIUM	--	0.61	0.33	0.4
SILVER	--	0.04 U	0.04 U	0.025 J
MISCELLANEOUS PARAMETERS				
PERCENT MOISTURE (%)	21.4	25.7	21.6	19.3
TOTAL ORGANIC CARBON (MG/KG)	39000	14000	6400	--
PH (S.U.)	--	6.1	--	--

SEDIMENT **Footnotes:**

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R = The value is rejected.

SOIL

LOCATION SAMPLE ID SAMPLE DATE	22SB001 22SB0010002 1/19/2011	22SB001 22SB0010305 1/19/2011	22SB001 22SB0010305-D 1/19/2011	22SB002 22SB0020002 1/19/2011	22SB002 22SB0020607 1/19/2011
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-DINITROBENZENE	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-NITROTOLUENE	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-NITROTOLUENE	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-NITROTOLUENE	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
NITROBENZENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
TETRYL	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)					
ARSENIC	3.6 J	4.1 J	4.7 J	4.6 J	3.8 J
BARIUM	30.9 J	38.4 J	85.5 J	44.6 J	19.3 J
CADMIUM	0.23 J	0.16 J	0.26 J	0.15 J	0.1 J
CHROMIUM	5.6 J	6 J	14 J	8 J	8.7 J
LEAD	8.9 J	6.5 J	144 J	10.2 J	9 J
MERCURY	0.04 U	0.044 U	0.043 U	0.026 U	0.032 U
SELENIUM	0.17 J	0.16 J	0.39 J	0.28 J	0.29 J
SILVER	0.04 UJ	0.04 UJ	0.027 J	0.04 UJ	0.04 UJ
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	--	--	--	--
TOTAL SOLIDS (%)	--	--	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	--	--	--	--	--
PERCHLORATE (MG/KG)	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
TOTAL ORGANIC CARBON (MG/KG)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
PH (S.U.)	7.3	7.9	7.7	--	--

SOIL Footnotes:

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SOIL

LOCATION SAMPLE ID SAMPLE DATE	22SB003 22SB0030002 1/19/2011	22SB003 22SB0030305 1/19/2011	22SB004 22SB0040002 1/19/2011	22SB004 22SB0040305 1/19/2011	22SB005 22SB0050002 1/19/2011
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-DINITROBENZENE	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-NITROTOLUENE	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-NITROTOLUENE	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-NITROTOLUENE	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
NITROBENZENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
TETRYL	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)					
ARSENIC	7.9 J	3.4 J	2.5 J	2 J	3.3 J
BARIUM	32.1 J	23.3 J	17.6 J	51.1 J	12.8 J
CADMIUM	0.12 J	0.11 J	0.14 J	0.16 J	0.18 J
CHROMIUM	14.1 J	10.7 J	3.4 J	12.1 J	13.4 J
LEAD	10.8 J	7 J	2.8 J	4.7 J	6.1 J
MERCURY	0.046 U	0.04 U	0.02 U	0.086 U	0.028 U
SELENIUM	0.23 J	0.13 J	0.088 J	0.15 J	0.18 J
SILVER	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	--	--	--	--
TOTAL SOLIDS (%)	--	--	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	--	--	--	--	--
PERCHLORATE (MG/KG)	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
TOTAL ORGANIC CARBON (MG/KG)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--

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SOIL

LOCATION SAMPLE ID SAMPLE DATE	22SB006 22SB0060002 1/19/2011	22SB006 22SB0060304 1/19/2011	22SB007 22SB0070002 1/21/2011	22SB007 22SB0070304 1/21/2011	22SB008 22SB0080002 1/19/2011
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-DINITROBENZENE	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-NITROTOLUENE	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-NITROTOLUENE	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-NITROTOLUENE	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
NITROBENZENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
TETRYL	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)					
ARSENIC	2.4 J	1.1 J	6	2	3.7 J
BARIUM	38 J	2.3 J	89 J	14.8 J	34.3 J
CADMIUM	0.19 J	0.092 J	0.16	0.1	0.33 J
CHROMIUM	10.6 J	7.4 J	11	5.3	8.9 J
LEAD	4.6 J	2.8 J	11.8	4.9	11.2 J
MERCURY	0.021 U	0.025 U	0.079 U	0.046 U	0.035 U
SELENIUM	0.17 J	0.06 J	0.31	0.11 J	0.23 J
SILVER	0.04 UJ	0.04 UJ	0.04 U	0.04 U	0.035 J
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	--	--	--	--
TOTAL SOLIDS (%)	--	--	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	--	--	--	--	--
PERCHLORATE (MG/KG)	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
TOTAL ORGANIC CARBON (MG/KG)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
PH (S.U.)	--	--	--	--	8.2

SOIL Footnotes:

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SOIL

LOCATION	22SB009	22SB009	22SB010	22SB010	22SB011
SAMPLE ID	22SB0090002	22SB0090305	22SB0100002	22SB0100305	22SB0110002
SAMPLE DATE	1/19/2011	1/19/2011	1/19/2011	1/19/2011	1/19/2011
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	0.158 U	0.158 U	0.158 U	0.158 U
1,3-DINITROBENZENE	0.126 U	0.126 U	0.126 U	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,4-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2,6-DINITROTOLUENE	0.166 U	0.166 U	0.166 U	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
2-NITROTOLUENE	0.132 U	0.132 U	0.132 U	0.132 U	0.132 U
3-NITROTOLUENE	0.142 U	0.142 U	0.142 U	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
4-NITROTOLUENE	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
HMX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
NITROBENZENE	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
TETRYL	0.182 U	0.182 U	0.182 U	0.182 U	0.182 U
METALS (MG/KG)					
ARSENIC	2.7 J	4.9 J	2.9 J	3.1 J	7 J
BARIUM	15.4 J	23.3 J	55.3 J	60.5 J	65.8 J
CADMIUM	0.075 J	0.14 J	0.079 J	0.1 J	0.19 J
CHROMIUM	5.9 J	9.2 J	8 J	7.6 J	12.4 J
LEAD	4.1 J	7 J	4.7 J	5.5 J	11.5 J
MERCURY	0.042 U	0.04 U	0.031 U	0.025 U	0.038 U
SELENIUM	0.094 J	0.14 J	0.14 J	0.16 J	0.38 J
SILVER	0.04 UJ	0.022 J	0.04 UJ	0.04 UJ	0.038 J
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	--	--	--	--
TOTAL SOLIDS (%)	--	--	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	--	--	--	--	--
PERCHLORATE (MG/KG)	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
TOTAL ORGANIC CARBON (MG/KG)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--

SOIL Footnotes:

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Data Qualifiers:

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SOIL

LOCATION	22SB011	22SB012	22SB012	22SB013	22SB014
SAMPLE ID	22SB0110304	22SB0120002	22SB0120002-D	22SB0130002	22SB0140002
SAMPLE DATE	1/19/2011	5/10/2012	5/10/2012	5/9/2012	5/9/2012
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	0.158 UJ	0.158 UJ	0.158 UJ	0.158 UJ
1,3-DINITROBENZENE	0.126 U	0.126 UJ	0.126 UJ	0.126 UJ	0.126 UJ
2,4,6-TRINITROTOLUENE	0.166 U	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ
2,4-DINITROTOLUENE	0.166 U	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ
2,6-DINITROTOLUENE	0.166 U	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ
2-AMINO-4,6-DINITROTOLUENE	0.15 U	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ
2-NITROTOLUENE	0.132 U	0.132 UJ	0.132 UJ	0.132 UJ	0.132 UJ
3-NITROTOLUENE	0.142 U	0.142 UJ	0.142 UJ	0.142 UJ	0.142 UJ
4-AMINO-2,6-DINITROTOLUENE	0.15 U	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ
4-NITROTOLUENE	0.16 U	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
HMX	0.16 U	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
NITROBENZENE	0.15 U	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ
NITROGLYCERIN	--	0.17 UJ	0.17 UJ	0.17 UJ	0.17 UJ
PETN	--	1.158 UJ	1.158 UJ	1.158 UJ	1.158 UJ
RDX	0.16 U	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
TETRYL	0.182 U	0.182 UJ	0.182 UJ	0.182 UJ	0.182 UJ
METALS (MG/KG)					
ARSENIC	6.1 J	2.9 J	3.6 J	5.6 J	4.2 J
BARIUM	40.6 J	22.4 J	108 J	126 J	144 J
CADMIUM	0.12 J	0.13 J	0.23 J	0.24 J	0.28 J
CHROMIUM	9 J	7 J	19.1 J	19.8 J	18.7 J
LEAD	8.9 J	4.5 J	7.4 J	7 J	8 J
MERCURY	0.067 U	0.026 J	0.025 J	0.021 J	0.03 J
SELENIUM	0.26 J	0.2 J	0.31 J	0.4 J	0.32 J
SILVER	0.023 J	0.04 UJ	0.04 UJ	0.04 UJ	0.021 J
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	16	18.5	13	18.9
TOTAL SOLIDS (%)	--	--	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	--	--	--	--	--
PERCHLORATE (MG/KG)	0.004 U	--	--	--	--
TOTAL ORGANIC CARBON (MG/KG)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
PH (S.U.)	--	7.7	7.6	--	--

SOIL Footnotes:

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Data Qualifiers:

Blank (i.e., no qualifier) = the chemical was detected.

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SOIL

LOCATION	22SB014	22SB015	22SB016	22SB016	22SB016
SAMPLE ID	22SB0140203	22SB0150002	22SB0160002	22SB0160305	22SB0160608
SAMPLE DATE	5/10/2012	5/10/2012	5/9/2012	5/9/2012	5/9/2012
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 UJ	0.158 UJ	0.158 UJ	0.158 UJ	0.158 UJ
1,3-DINITROBENZENE	0.126 UJ	0.126 UJ	0.126 UJ	0.126 UJ	0.126 UJ
2,4,6-TRINITROTOLUENE	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ
2,4-DINITROTOLUENE	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ
2,6-DINITROTOLUENE	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ	0.166 UJ
2-AMINO-4,6-DINITROTOLUENE	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ
2-NITROTOLUENE	0.132 UJ	0.132 UJ	0.132 UJ	0.132 UJ	0.132 UJ
3-NITROTOLUENE	0.142 UJ	0.142 UJ	0.142 UJ	0.142 UJ	0.142 UJ
4-AMINO-2,6-DINITROTOLUENE	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ
4-NITROTOLUENE	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
HMX	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
NITROBENZENE	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ	0.15 UJ
NITROGLYCERIN	0.17 UJ	0.17 UJ	0.17 UJ	0.17 UJ	0.17 UJ
PETN	1.158 UJ	1.158 UJ	1.158 UJ	1.158 UJ	1.158 UJ
RDX	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ	0.16 UJ
TETRYL	0.182 UJ	0.182 UJ	0.182 UJ	0.182 UJ	0.182 UJ
METALS (MG/KG)					
ARSENIC	2.5 J	4.7 J	5 J	4.6 J	3.4 J
BARIUM	52.3 J	47 J	79.2 J	69.5 J	54 J
CADMIUM	0.086 J	0.2 J	0.26	0.25 J	0.19 J
CHROMIUM	7.5 J	12.6 J	19.5 J	17.7 J	8.7 J
LEAD	2.8 J	6.1 J	10.6	10.6 J	8.7 J
MERCURY	0.04 U	0.04 U	0.02 J	0.021 J	0.027 J
SELENIUM	0.21 J	0.28 J	0.35 J	0.46 J	0.29 J
SILVER	0.04 UJ	0.04 UJ	0.04 U	0.04 UJ	0.04 UJ
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	8.1	14.3	9.1	13.4	15
TOTAL SOLIDS (%)	--	--	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	--	--	--	--	--
PERCHLORATE (MG/KG)	--	--	--	--	--
TOTAL ORGANIC CARBON (MG/KG)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--

SOIL Footnotes:

-- = The chemical was not analyzed or no value was available.

Data Qualifiers:

Blank (i.e., no qualifier) = the chemical was detected.

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U = The chemical was not detected.

UJ = The chemical was not detected but the value reported is an esti

SOIL

LOCATION SAMPLE ID SAMPLE DATE	22SB017 22SB0170002 5/9/2012	22SB017 22SB0170305 5/9/2012	22SB018 22SB0180002 5/10/2012	22SB018 22SB0180406 5/11/2012	22SB019 22SB0190002 5/10/2012
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 UJ	0.158 UJ	0.158 UJ	0.158 U	0.158 UJ
1,3-DINITROBENZENE	0.126 UJ	0.126 UJ	0.126 UJ	0.126 U	0.126 UJ
2,4,6-TRINITROTOLUENE	0.166 UJ	0.166 UJ	0.166 UJ	0.166 U	0.166 UJ
2,4-DINITROTOLUENE	0.166 UJ	0.166 UJ	0.166 UJ	0.166 U	0.166 UJ
2,6-DINITROTOLUENE	0.166 UJ	0.166 UJ	0.166 UJ	0.166 U	0.166 UJ
2-AMINO-4,6-DINITROTOLUENE	0.15 UJ	0.15 UJ	0.15 UJ	0.15 U	0.15 UJ
2-NITROTOLUENE	0.132 UJ	0.132 UJ	0.132 UJ	0.132 U	0.132 UJ
3-NITROTOLUENE	0.142 UJ	0.142 UJ	0.142 UJ	0.142 U	0.142 UJ
4-AMINO-2,6-DINITROTOLUENE	0.15 UJ	0.15 UJ	0.15 UJ	0.15 U	0.15 UJ
4-NITROTOLUENE	0.16 UJ	0.16 UJ	0.16 UJ	0.16 U	0.16 UJ
HMX	0.16 UJ	0.16 UJ	0.16 UJ	0.16 U	0.16 UJ
NITROBENZENE	0.15 UJ	0.15 UJ	0.15 UJ	0.15 U	0.15 UJ
NITROGLYCERIN	0.17 UJ	0.17 UJ	0.17 UJ	0.17 U	0.17 UJ
PETN	1.158 UJ	1.158 UJ	1.158 UJ	1.158 U	1.158 UJ
RDX	0.16 UJ	0.16 UJ	0.16 UJ	0.16 U	0.16 UJ
TETRYL	0.182 UJ	0.182 UJ	0.182 UJ	0.182 U	0.182 UJ
METALS (MG/KG)					
ARSENIC	5.2 J	5.3 J	6 J	3.2	7 J
BARIUM	39.9 J	43 J	73.5 J	72.6	69.4 J
CADMIUM	0.18	0.22	0.27 J	0.18	0.22 J
CHROMIUM	16.7 J	15.8 J	17.3 J	11.4	14.8 J
LEAD	17.3	10.9	9.4 J	4.5	8.4 J
MERCURY	0.04 J	0.033 J	0.054 J	0.04 U	0.032 J
SELENIUM	0.34 J	0.35 J	0.38 J	0.24	0.32 J
SILVER	0.04 U	0.04 U	0.022 J	0.04 U	0.04 UJ
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	12.2	9.4	16.3	15	15.4
TOTAL SOLIDS (%)	--	--	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	--	--	--	--	--
PERCHLORATE (MG/KG)	--	--	--	--	--
TOTAL ORGANIC CARBON (MG/KG)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--

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SOIL

LOCATION SAMPLE ID SAMPLE DATE	22SB020 22SB0200002 1/23/2013	22SB020 22SB0200002-D 1/23/2013	22SB020 22SB0200203 1/23/2013	22SS001 22SS0010002 1/21/2011	22SS001 22SS0010002-D 1/21/2011
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	--	--	--	0.158 U	0.158 U
1,3-DINITROBENZENE	--	--	--	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	0.2 U	0.2 U	0.2 U	0.166 U	0.166 U
2,4-DINITROTOLUENE	--	--	--	0.166 U	0.166 U
2,6-DINITROTOLUENE	--	--	--	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	--	--	--	0.15 U	0.15 U
2-NITROTOLUENE	--	--	--	0.132 U	0.132 U
3-NITROTOLUENE	--	--	--	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	--	--	--	0.15 U	0.15 U
4-NITROTOLUENE	--	--	--	0.16 U	0.16 U
HMX	--	--	--	0.16 U	0.16 U
NITROBENZENE	--	--	--	0.15 U	0.15 U
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.2 U	0.2 U	0.2 U	0.16 U	0.16 U
TETRYL	--	--	--	0.182 U	0.182 U
METALS (MG/KG)					
ARSENIC	--	--	--	2.4	3.1
BARIUM	--	--	--	27.1 J	48.9 J
CADMIUM	--	--	--	0.1	0.099 J
CHROMIUM	16.5	17.3	--	4.9	7.1
LEAD	--	--	--	6.5	7.3
MERCURY	--	--	--	0.068 U	0.063 U
SELENIUM	--	--	--	0.14 J	0.18 J
SILVER	--	--	--	0.04 U	0.04 U
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	--	--	--	--
TOTAL SOLIDS (%)	83.9	86	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	1.31	1.12	--	--	--
PERCHLORATE (MG/KG)	--	--	--	0.004 U	0.004 U
TOTAL ORGANIC CARBON (MG/KG)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	605	623	--	--	--
PH (S.U.)	5.36	5.26	--	--	--

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SOIL

LOCATION SAMPLE ID SAMPLE DATE	22SS002 22SS0020002 1/21/2011	22SS004 22SS0040002 1/23/2013	22SS005 22SS0050002 1/23/2013	22SS006 22SS0060002 1/23/2013	22SS007 22SS0070002 1/23/2013
EXPLOSIVES (MG/KG)					
1,3,5-TRINITROBENZENE	0.158 U	--	--	--	--
1,3-DINITROBENZENE	0.126 U	--	--	--	--
2,4,6-TRINITROTOLUENE	0.166 U	0.2 U	0.2 U	0.2 U	0.2 U
2,4-DINITROTOLUENE	0.166 U	--	--	--	--
2,6-DINITROTOLUENE	0.166 U	--	--	--	--
2-AMINO-4,6-DINITROTOLUENE	0.15 U	--	--	--	--
2-NITROTOLUENE	0.132 U	--	--	--	--
3-NITROTOLUENE	0.142 U	--	--	--	--
4-AMINO-2,6-DINITROTOLUENE	0.15 U	--	--	--	--
4-NITROTOLUENE	0.16 U	--	--	--	--
HMX	0.16 U	--	--	--	--
NITROBENZENE	0.15 U	--	--	--	--
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.16 U	0.2 U	0.2 U	0.2 U	0.2 U
TETRYL	0.182 U	--	--	--	--
METALS (MG/KG)					
ARSENIC	2.4	--	--	--	--
BARIUM	22 J	--	--	--	--
CADMIUM	0.057 J	--	--	--	--
CHROMIUM	4.9	--	--	--	--
LEAD	5.1	--	--	--	--
MERCURY	0.056 U	--	--	--	--
SELENIUM	0.086 J	--	--	--	--
SILVER	0.04 U	--	--	--	--
MISCELLANEOUS PARAMETERS					
PERCENT MOISTURE (%)	--	--	--	--	--
TOTAL SOLIDS (%)	--	--	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	--	--	--	--	--
PERCHLORATE (MG/KG)	0.004 U	--	--	--	--
TOTAL ORGANIC CARBON (MG/KG)	--	--	--	--	--
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--	--
PH (S.U.)	--	--	--	--	--

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SOIL

LOCATION SAMPLE ID SAMPLE DATE	22SS008 22SS0080002 1/23/2013	22SS022 22SS0220002 5/12/2012	22SS025 22SS0250002 5/11/2012	22SS025 22SS0250002-D 5/11/2012
EXPLOSIVES (MG/KG)				
1,3,5-TRINITROBENZENE	--	0.158 U	0.158 U	0.158 U
1,3-DINITROBENZENE	--	0.126 U	0.126 U	0.126 U
2,4,6-TRINITROTOLUENE	0.2 U	0.166 U	0.166 U	0.166 U
2,4-DINITROTOLUENE	--	0.166 U	0.166 U	0.166 U
2,6-DINITROTOLUENE	--	0.166 U	0.166 U	0.166 U
2-AMINO-4,6-DINITROTOLUENE	--	0.15 U	0.15 U	0.15 U
2-NITROTOLUENE	--	0.132 U	0.132 U	0.132 U
3-NITROTOLUENE	--	0.142 U	0.142 U	0.142 U
4-AMINO-2,6-DINITROTOLUENE	--	0.15 U	0.15 U	0.15 U
4-NITROTOLUENE	--	0.16 U	0.16 U	0.16 U
HMX	--	0.16 U	0.16 U	0.16 U
NITROBENZENE	--	0.15 U	0.15 U	0.15 U
NITROGLYCERIN	--	0.17 U	0.17 U	0.17 U
PETN	--	1.158 U	1.158 U	1.158 U
RDX	0.2 U	0.16 U	0.37 J	0.27 J
TETRYL	--	0.182 U	0.182 U	0.182 U
METALS (MG/KG)				
ARSENIC	--	4.1	9.8 J	9.4
BARIUM	--	56.5	48.6 J	83.5
CADMIUM	--	0.52	0.78	0.87
CHROMIUM	--	8.5	25.4 J	23.3
LEAD	--	31.4	31.7 J	26.3
MERCURY	--	0.054 J	0.6 J	0.29
SELENIUM	--	0.35 J	0.48 J	0.56
SILVER	--	0.04 U	0.026 J	0.025 J
MISCELLANEOUS PARAMETERS				
PERCENT MOISTURE (%)	--	14.9	22.8	19.3
TOTAL SOLIDS (%)	--	--	--	--
HEXAVALENT CHROMIUM (MG/KG)	--	--	--	--
PERCHLORATE (MG/KG)	--	--	--	--
TOTAL ORGANIC CARBON (MG/KG)	--	11000	4100	3900
OXIDATION REDUCTION POTENTIAL (MV)	--	--	--	--
PH (S.U.)	--	--	--	--

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SURFACE WATER

LOCATION	22SD/SW001	22SD/SW002	22SD/SW003	22SD/SW004	22SD/SW006
SAMPLE ID	22SW001	22SW002	22SW003	22SW004	22SW006
SAMPLE DATE	1/20/2011	1/20/2011	1/20/2011	1/20/2011	1/18/2011
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	0.26 U	0.26 U	0.26 U	0.26 U	0.52 U
1,3-DINITROBENZENE	0.262 U	0.262 U	0.262 U	0.262 U	0.52 U
2,4,6-TRINITROTOLUENE	0.266 U	0.266 U	0.266 U	0.266 U	0.52 U
2,4-DINITROTOLUENE	0.25 U	0.25 U	0.25 U	0.25 U	0.52 U
2,6-DINITROTOLUENE	0.25 U	0.25 U	0.25 U	0.25 U	0.52 U
2-AMINO-4,6-DINITROTOLUENE	0.25 U	0.25 U	0.25 U	0.25 U	0.52 U
2-NITROTOLUENE	0.252 U	0.252 U	0.252 U	0.252 U	0.52 U
3-NITROTOLUENE	0.266 U	0.266 U	0.266 U	0.266 U	0.52 U
4-AMINO-2,6-DINITROTOLUENE	0.20 U	0.20 U	0.20 U	0.20 U	0.40 U
4-NITROTOLUENE	0.266 U	0.266 U	0.266 U	0.266 U	0.52 U
HMX	0.82	0.79	0.87	0.23 U	0.48 U
NITROBENZENE	0.252 U	0.252 U	0.252 U	0.252 U	0.52 U
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.78	0.75	0.82	0.246 U	0.48 U
TETRYL	0.266 U	0.266 U	0.266 U	0.266 U	0.52 U
METALS (UG/L)					
ARSENIC	0.18 U	0.18 U	0.18 U	1.5	0.38
BARIUM	69	69.2	74.8	57.7	45.9
CADMIUM	0.04 U	0.04 U	0.04 U	0.04 U	0.5
CHROMIUM	0.55	0.48 J	0.43 R	3	1.5
LEAD	0.22 U	0.22 U	0.11 R	6.1	9.6
MERCURY	0.12 U	0.12 U	0.12 U	0.12 U	0.065 J
SELENIUM	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
SILVER	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ
DISSOLVED METALS (UG/L)					
ARSENIC	0.18 U	0.18 U	0.18 U	0.18 U	0.19 J
BARIUM	68	68.4	73.9	26	36 J
CADMIUM	0.04 U	0.04 U	0.04 U	0.04 U	0.24 J
CHROMIUM	0.5	0.39 J	0.92 R	0.75	0.29 J
LEAD	0.22 U	0.22 U	2.2 R	0.22 U	0.37 J
MERCURY	0.12 U	0.12 U	0.12 U	0.068 J	0.12 U
SELENIUM	0.20 U	0.20 U	0.20 U	0.20 U	0.20 UJ
SILVER	0.06 UJ	0.06 UJ	0.06 UJ	0.06 UJ	0.067 J
MISCELLANEOUS PARAMETERS					
PH (S.U.)	--	--	--	--	--
PERCHLORATE (UG/L)	0.40 U	0.4 J	0.40 U	0.40 U	0.40 U

SURFACE WATER Footnotes:

SURFACE WATER

LOCATION	22SD/SW007	22SD/SW009	22SD/SW009	22SD/SW010	22SD/SW010
SAMPLE ID	22SW007	22SW009	22SW009-D	22SW010	22SW010_20120512
SAMPLE DATE	1/18/2011	1/20/2011	1/20/2011	1/20/2011	5/12/2012
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	0.52 U	0.26 U	0.26 U	0.26 U	--
1,3-DINITROBENZENE	0.52 U	0.262 U	0.262 U	0.262 U	--
2,4,6-TRINITROTOLUENE	0.52 U	0.266 U	0.266 U	0.266 U	--
2,4-DINITROTOLUENE	0.52 U	0.25 U	0.25 U	0.25 U	--
2,6-DINITROTOLUENE	0.52 U	0.25 U	0.25 U	0.25 U	--
2-AMINO-4,6-DINITROTOLUENE	0.52 U	0.25 U	0.25 U	0.25 U	--
2-NITROTOLUENE	0.52 U	0.252 U	0.252 U	0.252 U	--
3-NITROTOLUENE	0.52 U	0.266 U	0.266 U	0.266 U	--
4-AMINO-2,6-DINITROTOLUENE	0.40 U	0.20 U	0.20 U	0.20 U	--
4-NITROTOLUENE	0.52 U	0.266 U	0.266 U	0.266 U	--
HMX	0.48 U	0.15 J	0.23 U	0.23 J	--
NITROBENZENE	0.52 U	0.252 U	0.252 U	0.252 U	--
NITROGLYCERIN	--	--	--	--	0.26 U
PETN	--	--	--	--	1.214 U
RDX	0.48 U	0.39 J	0.38 J	0.55	--
TETRYL	0.52 U	0.266 U	0.266 U	0.266 U	--
METALS (UG/L)					
ARSENIC	0.18 U	0.46 J	0.3 J	0.49 J	--
BARIUM	54.3	36.9 J	36.3 J	36.1 J	--
CADMIUM	0.24	0.073 U	0.064 U	0.083 U	--
CHROMIUM	0.47 J	0.4 J	0.49 J	0.43 J	--
LEAD	1.8	1 J	0.78 J	0.86 J	--
MERCURY	0.12 U	0.089 J	0.12 U	0.12 U	--
SELENIUM	0.20 U	0.1 J	0.20 UJ	0.20 UJ	--
SILVER	0.06 UJ	0.032 J	0.06 UJ	0.06 UJ	--
DISSOLVED METALS (UG/L)					
ARSENIC	0.23 J	0.23 J	0.18 J	0.2 J	--
BARIUM	53.8 J	34.5 J	33.8 J	34.4 J	--
CADMIUM	0.26 J	0.04 U	0.04 U	0.043 U	--
CHROMIUM	0.28 J	0.31 J	0.31 J	0.27 J	--
LEAD	0.69 J	0.11 J	0.12 J	0.22 UJ	--
MERCURY	0.067 J	0.12 U	0.12 U	0.12 U	--
SELENIUM	0.20 UJ	0.20 UJ	0.20 UJ	0.20 UJ	--
SILVER	0.057 J	0.06 UJ	0.06 UJ	0.06 UJ	--
MISCELLANEOUS PARAMETERS					
PH (S.U.)	--	--	--	--	--
PERCHLORATE (UG/L)	0.40 U	0.40 U	0.40 U	0.40 U	--

SURFACE WATER Footnotes:

SURFACE WATER

LOCATION	22SD/SW011	22SD/SW012	22SD/SW013	22SD/SW014	22SD/SW015
SAMPLE ID	22SW011	22SW012	22SW013	22SW014	22SW015
SAMPLE DATE	1/20/2011	4/9/2011	4/9/2011	4/9/2011	4/9/2011
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	0.26 U	--	--	--	--
1,3-DINITROBENZENE	0.262 U	--	--	--	--
2,4,6-TRINITROTOLUENE	0.266 U	--	--	--	--
2,4-DINITROTOLUENE	0.25 U	--	--	--	--
2,6-DINITROTOLUENE	0.25 U	--	--	--	--
2-AMINO-4,6-DINITROTOLUENE	0.25 U	--	--	--	--
2-NITROTOLUENE	0.252 U	--	--	--	--
3-NITROTOLUENE	0.266 U	--	--	--	--
4-AMINO-2,6-DINITROTOLUENE	0.20 U	--	--	--	--
4-NITROTOLUENE	0.266 U	--	--	--	--
HMX	0.88	0.23 U	11	0.23 U	0.23 U
NITROBENZENE	0.252 U	--	--	--	--
NITROGLYCERIN	--	--	--	--	--
PETN	--	--	--	--	--
RDX	0.79	0.246 U	0.98	0.246 U	0.246 U
TETRYL	0.266 U	--	--	--	--
METALS (UG/L)					
ARSENIC	0.41	--	--	--	--
BARIUM	76.5	--	--	--	--
CADMIUM	0.04 U	--	--	--	--
CHROMIUM	0.45 J	--	--	--	--
LEAD	0.22 U	--	--	--	--
MERCURY	0.12 U	--	--	--	--
SELENIUM	0.24 J	--	--	--	--
SILVER	0.06 UJ	--	--	--	--
DISSOLVED METALS (UG/L)					
ARSENIC	0.44 J	--	--	--	--
BARIUM	77.4 J	--	--	--	--
CADMIUM	0.04 UJ	--	--	--	--
CHROMIUM	0.46 J	--	--	--	--
LEAD	0.12 J	--	--	--	--
MERCURY	0.084 J	--	--	--	--
SELENIUM	0.28 J	--	--	--	--
SILVER	0.06 UJ	--	--	--	--
MISCELLANEOUS PARAMETERS					
PH (S.U.)	--	--	--	--	--
PERCHLORATE (UG/L)	0.40 U	--	--	--	--

SURFACE WATER Footnotes:

SURFACE WATER

LOCATION SAMPLE ID SAMPLE DATE	22SD/SW016 22SW016 4/9/2011	22SD/SW017 22SW017 4/9/2011	22SD/SW017 22SW017_20120511 5/11/2012	22SD/SW018 22SW018 4/9/2011	22SD/SW018 22SW018-D 4/9/2011
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	--	--	--	0.26 U	0.26 U
1,3-DINITROBENZENE	--	--	--	0.262 U	0.262 U
2,4,6-TRINITROTOLUENE	--	--	--	0.266 U	0.266 U
2,4-DINITROTOLUENE	--	--	--	0.25 U	0.25 U
2,6-DINITROTOLUENE	--	--	--	0.25 U	0.25 U
2-AMINO-4,6-DINITROTOLUENE	--	--	--	0.25 U	0.25 U
2-NITROTOLUENE	--	--	--	0.252 U	0.252 U
3-NITROTOLUENE	--	--	--	0.266 U	0.266 U
4-AMINO-2,6-DINITROTOLUENE	--	--	--	0.20 U	0.20 U
4-NITROTOLUENE	--	--	--	0.266 U	0.266 U
HMX	0.23 U	0.61	--	0.63	0.43 J
NITROBENZENE	--	--	--	0.252 U	0.252 U
NITROGLYCERIN	--	--	0.26 U	--	--
PETN	--	--	1.214 U	--	--
RDX	0.246 U	2.5	--	1.5	1.1
TETRYL	--	--	--	0.266 U	0.266 U
METALS (UG/L)					
ARSENIC	--	--	0.18 J	0.72	0.64 J
BARIUM	--	--	67.1	26.4	24.4
CADMIUM	--	--	0.29 J	0.25	0.19 J
CHROMIUM	--	--	0.51	1	1.1 J
LEAD	--	--	0.22 U	6 J	3.9 J
MERCURY	--	--	0.1 J	0.12 U	0.12 U
SELENIUM	--	--	0.12 J	0.17 J	0.15 J
SILVER	--	--	0.06 U	0.06 U	0.06 U
DISSOLVED METALS (UG/L)					
ARSENIC	--	--	--	0.35	0.34
BARIUM	--	--	--	27.1 J	20.1 J
CADMIUM	--	--	--	0.066 J	0.048 J
CHROMIUM	--	--	--	0.37 J	0.55 J
LEAD	--	--	--	0.22 U	0.22 U
MERCURY	--	--	--	0.12 U	0.12 U
SELENIUM	--	--	--	0.20 UJ	1 UJ
SILVER	--	--	--	0.06 U	0.06 U
MISCELLANEOUS PARAMETERS					
PH (S.U.)	--	--	--	--	--
PERCHLORATE (UG/L)	--	--	--	--	--

SURFACE WATER Footnotes:

SURFACE WATER

LOCATION SAMPLE ID SAMPLE DATE	22SD/SW019 22SW019 4/9/2011	22SD/SW020 22SW020 4/9/2011	22SD/SW021 22SW021 4/9/2011	22SD/SW023 22SW023 5/11/2012	22SD/SW024 22SW024 5/11/2012
EXPLOSIVES (UG/L)					
1,3,5-TRINITROBENZENE	--	--	--	0.26 U	0.26 U
1,3-DINITROBENZENE	--	--	--	0.262 U	0.262 U
2,4,6-TRINITROTOLUENE	--	--	--	0.266 U	0.266 U
2,4-DINITROTOLUENE	--	--	--	0.25 U	0.25 U
2,6-DINITROTOLUENE	--	--	--	0.25 U	0.25 U
2-AMINO-4,6-DINITROTOLUENE	--	--	--	0.25 U	0.25 U
2-NITROTOLUENE	--	--	--	0.252 U	0.252 U
3-NITROTOLUENE	--	--	--	0.266 U	0.266 U
4-AMINO-2,6-DINITROTOLUENE	--	--	--	0.2 U	0.2 U
4-NITROTOLUENE	--	--	--	0.266 U	0.266 U
HMX	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U
NITROBENZENE	--	--	--	0.252 U	0.252 U
NITROGLYCERIN	--	--	--	0.26 U	0.26 U
PETN	--	--	--	1.214 U	1.214 U
RDX	0.246 U	0.246 U	0.246 U	0.246 U	0.246 U
TETRYL	--	--	--	0.266 U	0.266 U
METALS (UG/L)					
ARSENIC	--	--	--	0.29	0.62
BARIUM	--	--	--	57.5	66.6
CADMIUM	--	--	--	0.23 J	1.7 J
CHROMIUM	--	--	--	0.72	1.1
LEAD	--	--	--	0.22 U	4.4
MERCURY	--	--	--	0.068 J	0.097 J
SELENIUM	--	--	--	0.11 J	0.56 J
SILVER	--	--	--	0.19 U	0.06 U
DISSOLVED METALS (UG/L)					
ARSENIC	--	--	--	--	--
BARIUM	--	--	--	--	--
CADMIUM	--	--	--	--	--
CHROMIUM	--	--	--	--	--
LEAD	--	--	--	--	--
MERCURY	--	--	--	--	--
SELENIUM	--	--	--	--	--
SILVER	--	--	--	--	--
MISCELLANEOUS PARAMETERS					
PH (S.U.)	--	--	--	6.3	--
PERCHLORATE (UG/L)	--	--	--	--	--

SURFACE WATER Footnotes:

SURFACE WATER

LOCATION	**22SD/SW024**
SAMPLE ID	**22SW024-D**
SAMPLE DATE	**5/11/2012**
EXPLOSIVES (UG/L)	
1,3,5-TRINITROBENZENE	0.26 U
1,3-DINITROBENZENE	0.262 U
2,4,6-TRINITROTOLUENE	0.266 U
2,4-DINITROTOLUENE	0.25 U
2,6-DINITROTOLUENE	0.25 U
2-AMINO-4,6-DINITROTOLUENE	0.25 U
2-NITROTOLUENE	0.252 U
3-NITROTOLUENE	0.266 U
4-AMINO-2,6-DINITROTOLUENE	0.2 U
4-NITROTOLUENE	0.266 U
HMX	0.23 U
NITROBENZENE	0.252 U
NITROGLYCERIN	0.26 U
PETN	1.214 U
RDX	0.246 U
TETRYL	0.266 U
METALS (UG/L)	
ARSENIC	0.71
BARIUM	67.2
CADMIUM	0.64 J
CHROMIUM	1.2
LEAD	1.6
MERCURY	0.082 J
SELENIUM	0.54 J
SILVER	0.15 U
DISSOLVED METALS (UG/L)	
ARSENIC	--
BARIUM	--
CADMIUM	--
CHROMIUM	--
LEAD	--
MERCURY	--
SELENIUM	--
SILVER	--
MISCELLANEOUS PARAMETERS	
PH (S.U.)	--
PERCHLORATE (UG/L)	--

SURFACE WATER Footnotes:

APPENDIX E

SUPPORTING DOCUMENTATION FOR THE HUMAN HEALTH RISK ASSESSMENT

APPENDIX E

SUPPORTING INFORMATION FOR HUMAN HEALTH RISK ASSESSMENT

E.1 Samples Used in Risk Assessment
E.2 RAGS Part D Tables
E.3 ProUCL Outputs
E.4 Sample Calculations
E.5 IEUBK Modeling Results
E.6 RAGS Part D Tables for Chemicals Present at Naturally Occurring Levels

APPENDIX E.1

SAMPLES USED IN RISK ASSESSMENT

TABLE 1
SAMPLES USED IN THE HUMAN HEALTH RISH ASSESSMENT

Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
22SB0010002	22SB0010305	22GWT002	22SW001	22SD0010006
22SB0020002	22SB0020607	22GWT003	22SW002	22SD0020006
22SB0030002	22SB0030305	22GWT004	22SW003	22SD0030006
22SB0040002	22SB0040305	22GWT005	22SW004	22SD0040006
22SB0050002	22SB0060304	22GWT005_20130123	22SW006	22SD0050006
22SB0060002	22SB0070304		22SW007	22SD0060006
22SB0070002	22SB0090305		22SW009	22SD0060624
22SB0080002	22SB0100305		22SW010	22SD0070006
22SB0090002	22SB0110304		22SW010_20120512	22SD0070624
22SB0100002	22SB0140203		22SW011	22SD0080006
22SB0110002	22SB0160305		22SW012	22SD0080624
22SB0120002	22SB0160608		22SW013	22SD0090006
22SB0130002	22SB0170305		22SW014	22SD0100006
22SB0140002	22SB0180406		22SW015	22SD0100006_20120512
22SB0150002	22SB0200203		22SW016	22SD0110006
22SB0160002			22SW017	22SD0170006
22SB0170002			22SW017_20120511	22SD0180006
22SB0180002			22SW018	22SD0180006_20120512
22SB0190002			22SW019	22SD0230006
22SB0200002			22SW020	22SD0240006
22SS0010002			22SW021	
22SS0020002			22SW023	
22SS0040002			22SW024	
22SS0050002				
22SS0060002				
22SS0070002				
22SS0080002				
22SS0220002				
22SS0250002				

APPENDIX E.2

RAGS-PART D TABLES

RAGS Part D Table 1

Selection of Exposure Pathways

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 22 – LEAD AZIDE POND
NSA CRANE, CRANE INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil	Surface Soil	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None None	No COPCs were identified for surface soil.
				Industrial Worker	Adult	Ingestion Dermal	None None	No COPCs were identified for surface soil.
				Trespassers	Adolescent	Ingestion Dermal	None None	No COPCs were identified for surface soil.
		Air	SWMU 22	Construction Workers	Adult	Inhalation	None	No COPCs were identified for surface soil.
				Industrial Worker	Adult	Inhalation	None	No COPCs were identified for surface soil.
				Trespassers	Adolescent	Inhalation	None	No COPCs were identified for surface soil.
	Subsurface Soil	Subsurface Soil	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
				Industrial Worker	Adult	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
				Trespassers	Adolescent	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
		Air	SWMU 22	Construction Workers	Adult	Inhalation	None	No COPCs were identified for subsurface soil.
				Industrial Worker	Adult	Inhalation	None	No COPCs were identified for subsurface soil.
				Trespassers	Adolescent	Inhalation	None	No COPCs were identified for subsurface soil.
	Groundwater	Groundwater	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None Quant	Construction workers may have contact with groundwater during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	None None	Industrial workers are not exposed to groundwater.
				Trespassers	Adolescent	Ingestion Dermal	None None	Current trespassers are not exposed to groundwater.
		Air	SWMU 22	Construction Workers	Adult	Inhalation	None	No volatile COPCs were identified in groundwater.
				Industrial Worker	Adult	Inhalation	None	Industrial workers are not expected to be exposed to COPCs that have volatilized from groundwater.
				Trespassers	Adolescent	Inhalation	None	Current trespassers are not exposed to groundwater.
			Vapor Intrusion	Industrial Worker	Adult	Inhalation	None	No COPCs were identified for vapor intrusion.

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 22 – LEAD AZIDE POND
NSA CRANE, CRANE INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Water	Surface Water	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None None	Construction workers are not exposed to surface water.
				Industrial Worker	Adult	Ingestion Dermal	None None	Industrial workers are not exposed to surface water.
				Trespassers	Adolescent	Ingestion Dermal	Quant Quant	Trespassers may be exposed to surface water while at the site.
	Sediment	Sediment	SWMU 22	Construction Workers	Adult	Ingestion Dermal	None None	Construction workers are not exposed to sediment.
				Industrial Worker	Adult	Ingestion Dermal	None None	Industrial workers are not exposed to sediment.
				Trespassers	Adolescent	Ingestion Dermal	Quant Quant	Current trespassers may be exposed to sediment while at the site.
Future	Surface Soil	Surface Soil	SWMU 22	Recreational Users	Child	Ingestion Dermal	None None	No COPCs were identified for surface soil.
					Adult	Ingestion Dermal	None None	
				Residents	Child	Ingestion Dermal	None None	No COPCs were identified for surface soil.
					Adult	Ingestion Dermal	None None	
		Air	SWMU 22	Recreational Users	Child	Inhalation	None	No COPCs were identified for surface soil.
					Adult	Inhalation	None	
				Residents	Child	Inhalation	None	No COPCs were identified for surface soil.
					Adult	Inhalation	None	
	Subsurface Soil	Subsurface Soil	SWMU 22	Recreational Users	Child	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
					Adult	Ingestion Dermal	None None	
				Residents	Child	Ingestion Dermal	None None	No COPCs were identified for subsurface soil.
					Adult	Ingestion Dermal	None None	

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 22 – LEAD AZIDE POND
NSA CRANE, CRANE INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Subsurface Soil	Air	SWMU 22	Recreational Users	Child	Inhalation	None	No COPCs were identified for subsurface soil.
					Adult	Inhalation	None	
				Residents	Child	Inhalation	None	No COPCs were identified for subsurface soil.
					Adult	Inhalation	None	
	Groundwater	Groundwater	SWMU 22	Recreational Users	Child	Ingestion Dermal	None None	Recreational users are not expected to be exposed to groundwater.
					Adult	Ingestion Dermal	None None	
				Residents	Child	Ingestion Dermal	Quant Quant	Although a future residential scenario is considered unlikely at the site this scenario is included to aid in future risk management decisions.
					Adult	Ingestion Dermal	Quant Quant	
		Air	SWMU 22	Recreational Users	Child	Inhalation	None	Recreational users are not expected to be exposed to groundwater.
					Adult	Inhalation	None	
				Residents	Child	Inhalation	None	No volatile COPCs were identified for groundwater.
					Adult	Inhalation	None	
			Vapor Intrusion	Residents	Child	Inhalation	None	No COPCs were identified for vapor intrusion.
					Adult	Inhalation	None	
	Surface Water	Surface Water	SWMU 22	Recreational Users	Child	Ingestion Dermal	Quant Quant	Recreational users may be exposed to surface water while at the site.
					Adult	Ingestion Dermal	Quant Quant	
				Residents	Child	Ingestion Dermal	Quant Quant	Although a future residential scenario is considered unlikely at the site this scenario is included to aid in future risk management decisions.
					Adult	Ingestion Dermal	Quant Quant	

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 22 – LEAD AZIDE POND
NSA CRANE, CRANE INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Sediment	Sediment	SWMU 22	Recreational Users	Child	Ingestion	Quant	Recreational users may be exposed to sediment while at the site.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	
				Residents	Child	Ingestion	Quant	Although a future residential scenario is considered unlikely at the site this scenario is included to aid in future risk management decisions.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	

Notes:
COPC - Chemical of potential concern.
Quant - Quantitative.

RAGS Part D Table 2

Occurrence, Distribution and Selection Of Chemicals of Potential Concern

LIST OF TABLES

RAGS PART D TABLE 2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Table No.

2.1 Surface Soil - Direct Contact

2.2 Surface Soil - Migration From Soil to Groundwater

2.3 Subsurface Soil - Direct Contact

2.4 Subsurface Soil - Migration From Soil to Groundwater

2.5 Groundwater - Direct Contact

2.6 Surface Water - Direct Contact

2.7 Sediment - Direct Contact

TABLE 2.1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(1)	Concentration Used for Screening(32)	Background 95% Upper Tolerance Limit(3)	Adjusted USEPA RSL Residential Soil(4)	IDEM Residential Soil(5)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
SWMU 22	**Explosives**													
	121-82-4	RDX	0.37 J	0.37 J	mg/kg	22SS0250002	1/29	0.16 - 0.2	0.37	NA	5.6 C	78 C	No	BSL
	Metals													
	7440-38-2	Arsenic	2.4 J	9.8 J	mg/kg	22SS0250002	23/23	-	9.8	11.83	0.39 C	5.5 C	No	BKG
	7440-39-3	Barium	12.8 J	144 J	mg/kg	22SB0140002	23/23	-	144	211	1,500 N	21,000 N	No	BSL, BKG
	7440-43-9	Cadmium	0.057 J	0.78	mg/kg	22SS0250002	23/23	-	0.78	6.05	7 N	98 N	No	BSL, BKG
	7440-47-3	Chromium	3.4 J	25.4 J	mg/kg	22SS0250002	24/24	-	25.4	28.7	12,000 N(7)	100,000 L(7)	No	BSL, BKG
	7439-92-1	Lead	2.8 J	31.7 J	mg/kg	22SS0250002	23/23	-	31.7	27	400	400	No	BSL
	7439-97-6	Mercury	0.02 J	0.6 J	mg/kg	22SS0250002	9/23	0.02 - 0.079	0.6	0.077	2.3 N(8)	32 N(8)	No	BSL
	7782-49-2	Selenium	0.086 J	0.48 J	mg/kg	22SS0250002	23/23	-	0.48	0.81	39 N	550 N	No	BSL, BKG
	7440-22-4	Silver	0.021 J	0.038 J	mg/kg	22SB0110002	5/23	0.04 - 0.04	0.038	0.13	39 N	550 N	No	BSL, BKG
	Miscellaneous Compounds													
	18540-29-9	Hexavalent Chromium	1.31	1.31	mg/kg	22SB0200002	1/1	-	1.31	(9)	0.29 C	4.1 C	No	BKG

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Final Basewide Background Soil Investigation Report (Tetra Tech, January 2001).
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
5 - IDEM Closure Guide, March 1, 2013.
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
7 - Value is for trivalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).
9 - Since concentrations of total chromium are within background levels it is assumed that concentrations of hexavalent chromium are also within background levels.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

Associated Samples

22SB0010002	22SB0160002
22SB0020002	22SB0170002
22SB0030002	22SB0180002
22SB0040002	22SB0190002
22SB0050002	22SB0200002
22SB0060002	22SS0010002
22SB0070002	22SS0020002
22SB0080002	22SS0040002
22SB0090002	22SS0050002
22SB0100002	22SS0060002
22SB0110002	22SS0070002
22SB0120002	22SS0080002
22SB0130002	22SS0220002

TABLE 2.2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(1)	Concentration Used for Screening(2)	Above Background Concentration?(3)	USEPA RSL Protection of Groundwater(4)	IDEM Migration to Groundwater(5)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
SWMU 22	**Explosives**													
	121-82-4	RDX	0.37 J	0.37 J	mg/kg	22SS0250002	1/29	0.16 - 0.2	0.37	NA	0.0046	0.046 C	Yes	ASL
	Metals													
	7440-38-2	Arsenic	2.4 J	9.8 J	mg/kg	22SS0250002	23/23	-	9.8	11.83	0.026	5.9 M	No	BKG
	7440-39-3	Barium	12.8 J	144 J	mg/kg	22SB0140002	23/23	-	144	211	2400	1700 M	No	BSL, BKG
	7440-43-9	Cadmium	0.057 J	0.78	mg/kg	22SS0250002	23/23	-	0.78	6.05	10.4	7.5 M	No	BSL, BKG
	7440-47-3	Chromium	3.4 J	25.4 J	mg/kg	22SS0250002	24/24	-	25.4	28.7	56,000,000 (7)	1,000,000 R(7)	No	BSL, BKG
	7439-92-1	Lead	2.8 J	31.7 J	mg/kg	22SS0250002	23/23	-	31.7		280 (8)	270 M	No	BSL
	7439-97-6	Mercury	0.02 J	0.6 J	mg/kg	22SS0250002	9/23	0.02 - 0.079	0.6		0.66	2.1 M	No	BSL
	7782-49-2	Selenium	0.086 J	0.48 J	mg/kg	22SS0250002	23/23	-	0.48	0.81	8	5.3 M	No	BSL, BKG
	7440-22-4	Silver	0.021 J	0.038 J	mg/kg	22SB0110002	5/23	0.04 - 0.04	0.038	0.13	12	12 N	No	BSL, BKG
	Miscellaneous Compounds													
	18540-29-9	Hexavalent Chromium	1.31	1.31	mg/kg	22SB0200002	1/1	-	1.31	(9)	0.012 (7)	0.12 C(7)	No	BKG

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - To determine whether chemical concentrations were within background levels, a statistical analysis was conducted using the site and background datasets.
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012. Values are based on a dilution attenuation factor of 20.
5 - IDEM Closure Guide, March 1, 2013.
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
7 - Value is for hexavalent chromium.
8 - Value is MCL based soil screening level.
9 - Since concentrations of total chromium are within background levels it is assumed that concentrations of hexavalent chromium are also within background levels.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples

22SB0010002	22SB0160002
22SB0020002	22SB0170002
22SB0030002	22SB0180002
22SB0040002	22SB0190002
22SB0050002	22SB0200002
22SB0060002	22SS0010002
22SB0070002	22SS0020002
22SB0080002	22SS0040002
22SB0090002	22SS0050002
22SB0100002	22SS0060002
22SB0110002	22SS0070002
22SB0120002	22SS0080002
22SB0130002	22SS0220002
22SB0140002	22SS0250002
22SB0150002	

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
M = Maximum Contaminant Level
N = Noncarcinogen
NA = Not Applicable/Not Available
R = Capped at 1,000,000

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 2.3
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background 95% Upper Tolerance Limit[3]	Adjusted USEPA RSL Residential Soil[4]	IDEM Residential Soil[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
SWMU 22	**Metals**													
	7440-38-2	Arsenic	1.1 J	6.1 J	mg/kg	22SB0110304	14/14	-	6.1	12.5	0.39 C	5.5 C	No	BKG
	7440-39-3	Barium	2.3 J	72.6	mg/kg	22SB0180406	14/14	-	72.6	115	1500 N	21000 N	No	BSL, BKG
	7440-43-9	Cadmium	0.086 J	0.25 J	mg/kg	22SB0160305	14/14	-	0.25	0.8	7 N	98 N	No	BSL, BKG
	7440-47-3	Chromium	5.3	17.7 J	mg/kg	22SB0160305	14/14	-	17.7	33	12,000 N[7]	100,000 L[7]	No	BSL, BKG
	7439-92-1	Lead	2.8 J	10.9	mg/kg	22SB0170305	14/14	-	10.9	19.6	400	400	No	BSL, BKG
	7439-97-6	Mercury	0.021 J	0.033 J	mg/kg	22SB0170305	3/14	0.025 - 0.086	0.033	0.18	2.3 N[8]	32 N[8]	No	BSL, BKG
	7782-49-2	Selenium	0.06 J	0.46 J	mg/kg	22SB0160305	14/14	-	0.46	1.07	39 N	550 N	No	BSL, BKG
	7440-22-4	Silver	0.022 J	0.023 J	mg/kg	22SB0110304	2/14	0.04 - 0.04	0.023	0.14	39 N	550 N	No	BSL, BKG

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Final Basewide Background Soil Investigation Report (Tetra Tech, January 2001).
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
5 - IDEM Closure Guide, March 1, 2013.
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
7 - Value is for trivalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
22SB0010305
22SB0020607
22SB0030305
22SB0040305
22SB0060304
22SB0070304
22SB0090305
22SB0100305
22SB0110304
22SB0140203
22SB0160305
22SB0160608
22SB0170305
22SB0180406
22SB0200203

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 2.4
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SUBSURFACE SOIL TO GROUNDWATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(1)	Concentration Used for Screening(2)	Background 95% Upper Tolerance Limit(3)	USEPA RSL Protection of Groundwater(4)	IDEM Migration to Groundwater(5)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
SWMU 22	**Metals**													
	7440-38-2	Arsenic	1.1 J	6.1 J	mg/kg	22SB0110304	14/14	-	6.1	12.5	**0.026**	**5.9 M**	No	BKG
	7440-39-3	Barium	2.3 J	72.6	mg/kg	22SB0180406	14/14	-	72.6	115	2400	1700 M	No	BSL, BKG
	7440-43-9	Cadmium	0.086 J	0.25 J	mg/kg	22SB0160305	14/14	-	0.25	0.8	10.4	7.5 M	No	BSL, BKG
	7440-47-3	Chromium	5.3	17.7 J	mg/kg	22SB0160305	14/14	-	17.7	33	56,000,000 (7)	1,000,000 R(7)	No	BSL, BKG
	7439-92-1	Lead	2.8 J	10.9	mg/kg	22SB0170305	14/14	-	10.9	19.6	280 (8)	270 M	No	BSL, BKG
	7439-97-6	Mercury	0.021 J	0.033 J	mg/kg	22SB0170305	3/14	0.025 - 0.086	0.033	0.18	0.66	2.1 M	No	BSL, BKG
	7782-49-2	Selenium	0.06 J	0.46 J	mg/kg	22SB0160305	14/14	-	0.46	1.07	8	5.3 M	No	BSL, BKG
	7440-22-4	Silver	0.022 J	0.023 J	mg/kg	22SB0110304	2/14	0.04 - 0.04	0.023	0.14	12	12 N	No	BSL, BKG

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Final Basewide Background Soil Investigation Report (Tetra Tech, January 2001).
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012. Values are based on a dilution attenuation factor of 20.
5 - IDEM Closure Guide, March 1, 2013.
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level
and is statistically determined to be greater than site background.
7 - Value is for trivalent chromium.
8 - Value is MCL based soil screening level.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
22SB0010305
22SB0020607
22SB0030305
22SB0040305
22SB0060304
22SB0070304
22SB0090305
22SB0100305
22SB0110304
22SB0140203
22SB0160305
22SB0160608
22SB0170305
22SB0180406
22SB0200203

Definitions:
COPC = Chemical Of Potential Concern
J = Estimated value
M = Maximum Contaminant Level
N = Noncarcinogen
NA = Not Applicable/Not Available
R = Capped at 1,000,000

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 2.5
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH GROUNDWATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(1)	Concentration Used for Screening(2)	Range of Background Concentrations(3)	Adjusted USEPA RSL Tapwater(4)	USEPA MCL(5)	IDEM Groundwater Residential(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
SWMU 22	**Explosives**														
	118-96-7	2,4,6-Trinitrotoluene	0.47 J	0.47 J	ug/L	22GWT002	1/4	0.266 - 0.266	0.47	**ND**	0.76 N(8)	NA	7.6 N	No	BSL
	19406-51-0	4-Amino-2,6-Dinitrotoluene	0.11 J	0.11 J	ug/L	22GWT002	1/4	0.2 - 0.2	0.11	**ND**	3 N	NA	30 N	No	BSL
	2691-41-0	HMX	1.1 J	1.1 J	ug/L	22GWT002	1/4	0.23 - 0.23	1.1	**ND**	78 N	NA	780 N	No	BSL
	121-82-4	**RDX**	0.19 J	15 J	ug/L	22GWT002	3/4	0.246 - 0.246	15	**0.32**	**0.61 C**	NA	**6.1 C**	**Yes**	ASL
	Metals (Total)														
	7440-38-2	**Arsenic**	1.9	5.5	ug/L	22GWT003	4/4	-	5.5	1.4 - 11	**0.045 C**	10	10 M	**Yes**	ASL
	7440-39-3	Barium	16.4	86.6 J	ug/L	22GWT005	4/4	-	86.6	**34.2 - 82**	290 N	2,000	2,000 M	No	BSL
	7440-43-9	**Cadmium**	0.59	4.7	ug/L	22GWT003	4/4	-	4.7	0.9 - 7.1	**0.69 N**	5	5 M	**Yes**	ASL
	7440-47-3	Chromium	5	90.8 J	ug/L	22GWT005_20130123	6/6	-	90.8	**4 - 19.3**	1,600 N(9)	100 (10)	16,000 N(9)	No	BSL
	18540-29-9	**Hexavalent Chromium**	0.046	0.046	ug/L	22GWT005	1/1	-	0.046	NA	**0.031 C**	100 (10)	0.31 C	**Yes**	ASL
	7439-92-1	**Lead**	7.5	21.4	ug/L	22GWT003	4/4	-	21.4	**3.2 - 49.7**	**15**	**15 (11)**	**15 M**	**Yes**	ASL
	7782-49-2	Selenium	0.41 J	5.3	ug/L	22GWT002	4/4	-	5.3	**0.45 - 8.1**	7.8 N	50	50 M	No	BSL
	Metals (Dissolved)														
	7440-38-2	**Arsenic**	0.45	3.2	ug/L	22GWT002	3/3	-	3.2	**0.44 - 3.3**	**0.045 C**	10	10 M	**Yes**	ASL
	7440-39-3	Barium	25.2	55.6	ug/L	22GWT005	3/3	-	55.6	23.6 - 28.5	290 N	2,000	2,000 M	No	BSL
	7440-43-9	**Cadmium**	0.45	2.9	ug/L	22GWT002	3/3	-	2.9	0.99 - 3.9	**0.69 N**	5	5 M	**Yes**	ASL
	7440-47-3	Chromium	1.2	3	ug/L	22GWT002	3/5	1.5 - 1.5	3	**0.59 - 1.3**	1,600 N(9)	100 (10)	16,000 N(9)	No	BSL
	18540-29-9	**Hexavalent Chromium**	0.034	0.034	ug/L	22GWT005	1/1	-	0.034	**NA**	**0.031 C**	100 (10)	0.31 C	**Yes**	ASL
	7439-92-1	Lead	4.2 J	10.6 J	ug/L	22GWT002	3/3	-	10.6	**0.72 - 7**	15	15 (11)	15 M	No	BSL
	7782-49-2	Selenium	0.24 J	3.5	ug/L	22GWT002	3/3	-	3.5	0.56 - 5.7	7.8 N	50	50 M	No	BSL
	Miscellaneous Parameters														
	14797-73-0	**Perchlorate**	5.9 J	5.9 J	ug/L	22GWT002	1/4	0.4 - 0.4	5.9	0.25 - 0.44	**1.1 N**	15	15 M	**Yes**	ASL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Concentrations in upgradient monitor wells 22MWT01 and 22MWT06. Data is presented for information purposes only.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
5 - 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, April 2012).
6 - IDEM Closure Guide, March 1, 2013.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - Ten percent of the noncarcinogenic value is less than the carcinogenic value, therefore the noncarcinogenic value is presented.
9 - Values are for trivalent chromium.
10 - Value is for total chromium.
11 - The MCL for this parameter is actually a treatment technique. The SDWA action level (at the tap) has been presented.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
22GWT002
22GWT003
22GWT004
22GWT005
22GWT005_20130123

Definitions:
C = Carcinogen
CAS = Chemical Abstracts Service
COPC = Chemical Of Potential Concern
M = Maximum Contaminant Level
J = Estimated value
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level.

For elimination as a COPC:
BSL = Below COPC Screening Level

TABLE 2.6
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Range of Background Concentrations[3]	Adjusted USEPA RSL Tapwater[4]	USEPA MCL[5]	IDEM Groundwater Residential[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
SWMU 22	**Explosives**														
	2691-41-0	HMX	0.15 J	0.87	ug/L	22SW003	7/15	0.23 - 0.48	0.87	0.88 - 11	78 N	NA	780 N	No	BSL
	121-82-4	**RDX**	0.39 J	2.5	ug/L	22SW017	7/15	0.246 - 0.48	2.5	**0.79 - 0.98**	**0.61 C**	NA	6.1 C	**Yes**	ASL
	Metals (Total)														
	7440-38-2	**Arsenic**	0.18 J	1.5	ug/L	22SW004	8/12	0.18 - 0.18	1.5	**0.41**	**0.045 C**	10	10 M	**Yes**	ASL
	7440-39-3	Barium	26.4	74.8	ug/L	22SW003	12/12	-	74.8	76.5	290 N	2,000	2,000 M	No	BSL
	7440-43-9	**Cadmium**	0.23 J	1.7 J	ug/L	22SW024	6/12	0.04 - 0.083	1.7	**ND**	**0.69 N**	5	5 M	**Yes**	ASL
	7440-47-3	Chromium	0.4 J	3	ug/L	22SW004	11/11	-	3	**0.45 J**	1,600 N[8]	100	16,000 N[8]	No	BSL
	7439-92-1	Lead	0.86 J	9.6	ug/L	22SW006	7/11	0.22 - 0.22	9.6	**ND**	15	15 [9]	15 M	No	BSL
	7439-97-6	Mercury	0.065 J	0.1 J	ug/L	22SW017_20120511	5/12	0.12 - 0.12	0.1	**ND**	0.43 N[10]	2	2 M	No	BSL
	7782-49-2	Selenium	0.1 J	0.56 J	ug/L	22SW024	5/12	0.2 - 0.2	0.56	**0.24 J**	7.8 N	50	50 M	No	BSL
	7440-22-4	Silver	0.032 J	0.032 J	ug/L	22SW009	1/12	0.06 - 0.19	0.032	**ND**	7.1 N	NA	71 N	No	BSL
	Metals (Dissolved)														
	7440-38-2	**Arsenic**	0.19 J	0.35	ug/L	22SW018	5/9	0.18 - 0.18	0.35	0.44 J	**0.045 C**	10	10 M	**Yes**	ASL
	7440-39-3	Barium	26	73.9	ug/L	22SW003	9/9	-	73.9	77.4 J	290 N	2,000	2,000 M	No	BSL
	7440-43-9	Cadmium	0.066 J	0.26 J	ug/L	22SW007	3/9	0.04 - 0.043	0.26	**ND**	0.69 N	5	5 M	No	BSL
	7440-47-3	Chromium	0.27 J	0.75	ug/L	22SW004	8/8	-	0.75	**0.46 J**	1,600 N[8]	100	16,000 N[8]	No	BSL
	7439-92-1	Lead	0.11 J	0.69 J	ug/L	22SW007	3/8	0.22 - 0.22	0.69	0.12 J	15	15 [9]	15 M	No	BSL
	7439-97-6	Mercury	0.067 J	0.068 J	ug/L	22SW004	2/9	0.12 - 0.12	0.068	0.084 J	0.43 N[10]	2	2	No	BSL
	7440-22-4	Silver	0.057 J	0.067 J	ug/L	22SW006	2/9	0.06 - 0.06	0.067	**ND**	7.1 N	NA	71 N	No	BSL
	Miscellaneous Parameters														
	14797-73-0	Perchlorate	0.4 J	0.4 J	ug/L	22SW002	1/8	0.4 - 0.4	0.4	**ND**	1.1 N	15	15 M	No	BSL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Surface water samples 22SW011, 22SW012, 22SW013, 22SW014, 22SW015, and 22SW016. Only sample 22SW011 was analyzed for metals, therefore a background comparison could not be performed.
Concentrations are presented for information purposes only.
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
5 - 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, April 2012).
6 - IDEM Closure Guide, March 1, 2013.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - Values are for trivalent chromium.
9 - The MCL for this parameter is actually a treatment technique. The SDWA action level (at the tap) has been presented.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples

22SW001	22SW009	22SW017_20120511
22SW002	22SW010	22SW021
22SW003	22SW017	22SW023
22SW004	22SW018	22SW024
22SW006	22SW019	22SW010_20120512
22SW007	22SW020	

Definitions:
C = Carcinogen
CAS = Chemical Abstracts Service
COPC = Chemical Of Potential Concern
J = Estimated value
M = Maximum Contaminant Level
N = Noncarcinogen
NA = Not Applicable/Not Available
ND = Not detected

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level/ARAR/TBC

For elimination as a COPC:
BSL = Below COPC Screening Level

TABLE 2.7
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
SWMU 22 - LEAD AZIDE POND
NSA CRANE, CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[(1)]	Concentration Used for Screening[(2)]	Range of Background Concentrations[(3)]	Adjusted USEPA RSL Residential Soil[(4)]	IDEM Residential Soil[(5)]	COPC Flag	Rationale for Contaminant Deletion or Selection[(6)]
SWMU 22	**Metals**													
	7440-38-2	**Arsenic**	1.2 J	14.7	mg/kg	22SD0230006	17/17	-	14.7	**5.5**	**0.39 C**	**5.5 C**	**Yes**	ASL
	7440-39-3	Barium	8.6 J	173 J	mg/kg	22SD0030006	17/17	-	173	**42.1**	1500 N	21000 N	No	BSL
	7440-43-9	Cadmium	0.071 J	0.88 J	mg/kg	22SD0060006	17/17	-	0.88	**0.28**	7 N	98 N	No	BSL
	7440-47-3	Chromium	2.5 J	16.2 J	mg/kg	22SD0030006	17/17	-	13.9	**10**	12,000 N[(7)]	100,000 L[(7)]	No	BSL
	7439-92-1	Lead	4 J	20 J	mg/kg	22SD0080624	17/17	-	20	**11.3**	400	400	No	BSL
	7439-97-6	Mercury	0.038 J	0.26	mg/kg	22SD0090006	4/17	0.03 - 0.056	0.26	**0.086 J**	2.3 N[(8)]	32 N[(8)]	No	BSL
	7782-49-2	Selenium	0.044 J	0.61	mg/kg	22SD0230006	17/17	-	0.61	**0.42**	39 N	550 N	No	BSL
	7440-22-4	Silver	0.02 J	0.025 J	mg/kg	22SD0010006	3/17	0.04 - 0.04	0.025	**ND**	39 N	550 N	No	BSL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - Sediment sample 22SD0170006. There is only one upgradient sediment sample, therefore a background comparison could not be performed.
Concentrations are presented for information purposes only.
4 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
5 - IDEM Closure Guide, March 1, 2013.
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
7 - Value is for trivalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples

22SD0010006	22SD0080624
22SD0020006	22SD0090006
22SD0030006	22SD0100006
22SD0040006	22SD0100006_20120512
22SD0050006	22SD0110006
22SD0060006	22SD0180006
22SD0060624	22SD0180006_20120512
22SD0070006	22SD0230006
22SD0070624	22SD0240006
22SD0080006	

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000
N = Noncarcinogen
NA = Not Applicable/Not Available
ND = Not detected

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level.

For elimination as a COPC:
BSL = Below COPC Screening Level

RAGS Part D Table 3

Medium-Specific Exposure Point Concentration Summary

LIST OF TABLES

RAGS PART D TABLE 3

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Table No.

3.1.RME	Groundwater
3.2.RME	Surface Water
3.3.RME	Sediment

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE INDIANA

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 22	RDX	ug/L	4.0	(1)	15 J	15	ug/L	Maximum Detected Concentration	(1)
	Arsenic	ug/L	3.7	(1)	5.5	5.5	ug/L	Maximum Detected Concentration	(1)
	Cadmium	ug/L	2.6	(1)	4.7	4.7	ug/L	Maximum Detected Concentration	(1)
	Lead	ug/L	13.8	(2)	21.4 J	13.8	ug/L	Arithmetic Mean	(2)
	Perchlorate	ug/L	1.6	(1)	5.9 J	5.9	ug/L	Maximum Detected Concentration	(1)

G - Gamma distribution.
N - Normal distribution.

1 - ProUCL could not calculate an UCL therefore the maximum detected concentration is used as the exposure point concentration.
2 - USEPA Guidance recommends using the average concentration for the exposure point concentration for lead.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE 3.2.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE INDIANA

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 22	RDX	ug/L	0.51	0.85 (G)	2.5	0.85	ug/L	95% KM (t) UCL	ProUCL 4.1.01
	Arsenic	ug/L	0.42	0.64 (G)	1.5	0.64	ug/L	95% KM (Percentile Bootstrap) UCL	ProUCL 4.1.01
	Cadmium	ug/L	0.26	0.58 (NP)	1.7 J	0.58	ug/L	95% KM (t) UCL	ProUCL 4.1.01

G = Gamma distribution.
NP = Non-parametric

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE 3.3.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE INDIANA

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 22	Arsenic	mg/kg	4.6	6.2 (G)	14.7	6.2	mg/kg	95% Approximate Gamma UCL	ProUCL 4.1.01

G = Gamma distribution.
NP = Non-parametric

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

RAGS Part D Table 4

Values Used For Daily Intake Calculations

LIST OF TABLES
RAGS PART D TABLE 4
VALUES USED FOR DAILY INTAKE CALCULATIONS

Table No.

Reasonable Maximum Exposures

4.1.RME	Construction Workers Exposed to Groundwater
4.2.RME	Adolescent Trespassers Exposed to Surface Water
4.3.RME	Adolescent Trespassers Exposed to Sediment
4.4.RME	Child Recreational Users Exposed to Surface Water
4.5.RME	Child Recreational Users Exposed to Sediment
4.6.RME	Adult Recreational Users Exposed to Surface Water
4.7.RME	Adult Recreational Users Exposed to Sediment
4.8.RME	Child Residents Exposed to Groundwater
4.9.RME	Child Residents Exposed to Surface Water
4.10.RME	Child Residents Exposed to Sediment
4.11.RME	Adult Residents Exposed to Groundwater
4.12.RME	Adult Residents Exposed to Surface Water
4.13.RME	Adult Residents Exposed to Sediment

Tendency Exposures

4.1.CTE	Construction Workers Exposed to Groundwater
4.2.CTE	Adolescent Trespassers Exposed to Surface Water
4.3.CTE	Adolescent Trespassers Exposed to Sediment
4.4.CTE	Child Recreational Users Exposed to Surface Water
4.5.CTE	Child Recreational Users Exposed to Sediment
4.6.CTE	Adult Recreational Users Exposed to Surface Water
4.7.CTE	Adult Recreational Users Exposed to Sediment
4.8.CTE	Child Residents Exposed to Groundwater
4.9.CTE	Child Residents Exposed to Surface Water
4.10.CTE	Child Residents Exposed to Sediment
4.11.CTE	Adult Residents Exposed to Groundwater
4.12.CTE	Adult Residents Exposed to Surface Water
4.13.CTE	Adult Residents Exposed to Sediment

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - GROUNDWATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Workers	Adult	SWMU 22	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	$\frac{\text{DAevent x EV x EF x ED x SA}}{\text{BW x AT}}$
				CF	Conversion factor	0.001	L/cm^3	- -	
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	30	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	1	years	(1)	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	70	kg	USEPA, 1989	2 x τ +(1 + 3B + 3B^2)/(1+B^2)
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes

1 - Professional judgment. Assumes construction workers are only exposed to groundwater water during part of the construction project.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	4	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	52	events/year	(1)	BW x AT
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3,280	cm2	(3)	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	52	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	70	kg	USEPA, 1989	2 x τ +(1 + 3B + $3B^2$)/($1+B^2$)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

1 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.

2 - For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Assume 25 percent of total body surface area is exposed, U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CSx IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	3,280	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

1 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.

2 - For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Assume 25 percent of total body surface area is exposed, U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RECREATIONAL USERS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hr	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	4	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	52	events/year	(2)	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Recreational User	Child	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	52	days/year	(2)	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1989, 2005	2 x τ +(1 + 3B + $3B^2$)/($1+B^2$)
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Professional judgment.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RECREATIONAL USERS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Recreational User	Child	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	52	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Assume two days a week in warm weather months for RME and one day a week for CTE.

2 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.6.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RECREATIONAL USERS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	4	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	52	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Recreational User	Adult	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	52	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1989, 2005	2 x τ +(1 + 3B + $3B^2$)/($1+B^2$)
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.7.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RECREATIONAL USERS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CSx IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Recreational User	Adult	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	52	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.8.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - GROUNDWATER

NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Child	SWMU 22	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1	L/day	USEPA, 1991	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1991	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Residents	Child	SWMU 22	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	1	hr/event	USEPA, 2004	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,600	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1994	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.9.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hr	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	4	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	52	events/year	(2)	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	52	days/year	(2)	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1989, 2005	2 x τ +(1 + 3B + 3B^2)/(1+B^2)
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Professional judgment.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.10.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	52	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Assume two days a week in warm weather months for RME and one day a week for CTE.

2 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.11.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - GROUNDWATER

NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	SWMU 22	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	2	L/day	USEPA, 1991	$\frac{CGW \times CF \times IR\text{-}GW \times EF \times ED}{BW \times AT}$
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Residents	Adult	SWMU 22	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	$\frac{DAevent \times EV \times EF \times ED \times SA}{BW \times AT}$
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	
				CF	Conversion factor	0.001	L/cm^3	- -	
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	For inorganics
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	
				tevent	Duration of event	0.58	hr/event	USEPA, 2004	For organics if tevent <= t*
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				SA	Skin Surface Available for Contact	18,000	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1994	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.12.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	4	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	52	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	52	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1989, 2005	2 x τ +(1 + 3B + 3B^2)/(1+B^2)
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.13.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CSx IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	52	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - GROUNDWATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Workers	Adult	SWMU 22	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	15	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	1	years	(1)	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	70	kg	USEPA, 1989	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	26	events/year	(1)	BW x AT
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3,280	cm2	(3)	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	26	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	70	kg	USEPA, 1993	2 x τ +(1 + 3B + 3B^2)/(1+B^2)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

1 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.

2 - For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Assume 25 percent of total body surface area is exposed, U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

1 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.

2 - For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RECREATIONAL USERS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hr	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	26	events/year	(2)	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	1	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Recreational User	Child	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	26	days/year	(2)	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	1	years	(3), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	1	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Notes:

1 - Professional judgment.

2 - Assume two days a week in warm weather months for RME and one day a week for CTE.

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.5.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RECREATIONAL USERS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	(1)	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Recreational User	Child	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Notes:

1 - Assume two days a week in warm weather months for RME and one day a week for CTE.

2 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.6.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RECREATIONAL USERS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	26	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Recreational User	Adult	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	26	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	5	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1993	2 x τ +(1 + 3B + $3B^2$)/($1+B^2$)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.7.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RECREATIONAL USERS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Recreational User	Adult	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.8.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - GROUNDWATER

NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Child	SWMU 22	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	0.66	L/day	USEPA, 1997	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	234	days/year	USEPA, 1993	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Residents	Child	SWMU 22	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	0.33	hr/event	USEPA, 2004	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,600	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1993	2 x τ +(1 + 3B + 3B^2)/(1+B^2)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.9.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hr	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	26	events/year	(2)	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	1	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Resident	Child	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	26	days/year	(2)	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	1	years	(3), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	1	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	2 x τ +(1 + 3B + 3B^2)/(1+B^2)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Notes:

1 - Professional judgment.

2 - Assume two days a week in warm weather months for RME and one day a week for CTE.

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.10.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	(1)	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Resident	Child	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Notes:

1 - Assume two days a week in warm weather months for RME and one day a week for CTE.

2 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.11.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - GROUNDWATER

NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	SWMU 22	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1.4	L/day	USEPA, 1993	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	234	days/year	USEPA, 1993	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Residents	Adult	SWMU 22	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	0.25	hr/event	USEPA, 2004	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	18,000	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.12.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SURFACE WATER

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SWMU 22	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA, 2011	
				CF	Conversion factor	0.001	mg/ug	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	26	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Resident	Adult	SWMU 22	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	26	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	5	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1993	2 x τ +(1 + 3B + $3B^2$)/($1+B^2$)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2011: Exposure Factors Handbook: 2011 Edition. Table 3-93. Value is upper confidence limit for fishing.

TABLE 4.13.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SEDIMENT

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Resident	Adult	SWMU 22	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

RAGS Part D Table 5

Non-Cancer Toxicity Data

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RAGS PART D TABLE 5
NON-CANCER TOXICITY DATA

Table No.	
5-1	Non-Cancer Toxicity Data - Oral/Dermal
5-2	Non-Cancer Toxicity Data - Inhalation

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Explosives										
RDX	Subchronic	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	Central Nervous System	30/1	ATSDR	1/2012
	Chronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Prostate	100/1	IRIS	4/15/2013
Inorganics										
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, Cardiovascular System	3/1	IRIS	4/15/2013
Cadmium	Chronic	5.0E-04	mg/kg/day	0.05	2.5E-05	mg/kg/day	Kidney	10/1	IRIS	4/15/2013
Hexavalent Chromium	Subchronic	2.0E-02	mg/kg/day	0.025	5.0E-04	mg/kg/day	None Reported	100/3	HEAST	9/97
	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	None Reported	300/3	IRIS	4/15/2013
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Compounds										
Perchlorate	Chronic	7.0E-04	mg/kg/day	1	7.0E-04	mg/kg/day	Thyroid	10/1	IRIS	4/15/2013

Notes:

1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

Definitions:

ATSDR = Agency for Toxic Substances and Disease Registry

IRIS = Integrated Risk Information System

NA = Not Available.

PPRTV = Provisional Peer Reviewed Toxicity Value.

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Explosives									
RDX	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics									
Arsenic	Chronic	1.5E-05	mg/m3	4.3E-06	(mg/kg/day)	Skin, Cardiovascular System	NA	Cal EPA	9/2009
Cadmium	Chronic	2.0E-05	mg/m3	5.7E-06	(mg/kg/day)	Kidney, Respiratory	NA	Cal EPA	9/2009
Hexavalent Chromium	Chronic	1.0E-04	mg/m3	2.9E-05	(mg/kg/day)	Respiratory	300/1	IRIS	4/15/2013
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Compounds									
Perchlorate	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - Extrapolated RfD = RfC *20m^3/day / 70 kg

Definitions:
Cal EPA = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.
NA = Not Applicable

RAGS Part D Table 6

Cancer Toxicity Data

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RAGS PART D TABLE 6
CANCER TOXICITY DATA

Table No.

Table No.	
6-1	Cancer Toxicity Data - Oral/Dermal
6-2	Cancer Toxicity Data - Inhalation

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal(1)	Absorbed Cancer Slope Factor for Dermal(2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Explosives								
RDX	1.1E-01	$(mg/kg/day)^{-1}$	1	1.1E-01	$(mg/kg/day)^{-1}$	C (Possible human carcinogen)	IRIS	4/15/2013
Inorganics								
Arsenic	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A / human carcinogen	IRIS	4/15/2013
Cadmium	NA	NA	NA	NA	NA	B1 /Known/likely human carcinogen.	IRIS	4/15/2013
Hexavalent Chromium	5.0E-01	$(mg/kg/day)^{-1}$	0.025	2.0E+01	$(mg/kg/day)^{-1}$	Carcinogenic potential cannot be determined (Oral route)	NJDEP	4/8/2009
Lead	NA	NA	NA	NA	NA	B2 / Probable human carcinogen	IRIS	4/15/2013
Miscellaneous Compounds								
Perchlorate	NA	NA	NA	NA	NA	Not likely to be carcinogenic to humans	IRIS	4/15/2013

Notes:

1 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral absorption efficiency for dermal.

IRIS = Integrated Risk Information System.

NA = Not Available.

NJDEP = New Jersey Department of Environmental Protection.

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor(1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Explosives							
RDX	NA	NA	NA	NA	C (Possible human carcinogen)	IRIS	4/15/2013
Inorganics							
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	4/15/2013
Cadmium	1.8E-03	$(ug/m^3)^{-1}$	6.3E+00	$(mg/kg/day)^{-1}$	B1 /Known/likely human carcinogen.	IRIS	4/15/2013
Hexavalent Chromium	8.4E-02	$(ug/m^3)^{-1}$	2.9E+02	$(mg/kg/day)^{-1}$	Known/likely human carcinogen (Inhalation route)	IRIS	4/15/2013
Lead	NA	NA	NA	NA	B2 / Probable human carcinogen	IRIS	4/15/2013
Miscellaneous Compounds							
Perchlorate	NA	NA	NA	NA	Not likely to be carcinogenic to humans	IRIS	4/15/2013

Notes:
1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

Definitions:
IRIS = Integrated Risk Information System.

RAGS Part D Table 7

Calculation of Cancer Risks and Non-Cancer Hazards

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RAGS PART D TABLE 7

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

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	Reasonable Maximum Exposures
7.1.RME	Construction Workers
7.2.RME	Adolescent Trespassers
7.3.RME	Child Recreational Users
7.4.RME	Adult Recreational Users
7.5.RME	Child Residents
7.6.RME	Adult Residents
	Central Tendency Exposures
7.1.CTE	Construction Workers
7.2.CTE	Adolescent Trespassers
7.3.CTE	Child Recreational Users
7.4.CTE	Adult Recreational Users
7.5.CTE	Child Residents
7.6.CTE	Adult Residents

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 22	Dermal	RDX	15.0	ug/L	2.1E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	2.3E-10	1.5E-07	(mg/kg/day)	1.0E-01	(mg/kg/day)	0.000001
				Arsenic	5.50	ug/L	1.2E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.8E-09	8.5E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0003
				Cadmium	4.70	ug/L	1.0E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.3E-08	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.003
				Hexavalent Chromium	0.05	ug/L	2.0E-11	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	4.1E-10	1.4E-09	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.000003
				Lead	13.8	ug/L	3.1E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.1E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	1.3E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	9.1E-08	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.0001
			Exp. Route Total								2.5E-09					0.003
		Exposure Point Total									2.5E-09					0.003
	Exposure Medium Total										2.5E-09					0.003
Medium Total											2.5E-09					0.003
							Total of Receptor Risks Across All Media				2.5E-09	Total of Receptor Hazards Across All Media				0.003

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	1.6E-08	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	1.8E-09	1.1E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00004
				Arsenic	0.640	ug/L	1.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.8E-08	8.5E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0003
				Cadmium	0.580	ug/L	1.1E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.7E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0002
			Exp. Route Total								2.0E-08					0.0005
			Dermal	RDX	0.850	ug/L	3.3E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	3.7E-10	2.3E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000008
				Arsenic	0.640	ug/L	4.0E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6.0E-09	2.8E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00009
				Cadmium	0.580	ug/L	3.6E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.5E-08	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.001
			Exp. Route Total								6.3E-09					0.001
		Exposure Point Total									2.6E-08					0.002
	Exposure Medium Total										2.6E-08					0.002
Medium Total											2.6E-08					0.002
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	7.3E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-07	5.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								1.1E-07					0.002
			Dermal	Arsenic	6.20	mg/kg	2.9E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.3E-08	2.0E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0007
			Exp. Route Total								4.3E-08					0.0007
		Exposure Point Total									1.5E-07					0.002
	Exposure Medium Total										1.5E-07					0.002
Medium Total											1.5E-07					0.002
										Total of Receptor Risks Across All Media	1.8E-07				Total of Receptor Hazards Across All Media	0.004

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	2.8E-08	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	3.0E-09	3.2E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0001
				Arsenic	0.640	ug/L	2.1E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.1E-08	2.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0008
				Cadmium	0.580	ug/L	1.9E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.2E-07	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0004
			Exp. Route Total								3.4E-08					0.001
			Dermal	RDX	0.850	ug/L	4.9E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	5.4E-10	5.7E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00002
				Arsenic	0.640	ug/L	5.8E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	8.8E-09	6.8E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Cadmium	0.580	ug/L	5.3E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.2E-08	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.002
			Exp. Route Total								9.3E-09					0.003
		Exposure Point Total									4.4E-08					0.004
	Exposure Medium Total										4.4E-08					0.004
Medium Total											4.4E-08					0.004
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	5.0E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.6E-07	5.9E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
			Exp. Route Total								7.6E-07					0.02
			Dermal	Arsenic	6.20	mg/kg	8.5E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.3E-07	9.9E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
			Exp. Route Total								1.3E-07					0.003
		Exposure Point Total									8.8E-07					0.02
	Exposure Medium Total										8.8E-07					0.02
Medium Total											8.8E-07					0.02
							Total of Receptor Risks Across All Media				9.3E-07	Total of Receptor Hazards Across All Media				0.03

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.4.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	2.4E-08	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	2.6E-09	6.9E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00002
				Arsenic	0.640	ug/L	1.8E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.7E-08	5.2E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Cadmium	0.580	ug/L	1.6E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.7E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.00009
			Exp. Route Total								2.9E-08					0.0003
			Dermal	RDX	0.850	ug/L	8.5E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	9.4E-10	2.5E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000008
				Arsenic	0.640	ug/L	1.0E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.5E-08	3.0E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00010
				Cadmium	0.580	ug/L	9.2E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.7E-08	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.001
			Exp. Route Total								1.6E-08					0.001
		Exposure Point Total									4.6E-08					0.001
	Exposure Medium Total										4.6E-08					0.001
Medium Total											4.6E-08					0.001
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	2.2E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.2E-07	6.3E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								3.2E-07					0.002
			Dermal	Arsenic	6.20	mg/kg	5.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.8E-08	1.5E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
			Exp. Route Total								7.8E-08					0.0005
		Exposure Point Total									4.0E-07					0.003
	Exposure Medium Total										4.0E-07					0.003
Medium Total											4.0E-07					0.003
										Total of Receptor Risks Across All Media	4.5E-07				Total of Receptor Hazards Across All Media	0.004

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 22	Ingestion	RDX	15.0	ug/L	8.2E-05	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	9.0E-06	9.6E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.3
				Arsenic	5.50	ug/L	3.0E-05	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.5E-05	3.5E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	1.2
				Cadmium	4.70	ug/L	2.6E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.0E-04	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.6
				Hexavalent Chromium	0.05	ug/L	1.3E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	6.7E-07	2.9E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0010
				Lead	13.8	ug/L	7.6E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.8E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	3.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.8E-04	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.5
			Exp. Route Total								5.5E-05					2.6
			Dermal	RDX	15.0	ug/L	6.8E-07	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	7.5E-08	8.0E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.003
				Arsenic	5.50	ug/L	2.0E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.0E-07	2.3E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.008
				Cadmium	4.70	ug/L	1.7E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.0E-06	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.08
				Hexavalent Chromium	0.05	ug/L	1.8E-08	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	3.5E-07	3.9E-08	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.0005
				Lead	13.8	ug/L	5.0E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.8E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	2.1E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.5E-06	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.004
			Exp. Route Total								7.3E-07					0.09
		Exposure Point Total									5.6E-05					2.7
	Exposure Medium Total										5.6E-05					2.7
Medium Total											5.6E-05					2.7
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	1.4E-08	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	1.5E-09	1.6E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00005
				Arsenic	0.640	ug/L	1.0E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.6E-08	1.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
				Cadmium	0.580	ug/L	9.4E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-07	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0002
			Exp. Route Total								1.7E-08					0.0007
			Dermal	RDX	0.850	ug/L	2.4E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	2.7E-10	2.8E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000009
				Arsenic	0.640	ug/L	2.9E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.4E-09	3.4E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0001
				Cadmium	0.580	ug/L	2.6E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.1E-08	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.001
			Exp. Route Total								4.6E-09					0.001
		Exposure Point Total									2.2E-08					0.002
	Exposure Medium Total										2.2E-08					0.002
Medium Total											2.2E-08					0.002
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	2.5E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.8E-07	2.9E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.010
			Exp. Route Total								3.8E-07					0.010
			Dermal	Arsenic	6.20	mg/kg	4.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6.4E-08	4.9E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								6.4E-08					0.002
		Exposure Point Total									4.4E-07					0.01
	Exposure Medium Total										4.4E-07					0.01
Medium Total											4.4E-07					0.01
							Total of Receptor Risks Across All Media				5.6E-05	Total of Receptor Hazards Across All Media				2.7

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.6.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 22	Ingestion	RDX	15.0	ug/L	1.4E-04	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	1.5E-05	4.1E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.1
				Arsenic	5.50	ug/L	5.2E-05	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.7E-05	1.5E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.5
				Cadmium	4.70	ug/L	4.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-04	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.3
				Hexavalent Chromium	0.05	ug/L	7.9E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	4.0E-07	1.3E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0004
				Lead	13.8	ug/L	1.3E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.8E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	5.5E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.6E-04	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.2
			Exp. Route Total								9.3E-05					1.1
			Dermal	RDX	15.0	ug/L	1.2E-06	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	1.3E-07	3.5E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.001
				Arsenic	5.50	ug/L	2.7E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.0E-07	7.9E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Cadmium	4.70	ug/L	2.3E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.7E-07	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.03
				Hexavalent Chromium	0.05	ug/L	8.3E-09	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	1.7E-07	1.3E-08	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.0002
				Lead	13.8	ug/L	6.8E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.0E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	2.9E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.4E-07	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.001
			Exp. Route Total								7.0E-07					0.03
		Exposure Point Total									9.4E-05					1.2
	Exposure Medium Total										9.4E-05					1.2
Medium Total											9.4E-05					1.2
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	2.4E-08	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	2.6E-09	6.9E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00002
				Arsenic	0.640	ug/L	1.8E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.7E-08	5.2E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Cadmium	0.580	ug/L	1.6E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.7E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.00009
			Exp. Route Total								2.9E-08					0.0003
			Dermal	RDX	0.850	ug/L	8.5E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	9.4E-10	2.5E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000008
				Arsenic	0.640	ug/L	1.0E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.5E-08	3.0E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00010
				Cadmium	0.580	ug/L	9.2E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.7E-08	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.001
			Exp. Route Total								1.6E-08					0.001
		Exposure Point Total									4.6E-08					0.001
	Exposure Medium Total										4.6E-08					0.001
Medium Total											4.6E-08					0.001
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	2.2E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.2E-07	6.3E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								3.2E-07					0.002
			Dermal	Arsenic	6.20	mg/kg	5.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.8E-08	1.5E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
			Exp. Route Total								7.8E-08					0.0005
		Exposure Point Total									4.0E-07					0.003
	Exposure Medium Total										4.0E-07					0.003
Medium Total											4.0E-07					0.003
										Total of Receptor Risks Across All Media	9.5E-05				Total of Receptor Hazards Across All Media	1.2

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.1.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 22	Dermal	RDX	15.0	ug/L	7.4E-10	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	8.1E-11	5.2E-08	(mg/kg/day)	1.0E-01	(mg/kg/day)	5.2E-7
				Arsenic	5.50	ug/L	3.0E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.6E-10	2.1E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00007
				Cadmium	4.70	ug/L	2.6E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.8E-08	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.0007
				Hexavalent Chromium	0.05	ug/L	5.1E-12	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	1.0E-10	3.6E-10	(mg/kg/day)	5.0E-04	(mg/kg/day)	7.1E-7
				Lead	13.8	ug/L	7.6E-11	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.3E-09	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	3.3E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.3E-08	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.00003
			Exp. Route Total								6.4E-10					0.0008
		Exposure Point Total									6.4E-10					0.0008
	Exposure Medium Total										6.4E-10					0.0008
Medium Total											6.4E-10					0.0008
							Total of Receptor Risks Across All Media				6.4E-10	Total of Receptor Hazards Across All Media				0.0008

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.2.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	4.0E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	4.4E-10	2.8E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000009
				Arsenic	0.640	ug/L	3.0E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.5E-09	2.1E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00007
				Cadmium	0.580	ug/L	2.7E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.9E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.00004
			Exp. Route Total								5.0E-09					0.0001
			Dermal	RDX	0.850	ug/L	1.2E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	1.3E-10	8.2E-09	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000003
				Arsenic	0.640	ug/L	9.9E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.5E-09	7.0E-09	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00002
				Cadmium	0.580	ug/L	9.0E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.3E-09	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.0003
			Exp. Route Total								1.6E-09					0.0003
		Exposure Point Total									6.6E-09					0.0004
	Exposure Medium Total										6.6E-09					0.0004
Medium Total											6.6E-09					0.0004
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	1.8E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.8E-08	1.3E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
			Exp. Route Total								2.8E-08					0.0004
			Dermal	Arsenic	6.20	mg/kg	5.1E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.6E-09	3.5E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0001
			Exp. Route Total								7.6E-09					0.0001
		Exposure Point Total									3.5E-08					0.0005
	Exposure Medium Total										3.5E-08					0.0005
Medium Total											3.5E-08					0.0005
										Total of Receptor Risks Across All Media	4.2E-08				Total of Receptor Hazards Across All Media	0.0009

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.3.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	2.3E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	2.5E-10	8.1E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00003
				Arsenic	0.640	ug/L	1.7E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.6E-09	6.1E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Cadmium	0.580	ug/L	1.6E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.5E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0001
			Exp. Route Total								2.9E-09					0.0003
			Dermal	RDX	0.850	ug/L	5.8E-10	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	6.3E-11	2.0E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000007
				Arsenic	0.640	ug/L	4.9E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.3E-10	1.7E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00006
				Cadmium	0.580	ug/L	4.4E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.5E-08	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.0006
			Exp. Route Total								7.9E-10					0.0007
		Exposure Point Total									3.7E-09					0.001
	Exposure Medium Total										3.7E-09					0.001
Medium Total											3.7E-09					0.001
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	4.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6.3E-08	1.5E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.005
			Exp. Route Total								6.3E-08					0.005
			Dermal	Arsenic	6.20	mg/kg	2.8E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.2E-09	9.9E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0003
			Exp. Route Total								4.2E-09					0.0003
		Exposure Point Total									6.7E-08					0.005
	Exposure Medium Total										6.7E-08					0.005
Medium Total											6.7E-08					0.005
									Total of Receptor Risks Across All Media		7.1E-08		Total of Receptor Hazards Across All Media			0.006

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.4.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	1.7E-09	(mg/kg/day)	1.1E-01	(mg/kg/day)$^{-1}$	1.9E-10	1.7E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000006
				Arsenic	0.640	ug/L	1.3E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2.0E-09	1.3E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00004
				Cadmium	0.580	ug/L	1.2E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.2E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.00002
			Exp. Route Total								2.1E-09					0.00007
			Dermal	RDX	0.850	ug/L	8.8E-10	(mg/kg/day)	1.1E-01	(mg/kg/day)$^{-1}$	9.7E-11	8.8E-09	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000003
				Arsenic	0.640	ug/L	7.4E-10	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.1E-09	7.4E-09	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00002
				Cadmium	0.580	ug/L	6.7E-10	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.7E-09	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.0003
			Exp. Route Total								1.2E-09					0.0003
		Exposure Point Total									3.4E-09					0.0004
	Exposure Medium Total										3.4E-09					0.0004
Medium Total											3.4E-09					0.0004
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	1.6E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2.4E-08	1.6E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
			Exp. Route Total								2.4E-08					0.0005
			Dermal	Arsenic	6.20	mg/kg	1.1E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.6E-09	1.1E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00004
			Exp. Route Total								1.6E-09					0.00004
		Exposure Point Total									2.5E-08					0.0006
	Exposure Medium Total										2.5E-08					0.0006
Medium Total											2.5E-08					0.0006
										Total of Receptor Risks Across All Media	2.9E-08				Total of Receptor Hazards Across All Media	0.0009

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.5.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 22	Ingestion	RDX	15.0	ug/L	3.6E-05	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	4.0E-06	4.2E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.1
				Arsenic	5.50	ug/L	1.3E-05	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.0E-05	1.6E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.5
				Cadmium	4.70	ug/L	1.1E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-04	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.3
				Hexavalent Chromium	0.05	ug/L	5.9E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	3.0E-07	1.3E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0004
				Lead	13.8	ug/L	3.3E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.9E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	1.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.7E-04	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.2
			Exp. Route Total								2.4E-05					1.2
			Dermal	RDX	15.0	ug/L	2.6E-07	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	2.9E-08	3.1E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.001
				Arsenic	5.50	ug/L	4.4E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6.6E-08	5.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Cadmium	4.70	ug/L	3.8E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.4E-07	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.02
				Hexavalent Chromium	0.05	ug/L	3.9E-09	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	7.8E-08	8.6E-09	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.0001
				Lead	13.8	ug/L	1.1E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	4.7E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.5E-07	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.0008
			Exp. Route Total								1.7E-07					0.02
		Exposure Point Total									2.4E-05					1.2
	Exposure Medium Total										2.4E-05					1.2
Medium Total											2.4E-05					1.2
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	1.2E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	1.3E-10	4.0E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00001
				Arsenic	0.640	ug/L	8.7E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.3E-09	3.0E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0001
				Cadmium	0.580	ug/L	7.9E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.8E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.00006
			Exp. Route Total								1.4E-09					0.0002
			Dermal	RDX	0.850	ug/L	2.9E-10	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	3.2E-11	1.0E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000003
				Arsenic	0.640	ug/L	2.4E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.6E-10	8.5E-09	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00003
				Cadmium	0.580	ug/L	2.2E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.7E-09	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.0003
			Exp. Route Total								4.0E-10					0.0003
		Exposure Point Total									1.8E-09					0.0005
	Exposure Medium Total										1.8E-09					0.0005
Medium Total											1.8E-09					0.0005
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	2.1E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.2E-08	7.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								3.2E-08					0.002
			Dermal	Arsenic	6.20	mg/kg	1.4E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.1E-09	4.9E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
			Exp. Route Total								2.1E-09					0.0002
		Exposure Point Total									3.4E-08					0.003
	Exposure Medium Total										3.4E-08					0.003
Medium Total											3.4E-08					0.003
							Total of Receptor Risks Across All Media				2.4E-05	Total of Receptor Hazards Across All Media				1.2

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.6.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 22	Ingestion	RDX	15.0	ug/L	1.9E-05	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	2.1E-06	1.9E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.06
				Arsenic	5.50	ug/L	7.1E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-05	7.1E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.2
				Cadmium	4.70	ug/L	6.0E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.0E-05	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.1
				Hexavalent Chromium	0.05	ug/L	9.3E-08	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	4.6E-08	5.9E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0002
				Lead	13.8	ug/L	1.8E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.8E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	7.6E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.6E-05	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.1
			Exp. Route Total								1.3E-05					0.5
			Dermal	RDX	15.0	ug/L	2.3E-07	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	2.6E-08	2.3E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0008
				Arsenic	5.50	ug/L	3.4E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.1E-08	3.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.001
				Cadmium	4.70	ug/L	2.9E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.9E-07	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.01
				Hexavalent Chromium	0.05	ug/L	8.9E-10	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	1.8E-08	5.7E-09	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.00008
				Lead	13.8	ug/L	8.5E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.5E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Perchlorate	5.90	ug/L	3.6E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.6E-07	(mg/kg/day)	7.0E-04	(mg/kg/day)	0.0005
			Exp. Route Total								9.4E-08					0.01
		Exposure Point Total									1.3E-05					0.5
	Exposure Medium Total										1.3E-05					0.5
Medium Total											1.3E-05					0.5
Surface Water	Surface Water	SWMU 22	Ingestion	RDX	0.850	ug/L	1.7E-09	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	1.9E-10	1.7E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000006
				Arsenic	0.640	ug/L	1.3E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.0E-09	1.3E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00004
				Cadmium	0.580	ug/L	1.2E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.00002
			Exp. Route Total								2.1E-09					0.00007
			Dermal	RDX	0.850	ug/L	8.8E-10	(mg/kg/day)	1.1E-01	$(mg/kg/day)^{-1}$	9.7E-11	8.8E-09	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.000003
				Arsenic	0.640	ug/L	7.4E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-09	7.4E-09	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00002
				Cadmium	0.580	ug/L	6.7E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.7E-09	(mg/kg/day)	2.5E-05	(mg/kg/day)	0.0003
			Exp. Route Total								1.2E-09					0.0003
		Exposure Point Total									3.4E-09					0.0004
	Exposure Medium Total										3.4E-09					0.0004
Medium Total											3.4E-09					0.0004
Sediment	Sediment	SWMU 22	Ingestion	Arsenic	6.20	mg/kg	1.6E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.4E-08	1.6E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
			Exp. Route Total								2.4E-08					0.0005
			Dermal	Arsenic	6.20	mg/kg	1.1E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.6E-09	1.1E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00004
			Exp. Route Total								1.6E-09					0.00004
		Exposure Point Total									2.5E-08					0.0006
	Exposure Medium Total										2.5E-08					0.0006
Medium Total											2.5E-08					0.0006
										Total of Receptor Risks Across All Media	1.3E-05				Total of Receptor Hazards Across All Media	0.5

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

RAGS Part D Table 9

Summary of Receptor Risks and Hazards for COPCs

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RAGS PART D TABLE 9

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

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9.1.CTE	Construction Workers
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TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 22	RDX	- -	--	2E-10	--	2E-10	CNS	--	--	0.000001	0.000001
			Arsenic	- -	--	2E-09	--	2E-09	Skin, CVS	--	--	0.0003	0.0003
			Cadmium	- -	--	- -	--	- -	Kidney	--	--	0.003	0.003
			Hexavalent Chromium	- -	--	4E-10	--	4E-10	None Specified	--	--	0.000003	0.000003
			Lead	- -	--	- -	--	- -	NA	--	--	--	--
			Perchlorate	- -	--	- -	--	- -	Thyroid	--	--	0.0001	0.0001
			Chemical Total	- -	--	2E-09	--	2E-09		--	--	0.003	0.003
		Exposure Point Total						2E-09					0.003
	Exposure Medium Total							2E-09					0.003
Medium Total								2E-09					0.003
Receptor Total							Receptor Risk Total	2E-09				Receptor HI Total	0.003

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	SWMU 22	RDX	2E-09	--	4E-10	--	2E-09	Prostrate	0.00004	--	0.000008	0.00005
			Arsenic	2E-08	--	6E-09	--	2E-08	Skin, CVS	0.0003	--	0.00009	0.0004
			Cadmium	- -	--	- -	--	- -	Kidney	0.0002	--	0.001	0.001
			Chemical Total	2E-08	--	6E-09	--	3E-08		0.0005	--	0.001	0.002
		Exposure Point Total						3E-08					0.002
	Exposure Medium Total							3E-08					0.002
Medium Total								3E-08					0.002
Sediment	Sediment	SWMU 22	Arsenic	1E-07	--	4E-08	--	2E-07	Skin, CVS	0.002	--	0.0007	0.002
			Chemical Total	1E-07	--	4E-08	--	2E-07		0.002	--	0.0007	0.002
		Exposure Point Total						2E-07					0.002
	Exposure Medium Total							2E-07					0.002
Medium Total								2E-07					0.002
Receptor Total							Receptor Risk Total	2E-07				Receptor HI Total	0.004

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	SWMU 22	RDX	3E-09	--	5E-10	--	4E-09	Prostrate	0.0001	--	0.00002	0.0001
			Arsenic	3E-08	--	9E-09	--	4E-08	Skin, CVS	0.0008	--	0.0002	0.001
			Cadmium	- -	--	- -	--	- -	Kidney	0.0004	--	0.002	0.003
			Chemical Total	3E-08	--	9E-09	--	4E-08		0.001	--	0.003	0.004
		Exposure Point Total						4E-08					0.004
	Exposure Medium Total							4E-08					0.004
Medium Total								4E-08					0.004
Sediment	Sediment	SWMU 22	Arsenic	8E-07	--	1E-07	--	9E-07	Skin, CVS	0.02	--	0.003	0.02
			Chemical Total	8E-07	--	1E-07	--	9E-07		0.02	--	0.003	0.02
		Exposure Point Total						9E-07					0.02
	Exposure Medium Total							9E-07					0.02
Medium Total								9E-07					0.02
Receptor Total							Receptor Risk Total	9E-07				Receptor HI Total	0.03

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	SWMU 22	RDX	3E-09	--	9E-10	--	4E-09	Prostrate	0.00002	--	0.000008	0.00003
			Arsenic	3E-08	--	2E-08	--	4E-08	Skin, CVS	0.0002	--	0.00010	0.0003
			Cadmium	- -	--	- -	--	- -	Kidney	0.00009	--	0.001	0.001
			Chemical Total	3E-08	--	2E-08	--	5E-08		0.0003	--	0.001	0.001
		Exposure Point Total						5E-08					0.001
	Exposure Medium Total							5E-08					0.001
Medium Total								5E-08					0.001
Sediment	Sediment	SWMU 22	Arsenic	3E-07	--	8E-08	--	4E-07	Skin, CVS	0.002	--	0.0005	0.003
			Chemical Total	3E-07	--	8E-08	--	4E-07		0.002	--	0.0005	0.003
		Exposure Point Total						4E-07					0.003
	Exposure Medium Total							4E-07					0.003
Medium Total								4E-07					0.003
Receptor Total							Receptor Risk Total	4E-07				Receptor HI Total	0.004

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	SWMU 22	RDX	6E-09	--	1E-09	--	7E-09					
			Arsenic	6E-08	--	2E-08	--	8E-08					
			Cadmium	- -	--	- -	--	- -					
			Chemical Total	6E-08	--	3E-08	--	9E-08					
		Exposure Point Total						9E-08					
	Exposure Medium Total							9E-08					
Medium Total								9E-08					
Sediment	Sediment	SWMU 22	Arsenic	1E-06	--	2E-07	--	1E-06					
			Chemical Total	1E-06	--	2E-07	--	1E-06					
		Exposure Point Total						1E-06					
	Exposure Medium Total							1E-06					
Medium Total								1E-06					
Receptor Total							Receptor Risk Total	1E-06					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 22	RDX	9E-06	--	8E-08	--	9E-06	Prostrate	0.3	--	0.003	0.3
			Arsenic	5E-05	--	3E-07	--	5E-05	Skin, CVS	1	--	0.008	1
			Cadmium	- -	--	- -	--	- -	Kidney	0.6	--	0.08	0.7
			Hexavalent Chromium	7E-07	--	4E-07	--	1E-06	None Specified	0.0010	--	0.0005	0.001
			Lead	- -	--	- -	--	- -	NA	--	--	--	--
			Perchlorate	- -	--	- -	--	- -	Thyroid	0.5	--	0.004	0.5
			Chemical Total	5E-05	--	7E-07	--	6E-05		3	--	0.09	3
		Exposure Point Total						6E-05					3
	Exposure Medium Total							6E-05					3
Medium Total								6E-05					3
Surface Water	Surface Water	SWMU 22	RDX	2E-09	--	3E-10	--	2E-09	Prostrate	0.00005	--	0.000009	0.00006
			Arsenic	2E-08	--	4E-09	--	2E-08	Skin, CVS	0.0004	--	0.0001	0.0005
			Cadmium	- -	--	- -	--	- -	Kidney	0.0002	--	0.001	0.001
			Chemical Total	2E-08	--	5E-09	--	2E-08		0.0007	--	0.001	0.002
		Exposure Point Total						2E-08					0.002
	Exposure Medium Total							2E-08					0.002
Medium Total								2E-08					0.002
Sediment	Sediment	SWMU 22	Arsenic	4E-07	--	6E-08	--	4E-07	Skin, CVS	0.010	--	0.002	0.01
			Chemical Total	4E-07	--	6E-08	--	4E-07		0.010	--	0.002	0.01
		Exposure Point Total						4E-07					0.01
	Exposure Medium Total							4E-07					0.01
Medium Total								4E-07					0.01
Receptor Total							Receptor Risk Total	6E-05				Receptor HI Total	3

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total CVS HI	1
Total Kidney HI	0.7
Total Skin HI	1
Total Thyroid HI	0.5
Total None Specified HI	0.001

TABLE 9.7.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 22	RDX	2E-05	--	1E-07	--	2E-05	Prostrate	0.1	--	0.001	0.1
			Arsenic	8E-05	--	4E-07	--	8E-05	Skin, CVS	0.5	--	0.003	0.5
			Cadmium	- -	--	- -	--	- -	Kidney	0.3	--	0.03	0.3
			Hexavalent Chromium	4E-07	--	2E-07	--	6E-07	None Specified	0.0004	--	0.0002	0.0006
			Lead	- -	--	- -	--	- -	NA	--	--	--	--
			Perchlorate	- -	--	- -	--	- -	Thyroid	0.2	--	0.001	0.2
			Chemical Total	9E-05	--	7E-07	--	9E-05		1	--	0.03	1
		Exposure Point Total						9E-05					1
	Exposure Medium Total							9E-05					1
Medium Total								9E-05					1
Surface Water	Surface Water	SWMU 22	RDX	3E-09	--	9E-10	--	4E-09	Prostrate	0.00002	--	0.000008	0.00003
			Arsenic	3E-08	--	2E-08	--	4E-08	Skin, CVS	0.0002	--	0.00010	0.0003
			Cadmium	- -	--	- -	--	- -	Kidney	0.00009	--	0.001	0.001
			Chemical Total	3E-08	--	2E-08	--	5E-08		0.0003	--	0.001	0.001
		Exposure Point Total						5E-08					0.001
	Exposure Medium Total							5E-08					0.001
Medium Total								5E-08					0.001
Sediment	Sediment	SWMU 22	Arsenic	3E-07	--	8E-08	--	4E-07	Skin, CVS	0.002	--	0.0005	0.003
			Chemical Total	3E-07	--	8E-08	--	4E-07		0.002	--	0.0005	0.003
		Exposure Point Total						4E-07					0.003
	Exposure Medium Total							4E-07					0.003
Medium Total								4E-07					0.003
Receptor Total							Receptor Risk Total	9E-05				Receptor HI Total	1

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.8.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 22	RDX	2E-05	--	2E-07	--	2E-05					
			Arsenic	1E-04	--	7E-07	--	1E-04					
			Cadmium	- -	--	- -	--	- -					
			Hexavalent Chromium	1E-06	--	5E-07	--	2E-06					
			Lead	- -	--	- -	--	- -					
			Perchlorate	- -	--	- -	--	- -					
			Chemical Total	1E-04	--	1E-06	--	1E-04					
		Exposure Point Total						1E-04					
	Exposure Medium Total							1E-04					
Medium Total								1E-04					
Surface Water	Surface Water	SWMU 22	RDX	4E-09	--	1E-09	--	5E-09					
			Arsenic	4E-08	--	2E-08	--	6E-08					
			Cadmium	- -	--	- -	--	- -					
			Chemical Total	5E-08	--	2E-08	--	7E-08					
		Exposure Point Total						7E-08					
	Exposure Medium Total							7E-08					
Medium Total								7E-08					
Sediment	Sediment	SWMU 22	Arsenic	7E-07	--	1E-07	--	8E-07					
			Chemical Total	7E-07	--	1E-07	--	8E-07					
		Exposure Point Total						8E-07					
	Exposure Medium Total							8E-07					
Medium Total								8E-07					
Receptor Total							Receptor Risk Total	2E-04					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 22	RDX	- -	--	8E-11	--	8E-11	CNS	--	--	0.0000005	0.0000005
			Arsenic	- -	--	5E-10	--	5E-10	Skin, CVS	--	--	0.00007	0.00007
			Cadmium	- -	--	- -	--	- -	Kidney	--	--	0.0007	0.0007
			Hexavalent Chromium	- -	--	1E-10	--	1E-10	None Specified	--	--	0.0000007	0.0000007
			Lead	- -	--	- -	--	- -	NA	--	--	--	--
			Perchlorate	- -	--	- -	--	- -	Thyroid	--	--	0.00003	0.00003
			Chemical Total	- -	--	6E-10	--	6E-10		--	--	0.0008	0.0008
		Exposure Point Total						6E-10					0.0008
	Exposure Medium Total							6E-10					0.0008
Medium Total								6E-10					0.0008
Receptor Total							Receptor Risk Total	6E-10				Receptor HI Total	0.0008

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.2.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	SWMU 22	RDX	4E-10	--	1E-10	--	6E-10	Prostrate	0.000009	--	0.000003	0.00001
			Arsenic	5E-09	--	1E-09	--	6E-09	Skin, CVS	0.00007	--	0.00002	0.00009
			Cadmium	- -	--	- -	--	- -	Kidney	0.00004	--	0.0003	0.0003
			Chemical Total	5E-09	--	2E-09	--	7E-09		0.0001	--	0.0003	0.0004
		Exposure Point Total						7E-09					0.0004
	Exposure Medium Total							7E-09					0.0004
Medium Total								7E-09					0.0004
Sediment	Sediment	SWMU 22	Arsenic	3E-08	--	8E-09	--	4E-08	Skin, CVS	0.0004	--	0.0001	0.0005
			Chemical Total	3E-08	--	8E-09	--	4E-08		0.0004	--	0.0001	0.0005
		Exposure Point Total						4E-08					0.0005
	Exposure Medium Total							4E-08					0.0005
Medium Total								4E-08					0.0005
Receptor Total							Receptor Risk Total	4E-08				Receptor HI Total	0.0009

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.3.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	SWMU 22	RDX	3E-10	--	6E-11	--	3E-10	Prostrate	0.00003	--	0.000007	0.00003
			Arsenic	3E-09	--	7E-10	--	3E-09	Skin, CVS	0.0002	--	0.00006	0.0003
			Cadmium	- -	--	- -	--	- -	Kidney	0.0001	--	0.0006	0.0007
			Chemical Total	3E-09	--	8E-10	--	4E-09		0.0003	--	0.0007	0.001
		Exposure Point Total						4E-09					0.001
	Exposure Medium Total							4E-09					0.001
Medium Total								4E-09					0.001
Sediment	Sediment	SWMU 22	Arsenic	6E-08	--	4E-09	--	7E-08	Skin, CVS	0.005	--	0.0003	0.005
			Chemical Total	6E-08	--	4E-09	--	7E-08		0.005	--	0.0003	0.005
		Exposure Point Total						7E-08					0.005
	Exposure Medium Total							7E-08					0.005
Medium Total								7E-08					0.005
Receptor Total							Receptor Risk Total	7E-08				Receptor HI Total	0.006

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.4.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	SWMU 22	RDX	2E-10	--	1E-10	--	3E-10	Prostrate	0.000006	--	0.000003	0.000009
			Arsenic	2E-09	--	1E-09	--	3E-09	Skin, CVS	0.00004	--	0.00002	0.00007
			Cadmium	- -	--	- -	--	- -	Kidney	0.00002	--	0.0003	0.0003
			Chemical Total	2E-09	--	1E-09	--	3E-09		0.00007	--	0.0003	0.0004
		Exposure Point Total						3E-09					0.0004
	Exposure Medium Total							3E-09					0.0004
Medium Total								3E-09					0.0004
Sediment	Sediment	SWMU 22	Arsenic	2E-08	--	2E-09	--	3E-08	Skin, CVS	0.0005	--	0.00004	0.0006
			Chemical Total	2E-08	--	2E-09	--	3E-08		0.0005	--	0.00004	0.0006
		Exposure Point Total						3E-08					0.0006
	Exposure Medium Total							3E-08					0.0006
Medium Total								3E-08					0.0006
Receptor Total							Receptor Risk Total	3E-08				Receptor HI Total	0.0009

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.5.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	SWMU 22	RDX	4E-10	--	2E-10	--	6E-10					
			Arsenic	5E-09	--	2E-09	--	6E-09					
			Cadmium	- -	--	- -	--	- -					
			Chemical Total	5E-09	--	2E-09	--	7E-09					
		Exposure Point Total						7E-09					
	Exposure Medium Total							7E-09					
Medium Total								7E-09					
Sediment	Sediment	SWMU 22	Arsenic	9E-08	--	6E-09	--	9E-08					
			Chemical Total	9E-08	--	6E-09	--	9E-08					
		Exposure Point Total						9E-08					
	Exposure Medium Total							9E-08					
Medium Total								9E-08					
Receptor Total							Receptor Risk Total	1E-07					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.6.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 22	RDX	4E-06	--	3E-08	--	4E-06	Prostrate	0.1	--	0.001	0.1
			Arsenic	2E-05	--	7E-08	--	2E-05	Skin, CVS	0.5	--	0.002	0.5
			Cadmium	- -	--	- -	--	- -	Kidney	0.3	--	0.02	0.3
			Hexavalent Chromium	3E-07	--	8E-08	--	4E-07	None Specified	0.0004	--	0.0001	0.0005
			Lead	- -	--	- -	--	- -	NA	--	--	--	--
			Perchlorate	- -	--	- -	--	- -	Thyroid	0.2	--	0.0008	0.2
			Chemical Total	2E-05	--	2E-07	--	2E-05		1	--	0.02	1
		Exposure Point Total						2E-05					1
	Exposure Medium Total							2E-05					1
Medium Total								2E-05					1
Surface Water	Surface Water	SWMU 22	RDX	1E-10	--	3E-11	--	2E-10	Prostrate	0.00001	--	0.000003	0.00002
			Arsenic	1E-09	--	4E-10	--	2E-09	Skin, CVS	0.0001	--	0.00003	0.0001
			Cadmium	- -	--	- -	--	- -	Kidney	0.00006	--	0.0003	0.0004
			Chemical Total	1E-09	--	4E-10	--	2E-09		0.0002	--	0.0003	0.0005
		Exposure Point Total						2E-09					0.0005
	Exposure Medium Total							2E-09					0.0005
Medium Total								2E-09					0.0005
Sediment	Sediment	SWMU 22	Arsenic	3E-08	--	2E-09	--	3E-08	Skin, CVS	0.002	--	0.0002	0.003
			Chemical Total	3E-08	--	2E-09	--	3E-08		0.002	--	0.0002	0.003
		Exposure Point Total						3E-08					0.003
	Exposure Medium Total							3E-08					0.003
Medium Total								3E-08					0.003
Receptor Total							Receptor Risk Total	2E-05				Receptor HI Total	1

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.7.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 22	RDX	2E-06	--	3E-08	--	2E-06	Prostrate	0.06	--	0.0008	0.06
			Arsenic	1E-05	--	5E-08	--	1E-05	Skin, CVS	0.2	--	0.001	0.2
			Cadmium	- -	--	- -	--	- -	Kidney	0.1	--	0.01	0.1
			Hexavalent Chromium	5E-08	--	2E-08	--	6E-08	None Specified	0.0002	--	0.00008	0.0003
			Lead	- -	--	- -	--	- -	NA	--	--	--	--
			Perchlorate	- -	--	- -	--	- -	Thyroid	0.1	--	0.0005	0.1
			Chemical Total	1E-05	--	9E-08	--	1E-05		0.5	--	0.01	0.5
		Exposure Point Total						1E-05					0.5
	Exposure Medium Total							1E-05					0.5
Medium Total								1E-05					0.5
Surface Water	Surface Water	SWMU 22	RDX	2E-10	--	1E-10	--	3E-10	Prostrate	0.000006	--	0.000003	0.000009
			Arsenic	2E-09	--	1E-09	--	3E-09	Skin, CVS	0.00004	--	0.00002	0.00007
			Cadmium	- -	--	- -	--	- -	Kidney	0.00002	--	0.0003	0.0003
			Chemical Total	2E-09	--	1E-09	--	3E-09		0.00007	--	0.0003	0.0004
		Exposure Point Total						3E-09					0.0004
	Exposure Medium Total							3E-09					0.0004
Medium Total								3E-09					0.0004
Sediment	Sediment	SWMU 22	Arsenic	2E-08	--	2E-09	--	3E-08	Skin, CVS	0.0005	--	0.00004	0.0006
			Chemical Total	2E-08	--	2E-09	--	3E-08		0.0005	--	0.00004	0.0006
		Exposure Point Total						3E-08					0.0006
	Exposure Medium Total							3E-08					0.0006
Medium Total								3E-08					0.0006
Receptor Total							Receptor Risk Total	1E-05				Receptor HI Total	0.5

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.8.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 22	RDX	6E-06	--	5E-08	--	6E-06					
			Arsenic	3E-05	--	1E-07	--	3E-05					
			Cadmium	- -	--	- -	--	- -					
			Hexavalent Chromium	3E-07	--	1E-07	--	4E-07					
			Lead	- -	--	- -	--	- -					
			Perchlorate	- -	--	- -	--	- -					
			Chemical Total	4E-05	--	3E-07	--	4E-05					
		Exposure Point Total						4E-05					
	Exposure Medium Total							4E-05					
Medium Total								4E-05					
Surface Water	Surface Water	SWMU 22	RDX	3E-10	--	1E-10	--	4E-10					
			Arsenic	3E-09	--	1E-09	--	5E-09					
			Cadmium	- -	--	- -	--	- -					
			Chemical Total	4E-09	--	2E-09	--	5E-09					
		Exposure Point Total						5E-09					
	Exposure Medium Total							5E-09					
Medium Total								5E-09					
Sediment	Sediment	SWMU 22	Arsenic	6E-08	--	4E-09	--	6E-08					
			Chemical Total	6E-08	--	4E-09	--	6E-08					
		Exposure Point Total						6E-08					
	Exposure Medium Total							6E-08					
Medium Total								6E-08					
Receptor Total							Receptor Risk Total	4E-05					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

APPENDIX E.3

PROUCL OUTPUTS

Surface Soil

PROUCL OUTPUT - SURFACE SOIL

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	C:\Work Folders\Projects\Crane\SWMU 22\Data\ProUCL Data - Surface Soil.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

ARSENIC

General Statistics			
Number of Valid Observations	23	Number of Distinct Observations	18
Raw Statistics		Log-transformed Statistics	
Minimum	2.4	Minimum of Log Data	0.875
Maximum	9.8	Maximum of Log Data	2.282
Mean	4.604	Mean of log Data	1.442
Geometric Mean	4.231	SD of log Data	0.418
Median	4.2		
SD	1.99		
Std. Error of Mean	0.415		
Coefficient of Variation	0.432		
Skewness	0.934		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.915	Shapiro Wilk Test Statistic	0.952
Shapiro Wilk Critical Value	0.914	Shapiro Wilk Critical Value	0.914
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	5.317	95% H-UCL	5.473
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	6.396
95% Adjusted-CLT UCL (Chen-1995)	5.373	97.5% Chebyshev (MVUE) UCL	7.174
95% Modified-t UCL (Johnson-1978)	5.33	99% Chebyshev (MVUE) UCL	8.701
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	5.305	Data appear Normal at 5% Significance Level	
Theta Star	0.868		
MLE of Mean	4.604		
MLE of Standard Deviation	1.999		
nu star	244		
Approximate Chi Square Value (.05)	208.9	Nonparametric Statistics	
Adjusted Level of Significance	0.0389	95% CLT UCL	5.287
Adjusted Chi Square Value	206.5	95% Jackknife UCL	5.317
		95% Standard Bootstrap UCL	5.29
Anderson-Darling Test Statistic	0.351	95% Bootstrap-t UCL	5.433
Anderson-Darling 5% Critical Value	0.746	95% Hall's Bootstrap UCL	5.435
Kolmogorov-Smirnov Test Statistic	0.125	95% Percentile Bootstrap UCL	5.274
Kolmogorov-Smirnov 5% Critical Value	0.182	95% BCA Bootstrap UCL	5.335
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	6.413
		97.5% Chebyshev(Mean, Sd) UCL	7.196
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	8.733
95% Approximate Gamma UCL (Use when n >= 40)	5.38		
95% Adjusted Gamma UCL (Use when n < 40)	5.441		
Potential UCL to Use		Use 95% Student's-t UCL	5.317

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

CHROMIUM			
General Statistics			
Number of Valid Observations	23	Number of Distinct Observations	21
Raw Statistics		Log-transformed Statistics	
Minimum	3.4	Minimum of Log Data	1.224
Maximum	25.4	Maximum of Log Data	3.235
Mean	11.8	Mean of log Data	2.342
Geometric Mean	10.4	SD of log Data	0.532
Median	11		
SD	5.801		
Std. Error of Mean	1.21		
Coefficient of Variation	0.492		
Skewness	0.552		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Test Statistic	0.972
Shapiro Wilk Critical Value	0.914	Shapiro Wilk Critical Value	0.914
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	13.88	95% H-UCL	15.04
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	17.91
95% Adjusted-CLT UCL (Chen-1995)	13.94	97.5% Chebyshev (MVUE) UCL	20.52
95% Modified-t UCL (Johnson-1978)	13.9	99% Chebyshev (MVUE) UCL	25.63
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.611	Data appear Normal at 5% Significance Level	
Theta Star	3.267		
MLE of Mean	11.8		
MLE of Standard Deviation	6.209		
nu star	166.1		
Approximate Chi Square Value (.05)	137.3	Nonparametric Statistics	
Adjusted Level of Significance	0.0389	95% CLT UCL	13.79
Adjusted Chi Square Value	135.4	95% Jackknife UCL	13.88
		95% Standard Bootstrap UCL	13.74
Anderson-Darling Test Statistic	0.211	95% Bootstrap-t UCL	14.05
Anderson-Darling 5% Critical Value	0.749	95% Hall's Bootstrap UCL	13.86
Kolmogorov-Smirnov Test Statistic	0.0831	95% Percentile Bootstrap UCL	13.73
Kolmogorov-Smirnov 5% Critical Value	0.182	95% BCA Bootstrap UCL	13.85
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	17.07
		97.5% Chebyshev(Mean, Sd) UCL	19.35
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	23.84
95% Approximate Gamma UCL (Use when n >= 40)	14.28		
95% Adjusted Gamma UCL (Use when n < 40)	14.47		
Potential UCL to Use		Use 95% Student's-t UCL	13.88
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.			

Subsurface Soil

PROUCL OUTPUT- SUBSURFACE SOIL

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	C:\Work Folders\Projects\Crane\SWMU 22\Data\ProUCL Data - Subsurface Soil.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

ARSENIC

General Statistics			
Number of Valid Observations	14	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	1.1	Minimum of Log Data	0.0953
Maximum	6.1	Maximum of Log Data	1.808
Mean	3.536	Mean of log Data	1.177
Geometric Mean	3.244	SD of log Data	0.458
Median	3.4		
SD	1.39		
Std. Error of Mean	0.372		
Coefficient of Variation	0.393		
Skewness	0.112		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.987	Shapiro Wilk Test Statistic	0.94
Shapiro Wilk Critical Value	0.874	Shapiro Wilk Critical Value	0.874
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	4.194	95% H-UCL	4.648
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	5.525
95% Adjusted-CLT UCL (Chen-1995)	4.159	97.5% Chebyshev (MVUE) UCL	6.369
95% Modified-t UCL (Johnson-1978)	4.196	99% Chebyshev (MVUE) UCL	8.028
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	4.745	Data appear Normal at 5% Significance Level	
Theta Star	0.745		
MLE of Mean	3.536		
MLE of Standard Deviation	1.623		
nu star	132.8		
Approximate Chi Square Value (.05)	107.2	Nonparametric Statistics	
Adjusted Level of Significance	0.0312	95% CLT UCL	4.147
Adjusted Chi Square Value	104.2	95% Jackknife UCL	4.194
		95% Standard Bootstrap UCL	4.106
Anderson-Darling Test Statistic	0.215	95% Bootstrap-t UCL	4.167
Anderson-Darling 5% Critical Value	0.737	95% Hall's Bootstrap UCL	4.207
Kolmogorov-Smirnov Test Statistic	0.144	95% Percentile Bootstrap UCL	4.1
Kolmogorov-Smirnov 5% Critical Value	0.229	95% BCA Bootstrap UCL	4.136
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	5.155
		97.5% Chebyshev(Mean, Sd) UCL	5.856
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	7.233
95% Approximate Gamma UCL (Use when n >= 40)	4.381		
95% Adjusted Gamma UCL (Use when n < 40)	4.509		
Potential UCL to Use		Use 95% Student's-t UCL	4.194

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

CHROMIUM			
General Statistics			
Number of Valid Observations	14	Number of Distinct Observations	13
Raw Statistics		Log-transformed Statistics	
Minimum	5.3	Minimum of Log Data	1.668
Maximum	17.7	Maximum of Log Data	2.874
Mean	9.793	Mean of log Data	2.227
Geometric Mean	9.272	SD of log Data	0.338
Median	8.85		
SD	3.52		
Std. Error of Mean	0.941		
Coefficient of Variation	0.359		
Skewness	1.118		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.901	Shapiro Wilk Test Statistic	0.968
Shapiro Wilk Critical Value	0.874	Shapiro Wilk Critical Value	0.874
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	11.46	95% H-UCL	11.76
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	13.67
95% Adjusted-CLT UCL (Chen-1995)	11.64	97.5% Chebyshev (MVUE) UCL	15.36
95% Modified-t UCL (Johnson-1978)	11.51	99% Chebyshev (MVUE) UCL	18.67
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	7.362	Data appear Normal at 5% Significance Level	
Theta Star	1.33		
MLE of Mean	9.793		
MLE of Standard Deviation	3.609		
nu star	206.1		
Approximate Chi Square Value (.05)	173.9	Nonparametric Statistics	
Adjusted Level of Significance	0.0312	95% CLT UCL	11.34
Adjusted Chi Square Value	170	95% Jackknife UCL	11.46
		95% Standard Bootstrap UCL	11.26
Anderson-Darling Test Statistic	0.331	95% Bootstrap-t UCL	12.29
Anderson-Darling 5% Critical Value	0.735	95% Hall's Bootstrap UCL	12.6
Kolmogorov-Smirnov Test Statistic	0.174	95% Percentile Bootstrap UCL	11.44
Kolmogorov-Smirnov 5% Critical Value	0.229	95% BCA Bootstrap UCL	11.66
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	13.89
		97.5% Chebyshev(Mean, Sd) UCL	15.67
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	19.15
95% Approximate Gamma UCL (Use when n >= 40)	11.61		
95% Adjusted Gamma UCL (Use when n < 40)	11.88		
Potential UCL to Use		Use 95% Student's-t UCL	11.46
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.			

Groundwater

	General UCL Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	C:\Work Folders\Projects\Crane\SWMU 22\Data\New Data\ProUCL Data - Groundwater.xls.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

RDX

General Statistics			
Number of Valid Data	4	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	1
		Percent Non-Detects	25.00%

Warning: This data set only has 4 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable RDX was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

PERCHLORATE (UG/L)

General Statistics			
Number of Valid Data	4	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	3
		Percent Non-Detects	75.00%

Warning: This data set only has 4 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable PERCHLORATE (UG/L) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	C:\Work Folders\Projects\Crane\SWMU 22\Data\New Data\ProUCL Data - Groundwater.xls.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

ARSENIC

General Statistics			
Number of Valid Observations	4	Number of Distinct Observations	4

Warning: This data set only has 4 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable ARSENIC was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

CADMIUM

General Statistics			
Number of Valid Observations	4	Number of Distinct Observations	4

Warning: This data set only has 4 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable CADMIUM was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

LEAD			
General Statistics			
Number of Valid Observations	4	Number of Distinct Observations	4
Warning: This data set only has 4 observations!			
Data set is too small to compute reliable and meaningful statistics and estimates!			
The data set for variable LEAD was not processed!			
It is suggested to collect at least 8 to 10 observations before using these statistical methods!			
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.			

Surface Water

	General UCL Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	C:\Work Folders\Projects\Crane\SWMU 22\EPCs\ProUCL Data - Surface Water.xls.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

RDX

General Statistics			
Number of Valid Data	15	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	8
Number of Missing Values	2	Percent Non-Detects	53.33%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.39	Minimum Detected	-0.942
Maximum Detected	2.5	Maximum Detected	0.916
Mean of Detected	1.041	Mean of Detected	-0.136
SD of Detected	0.731	SD of Detected	0.619
Minimum Non-Detect	0.246	Minimum Non-Detect	-1.402
Maximum Non-Detect	0.48	Maximum Non-Detect	-0.734
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	9
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	6
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	60.00%

Warning: There are only 7 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.811	Shapiro Wilk Test Statistic	0.944
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.567	Mean	-1.092
SD	0.664	SD	1.034
95% DL/2 (t) UCL	0.869	95% H-Stat (DL/2) UCL	1.241
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.17	Mean in Log Scale	-1.11
SD	1.053	SD in Log Scale	1.097
95% MLE (t) UCL	0.649	Mean in Original Scale	0.57
95% MLE (Tiku) UCL	0.851	SD in Original Scale	0.663
		95% t UCL	0.872
		95% Percentile Bootstrap UCL	0.855
		95% BCA Bootstrap UCL	0.951
		95% H UCL	1.409

RDX (Continued)			
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.802	Data appear Normal at 5% Significance Level	
Theta Star	0.578		
nu star	25.23		
A-D Test Statistic	0.423	Nonparametric Statistics	
5% A-D Critical Value	0.712	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.712	Mean	0.694
5% K-S Critical Value	0.314	SD	0.565
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.158
		95% KM (t) UCL	0.972
Assuming Gamma Distribution		95% KM (z) UCL	0.953
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.932
Minimum	0.000001	95% KM (bootstrap t) UCL	1.347
Maximum	2.5	95% KM (BCA) UCL	1.159
Mean	0.486	95% KM (Percentile Bootstrap) UCL	1.047
Median	0.000001	95% KM (Chebyshev) UCL	1.381
SD	0.72	97.5% KM (Chebyshev) UCL	1.678
k star	0.139	99% KM (Chebyshev) UCL	2.262
Theta star	3.492		
Nu star	4.175	Potential UCLs to Use	
AppChi2	0.792	95% KM (t) UCL	0.972
95% Gamma Approximate UCL (Use when n >= 40)	2.562	95% KM (Percentile Bootstrap) UCL	1.047
95% Adjusted Gamma UCL (Use when n < 40)	3.209		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

ARSENIC			
General Statistics			
Number of Valid Data	12	Number of Detected Data	8
Number of Distinct Detected Data	8	Number of Non-Detect Data	4
Number of Missing Values	5	Percent Non-Detects	33.33%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.18	Minimum Detected	-1.715
Maximum Detected	1.5	Maximum Detected	0.405
Mean of Detected	0.58	Mean of Detected	-0.726
SD of Detected	0.41	SD of Detected	0.633
Minimum Non-Detect	0.18	Minimum Non-Detect	-1.715
Maximum Non-Detect	0.18	Maximum Non-Detect	-1.715
Warning: There are only 8 Detected Values in this data			
Note: It should be noted that even though bootstrap may be performed on this data set			
the resulting calculations may not be reliable enough to draw conclusions			
It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.			
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.815	Shapiro Wilk Test Statistic	0.984
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.417	Mean	-1.287
SD	0.406	SD	0.97
95% DL/2 (t) UCL	0.627	95% H-Stat (DL/2) UCL	1.019
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.331	Mean in Log Scale	-1.276
SD	0.496	SD in Log Scale	0.979
95% MLE (t) UCL	0.589	Mean in Original Scale	0.42
95% MLE (Tiku) UCL	0.608	SD in Original Scale	0.404
		95% t UCL	0.629
		95% Percentile Bootstrap UCL	0.621
		95% BCA Bootstrap UCL	0.658
		95% H UCL	1.055

ARSENIC (Continued)			
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.901	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.305		
nu star	30.41		
A-D Test Statistic	0.266	Nonparametric Statistics	
5% A-D Critical Value	0.722	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.722	Mean	0.447
5% K-S Critical Value	0.296	SD	0.365
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.113
		95% KM (t) UCL	0.649
Assuming Gamma Distribution		95% KM (z) UCL	0.632
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.632
Minimum	0.000001	95% KM (bootstrap t) UCL	0.803
Maximum	1.5	95% KM (BCA) UCL	0.728
Mean	0.387	95% KM (Percentile Bootstrap) UCL	0.675
Median	0.335	95% KM (Chebyshev) UCL	0.938
SD	0.434	97.5% KM (Chebyshev) UCL	1.151
k star	0.191	99% KM (Chebyshev) UCL	1.568
Theta star	2.024		
Nu star	4.584	Potential UCLs to Use	
AppChi2	0.965	95% KM (Percentile Bootstrap) UCL	0.675
95% Gamma Approximate UCL (Use when n >= 40)	1.836		
95% Adjusted Gamma UCL (Use when n < 40)	2.391		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

CADMIUM			
General Statistics			
Number of Valid Data	12	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	6
Number of Missing Values	5	Percent Non-Detects	50.00%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.23	Minimum Detected	-1.47
Maximum Detected	1.7	Maximum Detected	0.531
Mean of Detected	0.535	Mean of Detected	-0.947
SD of Detected	0.58	SD of Detected	0.778
Minimum Non-Detect	0.04	Minimum Non-Detect	-3.219
Maximum Non-Detect	0.083	Maximum Non-Detect	-2.489
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	6
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	6
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	50.00%
Warning: There are only 6 Detected Values in this data			
Note: It should be noted that even though bootstrap may be performed on this data set			
the resulting calculations may not be reliable enough to draw conclusions			
It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.			
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.622	Shapiro Wilk Test Statistic	0.748
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.281	Mean	-2.319
SD	0.473	SD	1.543
95% DL/2 (t) UCL	0.526	95% H-Stat (DL/2) UCL	2.068
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.00766	Mean in Log Scale	-2.039
SD	0.72	SD in Log Scale	1.303
95% MLE (t) UCL	0.381	Mean in Original Scale	0.292
95% MLE (Tiku) UCL	0.47	SD in Original Scale	0.466
		95% t UCL	0.533
		95% Percentile Bootstrap UCL	0.54
		95% BCA Bootstrap UCL	0.668
		95% H UCL	1.2

CADMIUM (Continued)			
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.962	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.556		
nu star	11.54		
A-D Test Statistic	0.94	**Nonparametric Statistics**	
5% A-D Critical Value	0.706	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.706	Mean	0.383
5% K-S Critical Value	0.337	SD	0.404
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.128
		95% KM (t) UCL	0.612
Assuming Gamma Distribution		95% KM (z) UCL	0.593
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.597
Minimum	0.000001	95% KM (bootstrap t) UCL	3.671
Maximum	1.7	95% KM (BCA) UCL	0.643
Mean	0.268	95% KM (Percentile Bootstrap) UCL	0.622
Median	0.115	95% KM (Chebyshev) UCL	0.939
SD	0.48	97.5% KM (Chebyshev) UCL	1.18
k star	0.153	99% KM (Chebyshev) UCL	1.654
Theta star	1.752		
Nu star	3.663	**Potential UCLs to Use**	
AppChi2	0.593	95% KM (t) UCL	0.612
95% Gamma Approximate UCL (Use when n >= 40)	1.651	95% KM (% Bootstrap) UCL	0.622
95% Adjusted Gamma UCL (Use when n < 40)	2.239		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Sediment

PROUCL OUTPUT - SEDIMENT

	General UCL Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	C:\Work Folders\Projects\Crane\SWMU 22\Data\New Data\ProUCL Data - Sediment.xls.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
ARSENIC			
General Statistics			
Number of Valid Observations	18	Number of Distinct Observations	17
Raw Statistics		Log-transformed Statistics	
Minimum	1.2	Minimum of Log Data	0.182
Maximum	14.7	Maximum of Log Data	2.688
Mean	4.522	Mean of log Data	1.245
Geometric Mean	3.473	SD of log Data	0.729
Median	3.25		
SD	3.718		
Std. Error of Mean	0.876		
Coefficient of Variation	0.822		
Skewness	1.752		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.776	Shapiro Wilk Test Statistic	0.931
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	6.047	95% H-UCL	6.767
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	8.001
95% Adjusted-CLT UCL (Chen-1995)	6.35	97.5% Chebyshev (MVUE) UCL	9.538
95% Modified-t UCL (Johnson-1978)	6.107	99% Chebyshev (MVUE) UCL	12.56
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.742	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	2.596		
MLE of Mean	4.522		
MLE of Standard Deviation	3.426		
nu star	62.71		
Approximate Chi Square Value (.05)	45.49	Nonparametric Statistics	
Adjusted Level of Significance	0.0357	95% CLT UCL	5.964
Adjusted Chi Square Value	44.09	95% Jackknife UCL	6.047
		95% Standard Bootstrap UCL	5.959
Anderson-Darling Test Statistic	0.705	95% Bootstrap-t UCL	6.957
Anderson-Darling 5% Critical Value	0.752	95% Hall's Bootstrap UCL	13.61
Kolmogorov-Smirnov Test Statistic	0.169	95% Percentile Bootstrap UCL	5.989
Kolmogorov-Smirnov 5% Critical Value	0.206	95% BCA Bootstrap UCL	6.228
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	8.342
		97.5% Chebyshev(Mean, Sd) UCL	9.995
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	13.24
95% Approximate Gamma UCL (Use when n >= 40)	6.234		
95% Adjusted Gamma UCL (Use when n < 40)	6.432		
Potential UCL to Use		Use 95% Approximate Gamma UCL	6.234
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.			

APPENDIX E.4

SAMPLE CALCULATIONS

CLIENT:		JOB NUMBER:
NSWC CRANE, CRANE INDIANA		112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989		
BY: R. JUPIN	CHECKED BY: L. Ciofani	DATE: 4/11/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from ingestion of groundwater.

EQUATION:

$$IEX = \frac{Cgw \times CF \times IR \times EF \times ED}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cgw	=	exposure point concentration in groundwater (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
IR	=	ingestion rate (L/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ((mg/kg/day)$^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)$^{-1}$

HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

Cgw	=	15	ug/L	Chemical: RDX
IR	=	2	L/day	
CF	=	1.0E-03	mg/ug	
EF	=	350	days/year	
ED	=	24	years	
BW	=	70	kg	
ATc	=	25,550	days	
ATnc	=	8,760	days	
CSFo	=	1.1E-01	(mg/kg/day)$^{-1}$	
RfDo	=	3.0E-03	(mg/kg/day)	

CLIENT: NSWC CRANE, CRANE INDIANA		JOB NUMBER: 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989		
BY: R. JUPIN	CHECKED BY: L. Cofani	DATE: 4/11/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{15 \text{ ug/L} \times 0.001 \text{ mg/ug} \times 2 \text{ L/day} \times 350 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}}$$

IEXc = 1.41E-04 mg/kg/day

ILCR = 1.41E-04 mg/kg/day x 1.10E-01 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 1.5E-05

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{15 \text{ ug/L} \times 0.001 \text{ mg/ug} \times 2 \text{ L/day} \times 350 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 8760 \text{ days}}$$

IEXnc = 4.11E-04 mg/kg/day

$$HQ = \frac{4.11E\text{-}04 \text{ mg/kg/day}}{3.00E\text{-}03 \text{ (mg/kg/day)}} = \text{Hazard Quotient}$$

HQ = 1.4E-01

CLIENT:		JOB NUMBER:
NSWC CRANE, CRANE INDIANA		112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	CHECKED BY: L. Ciofani	DATE: 4/11/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with groundwater.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT}$$

Where:

DAD	=	dermally absorbed dose (mg/kg/day)
DAevent	=	absorbed dose per event (mg/cm^2/event)
EV	=	event frequency (events/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
A	=	skin surface available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFd	=	dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDd	=	dermal noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = DAD (mg/kg/day) x CSFd $(mg/kg/day)^{-1}$

HQ (Noncarcinogens) = DAD (mg/kg/day) / RFDd (mg/kg/day)

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If tevent} \le t^*, \text{then: DAevent} = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If tevent} > t^*, \text{then: DAevent} = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT: NSWC CRANE, CRANE INDIANA	**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENTS	
BASED ON: USEPA, DECEMBER 1989, JULY 2004	

BY: R. JUPIN	**CHECKED BY:** L. Cifani	**DATE:** 4/11/2013

Where:

Kp	=	permeability coefficient from water (cm/hr)
FA	=	fraction absorbed water (dimensionless)
Cgw	=	concentration of chemical in groundwater (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)
t*	=	time it takes to reach steady-state (hr/event)
τ	=	lag time (hr/event)
B	=	Bunge Model Constant (dimensionless)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Cgw	=	0.015	mg/L	Chemical: RDX
Kp	=	3.36E-04	cm/hr	
FA	=	1	unitless	
tevent	=	0.58	hr/event	
CF	=	0.001	L/cm^3	
t*	=	4.43	hr/event	
τ	=	1.840	hr/event	
B	=	0.002		

tevent < t*, therefore,

$$\text{DAevent} = (2 \times 0.000336\ \text{cm/hr})\ (1)\ (0.015\ \text{mg/L})\ (0.001\ \text{L/cm3}) \times \sqrt{\frac{6 \times 1.84\ \text{hr/event} \times 0.58\ \text{hr/event}}{\pi}}$$

DAevent = 1.44E-08 mg/cm^2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	18,000	cm^2
EV	=	1	event/day
ED	=	24	years
EF	=	350	days/year
BW	=	70	kg
ATc	=	25,550	days
ATnc	=	8,760	days
CSFd	=	1.1E-01	(mg/kg/day)$^{-1}$
RfDd	=	3.0E-03	(mg/kg/day)

CLIENT: NSWC CRANE, CRANE INDIANA		JOB NUMBER: 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	CHECKED BY: L. Cifani	DATE: 4/11/2013

EXAMPLE CARCINOGENIC CALCULATION

DADc = $\dfrac{\text{1.44E-08 mg/cm2-event x 1 event/day x 24 years x 350 days/year x 18000 cm2}}{\text{70 kg x 25550 days}}$

DADc = 1.22E-06 mg/kg/day

DADc = 1.22E-06 mg/kg/day x 1.10E-01 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 1.3E-07

EXAMPLE NONCARCINOGENIC CALCULATION

DADnc = $\dfrac{\text{1.44E-08 mg/cm2-event x 1 event/day x 24 years x 350 days/year x 18000 cm2}}{\text{70 kg x 8760 days}}$

DADnc = 3.55E-06 mg/kg/day

HQ = 3.55E-06 mg/kg/day / 3.00E-03 (mg/kg/day) = Hazard Quotient

HQ = 1.2E-03

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SURFACE WATER ADULT RECREATIONAL USERS		
BASED ON: USEPA, DEC. 1989		
BY: R. JUPIN	**CHECKED BY:** L. Ciofani	**DATE:** 4/11/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from incidental ingestion of surface water.

EQUATION:

$$IEX = \frac{Csw \times CF \times CRsw \times ET \times EF \times ED}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Csw	=	exposure point concentration in surface water (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
CRsw	=	contact rate (L/hour)
ET	=	exposure time (hours/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo $(mg/kg/day)^{-1}$
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

Csw	=	0.85	ug/L	Chemical: RDX
CRsw	=	0.01	L/hr	
CF	=	1.0E-03	mg/ug	
ET	=	4	hours	
EF	=	52	days/year	
ED	=	24	years	
BW	=	70	kg	
ATc	=	25550	days	
ATnc	=	8760	days	
CSFo	=	1.1E-01	$(mg/kg/day)^{-1}$	
RfDo	=	3.0E-03	(mg/kg/day)	

CLIENT: NSWC CRANE, CRANE INDIANA		JOB NUMBER: 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SURFACE WATER ADULT RECREATIONAL USERS		
BASED ON: USEPA, DEC. 1989		
BY: R. JUPIN	CHECKED BY: L. Cifani	DATE: 4/11/2013

EXAMPLE CARCINOGENIC CALCULATION

IEXc = $\frac{0.85 \text{ ug/L} \times 1.0\text{E-03 mg/ug} \times 0.01 \text{ L/hr} \times 4 \text{ hours} \times 52 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}}$

IEXc = 2.37E-08 mg/kg/day

ICLR = 2.37E-08 mg/kg/day x 1.10E-01 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ICLR **2.6E-09**

EXAMPLE NONCARCINOGENIC CALCULATION

IEXnc = $\frac{0.85 \text{ ug/L} \times 1.0\text{E-03 mg/ug} \times 0.01 \text{ L/hr} \times 4 \text{ hours} \times 52 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 8760 \text{ days}}$

IEXnc = 6.92E-08 mg/kg/day

HQ = $\frac{6.92\text{E-08 mg/kg/day}}{3.00\text{E-03 (mg/kg/day)}}$ = Hazard Quotient

HQ = 2.3E-05

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SURFACE WATER ADULT RECREATIONAL USERS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	**CHECKED BY:** L. Ciofani	**DATE:** 4/11/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with surface water.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT}$$

Where:

DAD = dermally absorbed dose (mg/kg/day)
DAevent = absorbed dose per event (mg/cm^2/event)
EV = event frequency (events/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
A = skin surface available for contact (cm^2)
BW = body weight (kg)
AT = averaging time (days)
CSFd = dermal carcinogenic slope factor ((mg/kg/day)$^{-1}$)
RfDd = dermal noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = DAD (mg/kg/day) x CSFd (mg/kg/day)$^{-1}$
HQ (Noncarcinogens) = DAD (mg/kg/day) / RFDd (mg/kg/day)

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If } tevent \le t^*, \text{ then: } DAevent = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If } tevent > t^*, \text{ then: } DAevent = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT:		JOB NUMBER:
NSWC CRANE, CRANE INDIANA		112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SURFACE WATER ADULT RECREATIONAL USERS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	CHECKED BY: L. Ciofani	DATE: 4/11/2013

Where:

Kp	=	permeability coefficient from water (cm/hr)
Csw	=	concentration of chemical in surface water (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)
t*	=	time it takes to reach steady-state (hr/event)
τ	=	lag time (hr/event)
B	=	Bunge Model Constant (dimensionless)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Csw	=	0.0085	mg/L	Chemical: RDX
Kp	=	3.36E-04	cm/hr	
FA	=	1	unitless	
tevent	=	4	hr/event	
CF	=	0.001	L/cm^3	
t*	=	4.43	hr/event	
τ	=	1.840	hr/event	
B	=	0.002		

tevent < t*, therefore,

DAevent = (2 x 0.000336 cm/hr) (1) (0.0085 mg/L) (0.001 L/cm3) x

$$\sqrt{\frac{6 \times 1.84 \text{ hr/event} \times 4 \text{ hr/event}}{\pi}}$$

DAevent = 2.14E-08 mg/cm^2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	5,700	cm^2
EV	=	1	event/day
ED	=	24	years
EF	=	52	days/year
BW	=	70	kg
ATc	=	25,550	days
ATnc	=	8,760	days
CSFd	=	1.1E-01	$(mg/kg/day)^{-1}$
RfDd	=	3.0E-03	(mg/kg/day)

CLIENT:		JOB NUMBER:
NSWC CRANE, CRANE INDIANA		112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SURFACE WATER ADULT RECREATIONAL USERS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004		
BY: R. JUPIN	CHECKED BY: L. Ciafani	DATE: 4/11/2013

EXAMPLE CARCINOGENIC CALCULATION

DADc = $\dfrac{\text{2.14E-08 mg/cm2-event x 1 event/day x 24 years x 52 days/year x 5700 cm2}}{\text{70 kg x 25550 days}}$

DADc = 8.52E-08 mg/kg/day

DADc = 8.52E-08 mg/kg/day x 1.10E-01 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 9.4E-09

EXAMPLE NONCARCINOGENIC CALCULATION

DADnc = $\dfrac{\text{2.14E-08 mg/cm2-event x 1 event/day x 24 years x 52 days/year x 5700 cm2}}{\text{70 kg x 8760 days}}$

DADnc = 2.48E-07 mg/kg/day

HQ = 2.48E-07 mg/kg/day / 3.00E-03 (mg/kg/day) = Hazard Quotient

HQ = 8.3E-05

CLIENT: NSWC CRANE, CRANE INDIANA	**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SEDIMENT ADULT RECREATIONAL USERS	
BASED ON: USEPA, DECEMBER 1989	

BY: R. JUPIN	**CHECKED BY:** L. Cirfani	**DATE:** 4/11/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from incidental ingestion of sediment.

EQUATION:

$$IEX = \frac{CS \times IR \times EF \times ED \times FI \times CF}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in sediment (mg/kg)
IR	=	incidental ingestion rate (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
FI	=	fraction ingested from contaminated source (unitless)
CF	=	conversion factor (1.0E-6 kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo $(mg/kg/day)^{-1}$
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

Cs	=	6.2	mg/kg	Chemical: Arsenic
IR	=	100	mg/day	
EF	=	52	days/year	
ED	=	24	years	
FI	=	0.5		
CF	=	1.0E-06	kg/mg	
BW	=	70	kg	
ATc	=	25,550	days	
ATnc	=	8,760	days	
CSFo	=	1.5E+00	$(mg/kg/day)^{-1}$	
RfDo	=	3.0E-04	(mg/kg/day)	

CLIENT: NSWC CRANE, CRANE INDIANA		JOB NUMBER: 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SEDIMENT ADULT RECREATIONAL USERS		
BASED ON: USEPA, DECEMBER 1989		
BY: R. JUPIN	CHECKED BY: L. Ciofani	DATE: 4/11/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{6.2 \text{ mg/kg} \times 100 \text{ mg/day} \times 52 \text{ days/year} \times 24 \text{ years} \times 0.5 \times 1.0E\text{-}06 \text{ kg/mg}}{70 \text{ kg} \times 25550 \text{ days}}$$

IEXc = 2.16E-07 mg/kg/day

ILCR = 2.16E-07 mg/kg/day x 1.50E+00 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 3.2E-07

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{6.2 \text{ mg/kg} \times 100 \text{ mg/day} \times 52 \text{ days/year} \times 24 \text{ years} \times 0.5 \times 1.0E\text{-}06 \text{ kg/mg}}{70 \text{ kg} \times 8760 \text{ days}}$$

IEXnc = 6.31E-07 mg/kg/day

HQ = 6.31E-07 mg/kg/day / 3.00E-04 (mg/kg/day) = Hazard Quotient

HQ = 2.1E-03

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SEDIMENT ADULT RECREATIONAL USERS		
BASED ON: USEPA, JULY 2004		
BY: R. JUPIN	**CHECKED BY:** L. Crofani	**DATE:** 4/11/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with sediment.

EQUATION:

$$DEX = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

DEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in sediment (mg/kg)
CF	=	conversion factor (1.0E-6 kg/mg)
SA	=	skin surface available for contact (cm^2/day)
ABS	=	absorption factor (unitless)
AF	=	adherence factor (mg/cm^2)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFd	=	dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDd	=	dermal noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFd $(mg/kg/day)^{-1}$

HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDd (mg/kg/day)

ASSUMPTIONS:

Cs	=	6.2	mg/kg	Chemical: Arsenic
CF	=	1.0E-06	kg/mg	
SA	=	5,700	cm^2/day	
AF	=	0.07	mg/cm^2	
ABS	=	0.03		
EF	=	52	days/year	
ED	=	24	years	
BW	=	70	kg	
ATc	=	25,550	days	
ATnc	=	8,760	days	
CSFd	=	1.5E+00	$(mg/kg/day)^{-1}$	
RfDd	=	3.0E-04	(mg/kg/day)	

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SEDIMENT ADULT RECREATIONAL USERS		
BASED ON: USEPA, JULY 2004		
BY: R. JUPIN	**CHECKED BY:** L. Cifani	**DATE:** 4/11/2013

EXAMPLE CARCINOGENIC CALCULATION

$$DEXc = \frac{6.2 \text{ mg/kg} \times 1.0E\text{-}06 \text{ kg/mg} \times 5700 \text{ cm2/day} \times 0.07 \text{ mg/cm2} \times 0.03 \times 52 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}}$$

DEXc = 5.18E-08 mg/kg/day

ILCR = 5.18E-08 mg/kg/day x 1.50E+00 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 7.8E-08

EXAMPLE NONCARCINOGENIC CALCULATION

$$DEXnc = \frac{6.2 \text{ mg/kg} \times 1.0E\text{-}06 \text{ kg/mg} \times 5700 \text{ cm2/day} \times 0.07 \text{ mg/cm2} \times 0.03 \times 52 \text{ days/year} \times 24 \text{ years}}{70 \text{ kg} \times 8760 \text{ days}}$$

DEXnc = 1.51E-07 mg/kg/day

HQ = 1.51E-07 mg/kg/day / 3.00E-04 (mg/kg/day) = Hazard Quotient

HQ = 5.0E-04

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: R. JUPIN	**CHECKED BY:** L. Cifani	**DATE:** 4/29/2013

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from ingestion of groundwater.

EQUATION:

$$IEX = \frac{Cgw \times CF \times IR \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

IEX = estimated exposure intake (mg/kg/day)
Cgw = exposure point concentration in groundwater (ug/L)
CF = conversion factor (1.0E-3 mg/ug)
IR = ingestion rate (L/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)
ADAF = age-dependent adjustment factor
CSFo = oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cgw	=	0.046	ug/L	Chemical: Hexavalent Chromium
IR	=	1	L/day	
CF	=	1.0E-03	mg/ug	
EF	=	350	days/year	
ED_1	=	2	years	
ED_2	=	4	years	
BW	=	15	kg	
ATc	=	25550	days	
CSFo	=	5.0E-01	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	10		
$ADAF_2$	=	3		

CALCULATION WORKSHEET

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: R. JUPIN	**CHECKED BY:** L. Ciafani	**DATE:** 4/29/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{0.046 \text{ ug/L} \times 0.001 \text{ mg/ug} \times 1 \text{ L/day} \times 350 \text{ days/year} \times 2 \text{ years}}{15 \text{ kg} \times 25550 \text{ days}} \times 10$$

IEXc = 8.40E-07 mg/kg/day

$$IEXc = \frac{0.046 \text{ ug/L} \times 0.001 \text{ mg/ug} \times 1 \text{ L/day} \times 350 \text{ days/year} \times 4 \text{ years}}{15 \text{ kg} \times 25550 \text{ days}} \times 3$$

IEXc = 5.04E-07 mg/kg/day

ILCR = (8.40E-07 mg/kg/day + 5.04E-07 mg/kg/day) x 5.00E-01 (mg/kg/day)-1

ILCR = 6.7E-07

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENT		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: R. JUPIN	**CHECKED BY:** L. Cifa	**DATE:** 4/29/2013

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from ingestion of groundwater.

EQUATION:

$$IEX = \frac{Cgw \times CF \times IR \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cgw	=	exposure point concentration in groundwater (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
IR	=	ingestion rate (L/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cgw	=	0.046	ug/L	Chemical: Hexavalent Chromium
IR	=	2	L/day	
CF	=	1.0E-03	mg/ug	
EF	=	350	days/year	
ED_1	=	10	years	
ED_2	=	14	years	
BW	=	70	kg	
ATc	=	25550	days	
CSFo	=	5.0E-01	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	3		
$ADAF_2$	=	1		

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENT		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: R. JUPIN	**CHECKED BY:** L. Cifani	**DATE:** 4/29/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{0.046 \text{ ug/L} \times 0.001 \text{ mg/ug} \times 2 \text{ L/day} \times 350 \text{ days/year} \times 10 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}} \times 3$$

IEXc = 5.40E-07 mg/kg/day

$$IEXc = \frac{0.046 \text{ ug/L} \times 0.001 \text{ mg/ug} \times 2 \text{ L/day} \times 350 \text{ days/year} \times 14 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}} \times 1$$

IEXc = 2.52E-07 mg/kg/day

ILCR = (5.40E-07 mg/kg/day + 2.52E-07 mg/kg/day) x 5.00E-01 (mg/kg/day)-1

ILCR = 4.0E-07

CLIENT: NSWC CRANE, CRANE INDIANA		JOB NUMBER: 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004, MARCH 2005		
BY: R. JUPIN	CHECKED BY: L. Ciafani	DATE: 4/29/2013

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from dermal contact with groundwater.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT} \times ADAF$$

Where:

DAD = dermally absorbed dose (mg/kg/day)
DAevent = absorbed dose per event (mg/cm^2/event)
EV = event frequency (events/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
A = skin surface available for contact (cm^2)
BW = body weight (kg)
AT = averaging time (days)
ADAF = age-dependent adjustment factor
CSFd = dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = DAD (mg/kg/day) x CSFd $(mg/kg/day)^{-1}$

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If } tevent \le t^*, \text{ then: } DAevent = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If } tevent > t^*, \text{ then: } DAevent = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT: NSWC CRANE, CRANE INDIANA		JOB NUMBER: 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004, MARCH 2005		
BY: R. JUPIN	CHECKED BY: L. Cifani	DATE: 4/29/2013

Where:

Kp	=	permeability coefficient from water (cm/hr)
Cgw	=	concentration of chemical in groundwater (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)
t*	=	time it takes to reach steady-state (hr/event)
τ	=	lag time (hr/event)
B	=	Bunge Model Constant (dimensionless)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Cgw	=	0.000046	mg/L	Chemical: Hexavalent Chromium
Kp	=	2.00E-03	cm/hr	
tevent	=	1	hr/event	

DA_{event} = 0.002 cm/hr x 0.000046 mg/L x 0.001 L/cm3 x 1 hr/event

DA_{event} 9.20E-11 mg/cm2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	6,600	cm^2
EV	=	1	event/day
ED_1	=	2	years
ED_2	=	4	years
EF	=	350	days/year
BW	=	15	kg
ATc	=	25,550	days
CSFd	=	2.0E+01	$(mg/kg/day)^{-1}$
$ADAF_1$	=	10	
$ADAF_2$	=	3	

CLIENT: NSWC CRANE, CRANE INDIANA		JOB NUMBER: 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004, MARCH 2005		
BY: R. JUPIN	CHECKED BY: L. Ciofani	DATE: 4/29/2013

EXAMPLE CARCINOGENIC CALCULATION

$$DADc = \frac{9.20E\text{-}11 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 2 \text{ years} \times 350 \text{ days/year} \times 6600 \text{ cm2}}{15 \text{ kg} \times 25550 \text{ days}} \times 10$$

DADc = 1.11E-08 mg/kg/day

$$DADc = \frac{9.20E\text{-}11 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 4 \text{ years} \times 350 \text{ days/year} \times 6600 \text{ cm2}}{15 \text{ kg} \times 25550 \text{ days}} \times 3$$

DADc = 6.65E-09 mg/kg/day

ILCR = (1.11E-08 mg/kg/day+6.65E-09 mg/kg/day) x 2.00E+01 (mg/kg/day)-1

ILCR = 3.5E-07

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004, MARCH 2005		
BY: R. JUPIN	**CHECKED BY:** L. Cifer	**DATE:** 4/29/2013

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from dermal contact with groundwater.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT} \times ADAF$$

Where:

DAD	=	dermally absorbed dose (mg/kg/day)
DAevent	=	absorbed dose per event (mg/cm^2/event)
EV	=	event frequency (events/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
A	=	skin surface available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFd	=	dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = DAD (mg/kg/day) x CSFd $(mg/kg/day)^{-1}$

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If tevent} \le t^*\text{, then: DAevent} = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If tevent} > t^*\text{, then: DAevent} = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT: NSWC CRANE, CRANE INDIANA		**JOB NUMBER:** 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004, MARCH 2005		
BY: R. JUPIN	**CHECKED BY:** L. Cufani	**DATE:** 4/29/2013

Where:

Kp	=	permeability coefficient from water (cm/hr)
Cgw	=	concentration of chemical in groundwater (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)
t*	=	time it takes to reach steady-state (hr/event)
τ	=	lag time (hr/event)
B	=	Bunge Model Constant (dimensionless)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Cgw	=	0.000046	mg/L	Chemical: Hexavalent Chromium
Kp	=	2.00E-03	cm/hr	
tevent	=	0.58	hr/event	

DA_{event} = 0.002 cm/hr x 0.000046 mg/L x 0.001 L/cm3 x 0.58 hr/event

DA_{event} 5.34E-11 mg/cm2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	18,000	cm^2
EV	=	1	event/day
ED_1	=	10	years
ED_2	=	14	years
EF	=	350	days/year
BW	=	70	kg
ATc	=	25,550	days
CSFd	=	2.0E+01	$(mg/kg/day)^{-1}$
$ADAF_1$	=	3	
$ADAF_2$	=	1	

CLIENT: NSWC CRANE, CRANE INDIANA		JOB NUMBER: 112G02362
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004, MARCH 2005		
BY: R. JUPIN	CHECKED BY: L. C.	DATE: 4/29/2013

EXAMPLE CARCINOGENIC CALCULATION

$$DADc = \frac{5.34E\text{-}11 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 10 \text{ years} \times 350 \text{ days/year} \times 18000 \text{ cm2}}{70 \text{ kg} \times 25550 \text{ days}} \times 3$$

DADc = 5.64E-09 mg/kg/day

$$DADc = \frac{5.34E\text{-}11 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 14 \text{ years} \times 350 \text{ days/year} \times 18000 \text{ cm2}}{70 \text{ kg} \times 25550 \text{ days}} \times 1$$

DADc = 2.63E-09 mg/kg/day

ILCR = (5.64E-09 mg/kg/day+2.63E-09 mg/kg/day) x 2.00E+01 (mg/kg/day)-1

ILCR = 1.7E-07

APPENDIX E.5

IEUBK MODELING RESULTS

LEAD MODEL FOR WINDOWS Version 1.1

==
Model Version: 1.1 Build11
Date: 04/11/2013
Site Name: NSWC Crane, Crane Indiana
Operable Unit: SWMU 22 – Lead Azide Pond
Run Mode: Site Risk Assessment

Soil/Dust Data
Average concentration of lead in surface soil = 10.1 mg/kg.
Water Data
Average concentration of lead in groundwater = 13.8 ug/L.

==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 13.800 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 17.070 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	10.100	17.070
1-2	10.100	17.070
2-3	10.100	17.070
3-4	10.100	17.070
4-5	10.100	17.070
5-6	10.100	17.070
6-7	10.100	17.070

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

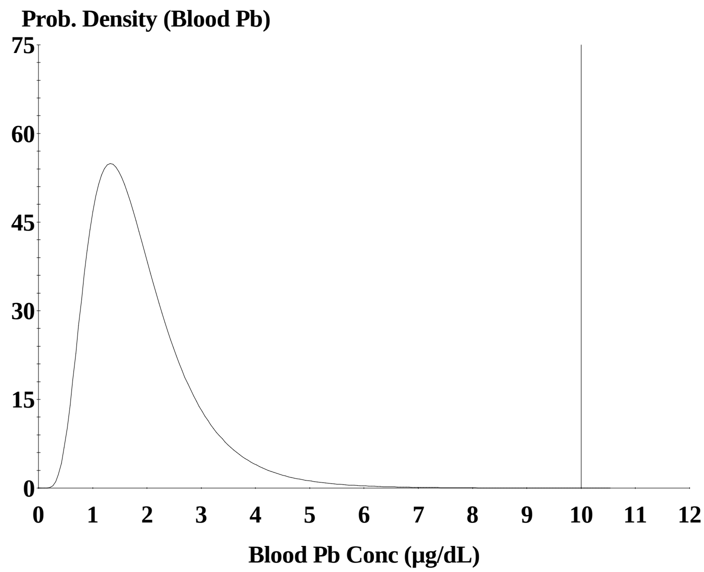
****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.095	0.000	1.337
1-2	0.034	0.940	0.000	3.309
2-3	0.062	1.026	0.000	3.457
3-4	0.067	0.988	0.000	3.541
4-5	0.067	0.949	0.000	3.692
5-6	0.093	0.999	0.000	3.901
6-7	0.093	1.084	0.000	3.975

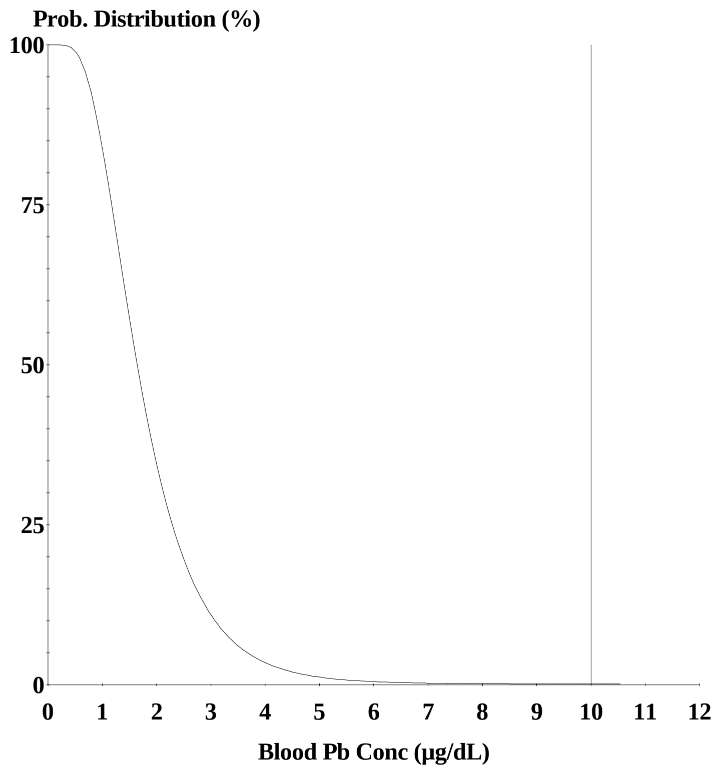
Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	0.344	2.798	1.5
1-2	0.541	4.824	2.0
2-3	0.544	5.089	1.9
3-4	0.546	5.142	1.8
4-5	0.407	5.114	1.7
5-6	0.367	5.361	1.6
6-7	0.347	5.498	1.6



Cutoff = 10.000 µg/dl
Geo Mean = 1.723
GSD = 1.600
% Above = 0.009
% Below = 99.991

Age Range = 0 to 84 months

Run Mode = Site Risk Assessment
Comment = SMWU 22



Cutoff = 10.000 µg/dl
Geo Mean = 1.723
GSD = 1.600
% Above = 0.009

Age Range = 0 to 84 months

Run Mode = Site Risk Assessment
Comment = SMWU 22

APPENDIX E.6

RAGS PART D TABLES FOR CHEMICALS PRESENT AT NATURALLY OCCURRING LEVELS

RAGS Part D Table 3

Medium-Specific Exposure Point Concentration Summary

LIST OF TABLES
RAGS PART D TABLE 3
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Table No.

3.1.RME Surface Soil
3.2.RME Subsurface Soil

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE INDIANA

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 22	Arsenic	mg/kg	4.6	5.3 (N)	9.8 J	5.3	mg/kg	95% Student's-t UCL	ProUCL 4.1.01
	Chromium VI	mg/kg	(1)	(1)	1.31	1.31	mg/kg	Maximum Detected Concentration	(1)

N = Normal

1 - Only one sample was analyzed for hexavalent chromium.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE 3.2.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 22	Arsenic	mg/kg	3.5	4.2 (N)	6.1 J	4.2	mg/kg	95% Student's-t UCL	ProUCL 4.1.01

N = Normal

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

RAGS Part D Table 4

Values Used For Daily Intake Calculations

LIST OF TABLES

RAGS PART D TABLE 4

VALUES USED FOR DAILY INTAKE CALCULATIONS

Table No.	
	Reasonable Maximum Exposures
4.1.RME	Construction Workers Exposed to Surface Soil/Subsurface Soil
4.2.RME	Construction Workers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.3.RME	Industrial Workers Exposed to Surface Soil/Subsurface Soil
4.4.RME	Industrial Workers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.5.RME	Adolescent Trespassers Exposed to Surface Soil/Subsurface Soil
4.6.RME	Adolescent Trespassers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.7.RME	Child Recreational Users Exposed to Surface Soil/Subsurface Soil
4.8.RME	Child Recreational Users Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.9.RME	Adult Recreational Users Exposed to Surface Soil/Subsurface Soil
4.10.RME	Adult Recreational Users Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.11.RME	Child Residents Exposed to Surface Soil/Subsurface Soil
4.12.RME	Child Residents Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.13.RME	Adult Residents Exposed to Surface Soil/Subsurface Soil
4.14.RME	Adult Residents Exposed to Air Emissions from Surface Soil/Subsurface Soil
	Central Tendency Exposures
4.1.CTE	Construction Workers Exposed to Surface Soil/Subsurface Soil
4.2.CTE	Construction Workers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.3.CTE	Industrial Workers Exposed to Surface Soil/Subsurface Soil
4.4.CTE	Industrial Workers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.5.CTE	Adolescent Trespassers Exposed to Surface Soil/Subsurface Soil
4.6.CTE	Adolescent Trespassers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.7.CTE	Child Recreational Users Exposed to Surface Soil/Subsurface Soil
4.8.CTE	Child Recreational Users Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.9.CTE	Adult Recreational Users Exposed to Surface Soil/Subsurface Soil
4.10.CTE	Adult Recreational Users Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.11.CTE	Child Residents Exposed to Surface Soil/Subsurface Soil
4.12.CTE	Child Residents Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.13.CTE	Adult Residents Exposed to Surface Soil/Subsurface Soil
4.14.CTE	Adult Residents Exposed to Air Emissions from Surface Soil/Subsurface Soil

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS- SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	330	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 2002b	BW x AT
				EF	Exposure Frequency	150	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal	Construction Workers	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	150	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assumes a 30 week construction project over one year.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 2002a:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.77E-08 Cancer Dermal Intake = 8.30E-08

Noncancer Ingestion Intake = 1.94E-06 Noncancer Dermal Intake = 5.81E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	150	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration	1	years	(1)	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.34E+06	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	14.31	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Professional judgment. Assumes a 30 week construction project over one year.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.96E-03

Noncancer Inhalation Intake = 1.37E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - INDUSTRIAL WORKERS - SOIL
NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Workers	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	250	days/year	USEPA, 1991	
				ED	Exposure Duration	25	years	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	
Dermal	Industrial Workers	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	250	days/year	USEPA, 1991	
				ED	Exposure Duration	25	years	USEPA, 1989	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
USEPA, 2002:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)
Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 3.49E-07
Noncancer Ingestion Intake = 9.78E-07

Cancer Dermal Intake = 2.31E-06
Noncancer Dermal Intake = 6.46E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor
Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor
Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose
Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - INDUSTRIAL WORKERS - SOIL TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Industrial Workers	Adult	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	250	days/year	USEPA, 1991	AT x 24 hours/day
				ED	Exposure Duration	25	years	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Length of typical work day.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 8.15E-02 Noncancer Inhalation Intake = 2.28E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	43	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3280	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	43	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	

Notes:

For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

1 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.

2 - Older child from age 6 to 17.

3 - Assume 25 percent of total body surface area is exposed, U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.37E-08 Cancer Dermal Intake = 1.55E-07

Noncancer Ingestion Intake = 1.66E-07 Noncancer Dermal Intake = 1.09E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.6.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Trespassers	Adolescent	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	4	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	26	days/year	(2)	AT x 24 hours/day
				ED	Exposure Duration	10	years	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

1 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.

2 - Older child from age 6 to 17.

3 - Assume 25 percent of total body surface area is exposed, U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.70E-03 Noncancer Inhalation Intake = 1.19E-02

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.7.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RECREATIONAL USERS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 1989	
Dermal	Recreational User	Child	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	52	days/year	(2)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 1989	

Notes:

1 - The child recreational user is assumed to be at the site only a portion of the day.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 8.14E-08 Cancer Dermal Intake (Age 0 - 6) = 4.56E-07

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 2.71E-08 Cancer Dermal Intake (Age 0 - 2) = 1.52E-07

Cancer Ingestion Intake (Age 2 - 6) = 5.43E-08 Cancer Dermal Intake (Age 2 - 6) = 3.04E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 9.50E-07 Noncancer Dermal Intake = 5.32E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.8.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RECREATIONAL USERS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Child	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	4	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	52	days/year	(2)	AT x 24 hours/day
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1989, 2005	CA = (1/PEF + 1/VF) x Cs
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Professional judgment.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 6) = 2.04E-03 Noncancer Inhalation Intake = 2.37E-02

Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 6.78E-04

Cancer Inhalation Intake (Age 2 - 6) = 1.36E-03

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.9.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RECREATIONAL USERS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Recreational User	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	9,070	cm2	(4)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	52	days/year	(2)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - The adult recreational user is assumed to be at the site only a portion of the day.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

4 - Assume that head, arms, hands, lower legs, and feet are exposed, USEPA, 2004.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 3.49E-08 Cancer Dermal Intake (Age 6 - 30) = 4.43E-07

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.45E-08 Cancer Dermal Intake (Age 6 - 16) = 1.85E-07

Cancer Ingestion Intake Age 16 - 30) = 2.04E-08 Cancer Dermal Intake (Age 16 - 30) = 2.58E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.02E-07 Noncancer Dermal Intake = 1.29E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.10.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RECREATIONAL USERS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Adult	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	4	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	52	days/year	(2)	AT x 24 hours/day
				ED1	Exposure Duration (Age 6 - 16)	10	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(3), USEPA, 1989, 2005	CA = (1/PEF + 1/VF) x Cs
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8760	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Professional judgment.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 30) = 8.14E-03

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 3.39E-03

Cancer Inhalation Intake (Age 16 - 30) = 4.75E-03

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 2.37E-02

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.11.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 1.10E-06 Cancer Dermal Intake (Age 0 - 6) = 3.07E-06

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 3.65E-07 Cancer Dermal Intake (Age 0 - 2) = 1.02E-06

Cancer Ingestion Intake (Age 2 - 6) = 7.31E-07 Cancer Dermal Intake (Age 2 - 6) = 2.05E-06

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.28E-05 Noncancer Dermal Intake = 3.58E-05

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.12.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS SOILS TO AIR

NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 1991	$\frac{CA \times ET \times EF \times ED}{AT \times 24 \text{ hours/day}}$
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	CA = (1/PEF + 1/VF) x Cs
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 6) = 8.22E-02

Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 2.74E-02

Cancer Inhalation Intake (Age 2 - 6) = 5.48E-02

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 1.92E+00

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.13.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 4.70E-07 Cancer Dermal Intake (Age 6 - 30) = 1.87E-06

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.96E-07 Cancer Dermal Intake (Age 6 - 16) = 7.81E-07

Cancer Ingestion Intake (Age 16 - 30) = 2.74E-07 Cancer Dermal Intake (Age 16 - 30) = 1.09E-06

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.37E-06 Noncancer Dermal Intake = 5.47E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.14.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 1991	CA x ET x EF x ED / AT x 24 hours/day
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	CA = (1/PEF + 1/VF) x Cs
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8760	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 30) = 3.29E-01

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 9.59E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 1.37E-01

Cancer Inhalation Intake (Age 16 - 30) = 1.92E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.1.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - SOILS
NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	165	mg/day	(1)	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 2002b	BW x AT
				EF	Exposure Frequency	75	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal	Construction Workers	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2002b	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.1	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	75	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes:

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 2002a:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 6.92E-09 Cancer Dermal Intake = 1.38E-08

Noncancer Ingestion Intake = 4.84E-07 Noncancer Dermal Intake = 9.69E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	75	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration	1	years	(1)	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.34E+06	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	14.31	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 9.78E-04 Noncancer Inhalation Intake = 6.85E-02

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.3.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURES - INDUSTRIAL WORKERS - SOIL
NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Workers	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	219	days/year	USEPA, 1993	
				ED	Exposure Duration	9	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 1989	
Dermal	Industrial Workers	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.02	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	219	days/year	USEPA, 1993	
				ED	Exposure Duration	9	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)
Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 5.51E-08 Cancer Dermal Intake = 7.27E-08
Noncancer Ingestion Intake = 4.29E-07 Noncancer Dermal Intake = 5.66E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor
Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor
Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose
Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - INDUSTRIAL WORKERS - SOIL TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Industrial Workers	Adult	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	219	days/year	USEPA, 1993	AT x 24 hours/day
				ED	Exposure Duration	9	years	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA 2004	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA 2008	

Notes:

1 - Length of typical work day.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 2.57E-02 Noncancer Inhalation Intake = 2.00E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.5.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CSs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	43	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	5300	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	43	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	

Notes:

For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

1 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.

2 - Older child from age 6 to 17.

3 - Assume 25 percent of total body surface area is exposed, U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 5.92E-09 Cancer Dermal Intake = 2.51E-08

Noncancer Ingestion Intake = 4.14E-08 Noncancer Dermal Intake = 1.76E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.6.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Trespassers	Adolescent	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	(1)	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	13	days/year	(2)	AT x 24 hours/day
				ED	Exposure Duration	10	years	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18 Chemical-specific	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.

2 - Older child from age 6 to 17.

3 - Assume 25 percent of total body surface area is exposed, U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 4.24E-04 Noncancer Inhalation Intake = 2.97E-03

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.7.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RECREATIONAL USERS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CSs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	26	days/year	(2)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Recreational User	Child	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(2)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Notes:

1 - The child recreational user is assumed to be at the site only a portion of the day.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 6.78E-09 Cancer Dermal Intake = 1.52E-08

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 3.39E-09 Cancer Dermal Intake (Age 0 - 2) = 7.60E-09

Cancer Ingestion Intake (Age 2 - 6) = 3.39E-09 Cancer Dermal Intake (Age 2 - 6) = 7.60E-09

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.37E-07 Noncancer Dermal Intake = 5.32E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.8.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RECREATIONAL USERS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Child	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	(1)	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	26	days/year	(2)	AT x 24 hours/day
				ED1	Exposure Duration (Age 0 - 2)	1	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(3), USEPA, 1989, 2005	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Professional judgment.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

<u>Unit Intake Calculations</u>

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

<u>Non-Mutagenic Chemicals</u>

Cancer Inhalation Intake = 1.70E-04 Noncancer Inhalation Intake = 5.94E-03

<u>Mutagenic Chemicals</u>

Cancer Inhalation Intake (Age 0 - 2) = 8.48E-05

Cancer Inhalation Intake (Age 2 - 6) = 8.48E-05

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.9.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RECREATIONAL USERS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Recreational User	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - The adult recreational user is assumed to be at the site only a portion of the day.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

4 - Assume that head, arms, hands, lower legs, and feet are exposed, USEPA, 2004.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 2.54E-09 Cancer Dermal Intake = 5.80E-09

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 7.27E-10 Cancer Dermal Intake (Age 6 - 16) = 1.66E-09

Cancer Ingestion Intake Age 16 - 30) = 1.82E-09 Cancer Dermal Intake (Age 16 - 30) = 4.14E-09

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.54E-08 Noncancer Dermal Intake = 5.80E-08

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.10.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RECREATIONAL USERS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Adult	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	(1)	$\frac{CA \times ET \times EF \times ED}{AT \times 24 \text{ hours/day}}$
				EF	Exposure Frequency	26	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(2), USEPA, 1989, 2005	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	2555	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Professional judgment.

2 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.

3 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake = 5.94E-04

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 5.94E-03

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 1.70E-04

Cancer Inhalation Intake (Age 16 - 30) = 4.24E-04

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.11.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Resident	Child	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 1.22E-07 Cancer Dermal Intake = 1.37E-07

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 6.11E-08 Cancer Dermal Intake (Age 0 - 2) = 6.84E-08

Cancer Ingestion Intake (Age 2 - 6) = 6.11E-08 Cancer Dermal Intake (Age 2 - 6) = 6.84E-08

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 4.27E-06 Noncancer Dermal Intake = 4.79E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.12.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 1993	CA x ET x EF x ED
				EF	Exposure Frequency	234	days/year	USEPA, 1993	AT x 24 hours/day
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 1989, 2005	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake = 1.83E-02

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 6.41E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 9.16E-03

Cancer Inhalation Intake (Age 2 - 6) = 9.16E-03

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.13.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SOILS

NSA CRANE, CRANE INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Resident	Adult	SWMU 18	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 4.58E-08 Cancer Dermal Intake = 5.22E-08

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.31E-08 Cancer Dermal Intake (Age 6 - 16) = 1.49E-08

Cancer Ingestion Intake (Age 16 - 30) = 3.27E-08 Cancer Dermal Intake (Age 16 - 30) = 3.73E-08

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 4.58E-07 Noncancer Dermal Intake = 5.22E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.14.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SOILS TO AIR

NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	SWMU 18	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 1993	$\frac{CA \times ET \times EF \times ED}{AT \times 24\text{ hours/day}}$
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	2555	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.32E+09	m3/kg	USEPA 2004	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.18	g/m2-s per kg/m3	USEPA 2008	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake = 6.41E-02

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 6.41E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 1.83E-02

Cancer Inhalation Intake (Age 16 - 30) = 4.58E-02

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

RAGS Part D Table 7

Calculation of Cancer Risks and Non-Cancer Hazards

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RAGS PART D TABLE 7
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

Table No.	
	Reasonable Maximum Exposures
7.1.RME	Construction Workers
7.2.RME	Industrial Workers
7.3.RME	Adolescent Trespassers
7.4.RME	Child Recreational Users
7.5.RME	Adult Recreational Users
7.6.RME	Child Residents
7.7.RME	Adult Residents
	Central Tendency Exposures
7.1.CTE	Construction Workers
7.2.CTE	Industrial Workers
7.3.CTE	Adolescent Trespassers
7.4.CTE	Child Recreational Users
7.5.CTE	Adult Recreational Users
7.6.CTE	Child Residents
7.7.CTE	Adult Residents

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	1.5E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2E-07	1.0E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.03
				Chromium VI	1.3	mg/kg	3.6E-08	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	2E-08	2.5E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	--
			Exp. Route Total								2E-07					0.03
			Dermal	Arsenic	5.30	mg/kg	1.3E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2E-08	9.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
			Exp. Route Total								2E-08					0.003
		Exposure Point Total									2E-07					0.03
	Exposure Medium Total										2E-07					0.03
	Air	SWMU 22	Inhalation	Arsenic	4.0E-6	mg/m^3	7.8E-09	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	3E-08	5.5E-07	(mg/m^3)	1.5E-05	(mg/m^3)	0.04
				Chromium VI	9.8E-7	mg/m^3	1.9E-09	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	2E-07	1.3E-07	(mg/m^3)	1.0E-04	(mg/m^3)	--
			Exp. Route Total								2E-07					0.04
		Exposure Point Total									2E-07					0.04
	Exposure Medium Total										2E-07					0.04
Medium Total											4E-07					0.07
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	1.2E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2E-07	8.1E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.03
			Exp. Route Total								2E-07					0.03
			Dermal	Arsenic	4.20	mg/kg	1.0E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2E-08	7.3E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								2E-08					0.002
		Exposure Point Total									2E-07					0.03
	Exposure Medium Total										2E-07					0.03
	Air	SWMU 22	Inhalation	Arsenic	3.1E-6	mg/m^3	6.1E-09	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	3E-08	4.2E-07	(mg/m^3)	1.5E-05	(mg/m^3)	0.03
			Exp. Route Total								3E-08					0.03
		Exposure Point Total									3E-08					0.03
	Exposure Medium Total										3E-08					0.03
Medium Total											2E-07					0.06
										Total of Receptor Risks Across All Media	6E-07			Total of Receptor Hazards Across All Media		0.1

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	1.8E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3E-06	5.2E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Chromium VI	1.3	mg/kg	4.5E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	2E-07	1.3E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
			Exp. Route Total								3E-06					0.02
			Dermal	Arsenic	5.30	mg/kg	3.7E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6E-07	1.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								6E-07					0.003
		Exposure Point Total									4E-06					0.02
	Exposure Medium Total										4E-06					0.02
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	3.3E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1E-09	9.1E-10	(mg/m^3)	1.5E-05	(mg/m^3)	0.00006
				Chromium VI	9.9E-10	mg/m^3	8.1E-11	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	7E-09	2.3E-10	(mg/m^3)	1.0E-04	(mg/m^3)	--
			Exp. Route Total								8E-09					0.00006
		Exposure Point Total									8E-09					0.00006
	Exposure Medium Total										8E-09					0.00006
Medium Total											4E-06					0.02
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	1.5E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2E-06	4.1E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.01
			Exp. Route Total								2E-06					0.01
			Dermal	Arsenic	4.20	mg/kg	2.9E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4E-07	8.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
			Exp. Route Total								4E-07					0.003
		Exposure Point Total									2E-06					0.01
	Exposure Medium Total										2E-06					0.01
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	2.6E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1E-09	7.3E-10	(mg/m^3)	1.5E-05	(mg/m^3)	0.00005
			Exp. Route Total								1E-09					0.00005
		Exposure Point Total									1E-09					0.00005
	Exposure Medium Total										1E-09					0.00005
Medium Total											2E-06					0.01
									Total of Receptor Risks Across All Media		6E-06	Total of Receptor Hazards Across All Media				0.03

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	1.3E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2E-07	8.8E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Chromium VI	1.3	mg/kg	9.2E-08	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	5E-08	2.2E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0001
			Exp. Route Total								3E-07					0.003
			Dermal	Arsenic	5.30	mg/kg	2.5E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4E-08	1.7E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0006
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								4E-08					0.0006
		Exposure Point Total									3E-07					0.004
	Exposure Medium Total										3E-07					0.004
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	6.8E-12	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	3E-11	4.8E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000003
				Chromium VI	9.9E-10	mg/m^3	5.0E-12	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	4E-10	1.2E-11	(mg/m^3)	1.0E-04	(mg/m^3)	--
			Exp. Route Total								4E-10					0.000003
		Exposure Point Total									4E-10					0.000003
	Exposure Medium Total										4E-10					0.000003
Medium Total											3E-07					0.004
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	1.0E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2E-07	7.0E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								2E-07					0.002
			Dermal	Arsenic	4.20	mg/kg	2.0E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	3E-08	1.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
			Exp. Route Total								3E-08					0.0005
		Exposure Point Total									2E-07					0.003
	Exposure Medium Total										2E-07					0.003
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	5.4E-12	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	2E-11	3.8E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000003
			Exp. Route Total								2E-11					0.000003
		Exposure Point Total									2E-11					0.000003
	Exposure Medium Total										2E-11					0.000003
Medium Total											2E-07					0.003
										Total of Receptor Risks Across All Media	5E-07				Total of Receptor Hazards Across All Media	0.007

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.4.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	4.3E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	6E-07	5.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Chromium VI	1.3	mg/kg	5.6E-07	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	3E-07	1.2E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
			Exp. Route Total								9E-07					0.02
			Dermal	Arsenic	5.30	mg/kg	7.3E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1E-07	8.5E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								1E-07					0.003
		Exposure Point Total									1E-06					0.02
	Exposure Medium Total										1E-06					0.02
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	8.2E-12	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	4E-11	9.5E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000006
				Chromium VI	9.9E-10	mg/m^3	1.1E-11	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	9E-10	2.3E-11	(mg/m^3)	1.0E-04	(mg/m^3)	--
			Exp. Route Total								9E-10					0.000006
		Exposure Point Total									9E-10					0.000006
	Exposure Medium Total										9E-10					0.000006
Medium Total											1E-06					0.02
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	3.4E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	5E-07	4.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.01
			Exp. Route Total								5E-07					0.01
			Dermal	Arsenic	4.20	mg/kg	5.7E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	9E-08	6.7E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								9E-08					0.002
		Exposure Point Total									6E-07					0.01
	Exposure Medium Total										6E-07					0.01
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	6.5E-12	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	3E-11	7.6E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000005
			Exp. Route Total								3E-11					0.000005
		Exposure Point Total									3E-11					0.000005
	Exposure Medium Total										3E-11					0.000005
Medium Total											6E-07					0.01
										Total of Receptor Risks Across All Media	2E-06				Total of Receptor Hazards Across All Media	0.03

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	1.8E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3E-07	5.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Chromium VI	1.3	mg/kg	8.3E-08	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	4E-08	1.3E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
			Exp. Route Total								3E-07					0.002
			Dermal	Arsenic	5.30	mg/kg	7.0E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1E-07	2.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0007
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								1E-07					0.0007
		Exposure Point Total									4E-07					0.003
	Exposure Medium Total										4E-07					0.003
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	3.3E-11	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1E-10	9.5E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000006
				Chromium VI	9.9E-10	mg/m^3	1.5E-11	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	1E-09	2.3E-11	(mg/m^3)	1.0E-04	(mg/m^3)	--
			Exp. Route Total								1E-09					0.000006
		Exposure Point Total									1E-09					0.000006
	Exposure Medium Total										1E-09					0.000006
Medium Total											4E-07					0.003
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	1.5E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2E-07	4.3E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.001
			Exp. Route Total								2E-07					0.001
			Dermal	Arsenic	4.20	mg/kg	5.6E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	8E-08	1.6E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
			Exp. Route Total								8E-08					0.0005
		Exposure Point Total									3E-07					0.002
	Exposure Medium Total										3E-07					0.002
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	2.6E-11	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1E-10	7.6E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000005
			Exp. Route Total								1E-10					0.000005
		Exposure Point Total									1E-10					0.000005
	Exposure Medium Total										1E-10					0.000005
Medium Total											3E-07					0.002
Total of Receptor Risks Across All Media											7E-07	Total of Receptor Hazards Across All Media				0.005

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.6.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	5.8E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	9E-06	6.8E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.2
				Chromium VI	1.3	mg/kg	7.6E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	4E-06	1.7E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.01
			Exp. Route Total								1E-05					0.2
			Dermal	Arsenic	5.30	mg/kg	4.9E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7E-07	5.7E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								7E-07					0.02
		Exposure Point Total									1E-05					0.2
	Exposure Medium Total										1E-05					0.2
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	3.3E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1E-09	3.8E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0003
				Chromium VI	9.9E-10	mg/m^3	4.3E-10	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	4E-08	9.5E-10	(mg/m^3)	1.0E-04	(mg/m^3)	--
			Exp. Route Total								4E-08					0.0003
		Exposure Point Total									4E-08					0.0003
	Exposure Medium Total										4E-08					0.0003
Medium Total											1E-05					0.2
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	4.6E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7E-06	5.4E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.2
			Exp. Route Total								7E-06					0.2
			Dermal	Arsenic	4.20	mg/kg	3.9E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6E-07	4.5E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
			Exp. Route Total								6E-07					0.02
		Exposure Point Total									8E-06					0.2
	Exposure Medium Total										8E-06					0.2
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	2.6E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1E-09	3.1E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0002
			Exp. Route Total								1E-09					0.0002
		Exposure Point Total									1E-09					0.0002
	Exposure Medium Total										1E-09					0.0002
Medium Total											8E-06					0.2
										Total of Receptor Risks Across All Media	2E-05				Total of Receptor Hazards Across All Media	0.4

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.7.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	2.5E-06	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4E-06	7.3E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Chromium VI	1.3	mg/kg	1.1E-06	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	6E-07	1.8E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.001
			Exp. Route Total								5E-06					0.02
			Dermal	Arsenic	5.30	mg/kg	3.0E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	5E-07	8.7E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								5E-07					0.003
		Exposure Point Total									6E-06					0.02
	Exposure Medium Total										6E-06					0.02
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	1.3E-09	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	6E-09	3.8E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0003
				Chromium VI	9.9E-10	mg/m^3	6.0E-10	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	5E-08	9.5E-10	(mg/m^3)	1.0E-04	(mg/m^3)	--
			Exp. Route Total								6E-08					0.0003
		Exposure Point Total									6E-08					0.0003
	Exposure Medium Total										6E-08					0.0003
Medium Total											6E-06					0.02
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	2.0E-06	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	3E-06	5.8E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
			Exp. Route Total								3E-06					0.02
			Dermal	Arsenic	4.20	mg/kg	2.4E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4E-07	6.9E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								4E-07					0.002
		Exposure Point Total									3E-06					0.02
	Exposure Medium Total										3E-06					0.02
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	1.1E-09	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	5E-09	3.1E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0002
			Exp. Route Total								5E-09					0.0002
		Exposure Point Total									5E-09					0.0002
	Exposure Medium Total										5E-09					0.0002
Medium Total											3E-06					0.02
										Total of Receptor Risks Across All Media	9E-06				Total of Receptor Hazards Across All Media	0.04

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.1.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	3.7E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	6E-08	2.6E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.009
				Chromium VI	1.3	mg/kg	9.0E-09	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	5E-09	6.3E-07	(mg/kg/day)	2.0E-02	(mg/kg/day)	--
			Exp. Route Total								7E-08					0.009
			Dermal	Arsenic	5.30	mg/kg	2.2E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	3E-09	1.5E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
			Exp. Route Total								3E-09					0.0005
		Exposure Point Total									7E-08					0.01
	Exposure Medium Total										7E-08					0.01
	Air	SWMU 22	Inhalation	Arsenic	4.0E-6	mg/m^3	3.9E-09	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	2E-08	2.7E-07	(mg/m^3)	1.5E-05	(mg/m^3)	0.02
				Chromium VI	9.8E-7	mg/m^3	9.6E-10	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	8E-08	6.7E-08	(mg/m^3)	1.0E-04	(mg/m^3)	0.001
			Exp. Route Total								1E-07					0.02
		Exposure Point Total									1E-07					0.02
	Exposure Medium Total										1E-07					0.02
Medium Total											2E-07					0.03
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	2.9E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4E-08	2.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.007
			Exp. Route Total								4E-08					0.007
			Dermal	Arsenic	4.20	mg/kg	1.7E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	3E-09	1.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
			Exp. Route Total								3E-09					0.0004
		Exposure Point Total									4E-08					0.007
	Exposure Medium Total										4E-08					0.007
	Air	SWMU 22	Inhalation	Arsenic	3.1E-6	mg/m^3	3.0E-09	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	1E-08	2.1E-07	(mg/m^3)	1.5E-05	(mg/m^3)	0.01
			Exp. Route Total								1E-08					0.01
		Exposure Point Total									1E-08					0.01
	Exposure Medium Total										1E-08					0.01
Medium Total											5E-08					0.02
							Total of Receptor Risks Across All Media				3E-07	Total of Receptor Hazards Across All Media				0.05

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.2.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	2.9E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4E-07	2.3E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.008
				Chromium VI	1.3	mg/kg	7.2E-08	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	4E-08	5.6E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
			Exp. Route Total								4E-07					0.01
			Dermal	Arsenic	5.30	mg/kg	1.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2E-08	9.0E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0003
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								2E-08					0.0003
		Exposure Point Total									4E-07					0.01
	Exposure Medium Total										4E-07					0.01
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	1.0E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	4E-10	8.0E-10	(mg/m^3)	1.5E-05	(mg/m^3)	0.00005
				Chromium VI	9.9E-10	mg/m^3	2.5E-11	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	2E-09	2.0E-10	(mg/m^3)	1.0E-04	(mg/m^3)	--
			Exp. Route Total								2E-09					0.00005
		Exposure Point Total									2E-09					0.00005
	Exposure Medium Total										2E-09					0.00005
Medium Total											4E-07					0.01
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	2.3E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3E-07	1.8E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.006
			Exp. Route Total								3E-07					0.006
			Dermal	Arsenic	4.20	mg/kg	9.2E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1E-08	7.1E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
			Exp. Route Total								1E-08					0.0002
		Exposure Point Total									3E-07					0.006
	Exposure Medium Total										3E-07					0.006
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	8.2E-11	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	4E-10	6.4E-10	(mg/m^3)	1.5E-05	(mg/m^3)	0.00004
			Exp. Route Total								4E-10					0.00004
		Exposure Point Total									4E-10					0.00004
	Exposure Medium Total										4E-10					0.00004
Medium Total											3E-07					0.006
										Total of Receptor Risks Across All Media	7E-07				Total of Receptor Hazards Across All Media	0.02

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.3.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	3.1E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	5E-08	2.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0007
				Chromium VI	1.3	mg/kg	2.3E-08	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	1E-08	5.4E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
			Exp. Route Total								6E-08					0.0007
			Dermal	Arsenic	5.30	mg/kg	4.0E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	6E-09	2.8E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00009
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								6E-09					0.00009
		Exposure Point Total									7E-08					0.001
	Exposure Medium Total										7E-08					0.001
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	1.7E-12	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	7E-12	1.2E-11	(mg/m^3)	1.5E-05	(mg/m^3)	8.0E-7
				Chromium VI	9.9E-10	mg/m^3	1.3E-12	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	1E-10	2.9E-12	(mg/m^3)	1.0E-04	(mg/m^3)	2.9E-8
			Exp. Route Total								1E-10					0.000001
		Exposure Point Total									1E-10					0.000001
	Exposure Medium Total										1E-10					0.000001
Medium Total											7E-08					0.001
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	2.5E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4E-08	1.7E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0006
			Exp. Route Total								4E-08					0.0006
			Dermal	Arsenic	4.20	mg/kg	3.2E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	5E-09	2.2E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00007
			Exp. Route Total								5E-09					0.00007
		Exposure Point Total									5E-08					0.0007
	Exposure Medium Total										5E-08					0.0007
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	1.4E-12	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	6E-12	9.5E-12	(mg/m^3)	1.5E-05	(mg/m^3)	6.3E-7
			Exp. Route Total								6E-12					6.3E-7
		Exposure Point Total									6E-12					6.3E-7
	Exposure Medium Total										6E-12					6.3E-7
Medium Total											5E-08					0.0007
										Total of Receptor Risks Across All Media	1E-07				Total of Receptor Hazards Across All Media	0.002

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.4.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	3.6E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5E-08	1.3E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.004
				Chromium VI	1.3	mg/kg	5.7E-08	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	3E-08	3.1E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
			Exp. Route Total								8E-08					0.004
			Dermal	Arsenic	5.30	mg/kg	2.4E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4E-09	8.5E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0003
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								4E-09					0.0003
		Exposure Point Total									8E-08					0.004
	Exposure Medium Total										8E-08					0.004
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	6.8E-13	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	3E-12	2.4E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000002
				Chromium VI	9.9E-10	mg/m^3	1.1E-12	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	9E-11	5.9E-12	(mg/m^3)	1.0E-04	(mg/m^3)	5.9E-8
			Exp. Route Total								9E-11					0.000002
		Exposure Point Total									9E-11					0.000002
	Exposure Medium Total										9E-11					0.000002
Medium Total											8E-08					0.004
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	2.8E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4E-08	1.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
			Exp. Route Total								4E-08					0.003
			Dermal	Arsenic	4.20	mg/kg	1.9E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3E-09	6.7E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
			Exp. Route Total								3E-09					0.0002
		Exposure Point Total									4E-08					0.003
	Exposure Medium Total										4E-08					0.003
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	5.4E-13	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	2E-12	1.9E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000001
			Exp. Route Total								2E-12					0.000001
		Exposure Point Total									2E-12					0.000001
	Exposure Medium Total										2E-12					0.000001
Medium Total											4E-08					0.003
										Total of Receptor Risks Across All Media	1E-07				Total of Receptor Hazards Across All Media	0.01

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.5.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	1.3E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2E-08	1.3E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
				Chromium VI	1.3	mg/kg	5.2E-09	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	3E-09	3.3E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
			Exp. Route Total								2E-08					0.0004
			Dermal	Arsenic	5.30	mg/kg	9.2E-10	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1E-09	9.2E-09	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00003
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								1E-09					0.00003
		Exposure Point Total									2E-08					0.0004
	Exposure Medium Total										2E-08					0.0004
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	2.4E-12	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	1E-11	2.4E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000002
				Chromium VI	9.9E-10	mg/m^3	9.2E-13	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	8E-11	5.9E-12	(mg/m^3)	1.0E-04	(mg/m^3)	5.9E-8
			Exp. Route Total								9E-11					0.000002
		Exposure Point Total									9E-11					0.000002
	Exposure Medium Total										9E-11					0.000002
Medium Total											2E-08					0.0004
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	1.1E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2E-08	1.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0004
			Exp. Route Total								2E-08					0.0004
			Dermal	Arsenic	4.20	mg/kg	7.3E-10	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1E-09	7.3E-09	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00002
			Exp. Route Total								1E-09					0.00002
		Exposure Point Total									2E-08					0.0004
	Exposure Medium Total										2E-08					0.0004
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	1.9E-12	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	8E-12	1.9E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000001
			Exp. Route Total								8E-12					0.000001
		Exposure Point Total									8E-12					0.000001
	Exposure Medium Total										8E-12					0.000001
Medium Total											2E-08					0.0004
										Total of Receptor Risks Across All Media	4E-08				Total of Receptor Hazards Across All Media	0.001

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.6.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	6.5E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1E-06	2.3E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.08
				Chromium VI	1.3	mg/kg	1.0E-06	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	5E-07	5.6E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
			Exp. Route Total								2E-06					0.1
			Dermal	Arsenic	5.30	mg/kg	2.2E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	3E-08	7.6E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								3E-08					0.003
		Exposure Point Total									2E-06					0.1
	Exposure Medium Total										2E-06					0.1
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	7.3E-11	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	3E-10	2.6E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0002
				Chromium VI	9.9E-10	mg/m^3	1.2E-10	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	1E-08	6.3E-10	(mg/m^3)	1.0E-04	(mg/m^3)	0.00001
			Exp. Route Total								1E-08					0.0002
		Exposure Point Total									1E-08					0.0002
	Exposure Medium Total										1E-08					0.0002
Medium Total											2E-06					0.1
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	5.1E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	8E-07	1.8E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.06
			Exp. Route Total								8E-07					0.06
			Dermal	Arsenic	4.20	mg/kg	1.7E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	3E-08	6.0E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
			Exp. Route Total								3E-08					0.002
		Exposure Point Total									8E-07					0.06
	Exposure Medium Total										8E-07					0.06
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	5.9E-11	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	3E-10	2.1E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0001
			Exp. Route Total								3E-10					0.0001
		Exposure Point Total									3E-10					0.0001
	Exposure Medium Total										3E-10					0.0001
Medium Total											8E-07					0.06
										Total of Receptor Risks Across All Media	3E-06				Total of Receptor Hazards Across All Media	0.2

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.7.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 22	Ingestion	Arsenic	5.30	mg/kg	2.4E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4E-07	2.4E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.008
				Chromium VI	1.3	mg/kg	9.4E-08	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	5E-08	6.0E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
			Exp. Route Total								5E-07					0.01
			Dermal	Arsenic	5.30	mg/kg	8.3E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1E-08	8.3E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0003
				Chromium VI	1.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
			Exp. Route Total								1E-08					0.0003
		Exposure Point Total									5E-07					0.01
	Exposure Medium Total										5E-07					0.01
	Air	SWMU 22	Inhalation	Arsenic	4.0E-9	mg/m^3	2.6E-10	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	1E-09	2.6E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0002
				Chromium VI	9.9E-10	mg/m^3	1.0E-10	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	8E-09	6.3E-10	(mg/m^3)	1.0E-04	(mg/m^3)	0.00001
			Exp. Route Total								9E-09					0.0002
		Exposure Point Total									9E-09					0.0002
	Exposure Medium Total										9E-09					0.0002
Medium Total											5E-07					0.01
Subsurface Soil	Subsurface Soil	SWMU 22	Ingestion	Arsenic	4.20	mg/kg	1.9E-07	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	3E-07	1.9E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.006
			Exp. Route Total								3E-07					0.006
			Dermal	Arsenic	4.20	mg/kg	6.6E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1E-08	6.6E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
			Exp. Route Total								1E-08					0.0002
		Exposure Point Total									3E-07					0.006
	Exposure Medium Total										3E-07					0.006
	Air	SWMU 22	Inhalation	Arsenic	3.2E-9	mg/m^3	2.1E-10	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	9E-10	2.1E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0001
			Exp. Route Total								9E-10					0.0001
		Exposure Point Total									9E-10					0.0001
	Exposure Medium Total										9E-10					0.0001
Medium Total											3E-07					0.006
										Total of Receptor Risks Across All Media	8E-07				Total of Receptor Hazards Across All Media	0.02

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

RAGS Part D Table 9

Summary of Receptor Risks and Hazards for COPCs

LIST OF TABLES

RAGS PART D TABLE 9

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

Table No.	
	Reasonable Maximum Exposures
9.1.RME	Construction Workers
9.2.RME	Industrial Workers
9.3.RME	Adolescent Trespassers
9.4.RME	Child Recreational Users
9.5.RME	Adult Recreational Users
9.6.RME	Lifelong Recreational Users
9.7.RME	Child Residents
9.8.RME	Adult Residents
9.9.RME	Lifelong Residents
	Central Tendency Exposures
9.1.CTE	Construction Workers
9.2.CTE	Industrial Workers
9.3.CTE	Adolescent Trespassers
9.4.CTE	Child Recreational Users
9.5.CTE	Adult Recreational Users
9.6.CTE	Lifelong Recreational Users
9.7.CTE	Child Residents
9.8.CTE	Adult Residents
9.9.CTE	Lifelong Residents

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	2E-07	--	2E-08	--	2E-07	Skin, CVS	0.03	--	0.003	0.03
			Chromium VI	2E-08	--	- -	--	2E-08	None Specified	--	--	--	--
			Chemical Total	2E-07	--	2E-08	--	2E-07		0.03	--	0.003	0.03
		Exposure Point Total						2E-07					0.03
	Exposure Medium Total							2E-07					0.03
	Air	SWMU 22	Arsenic	--	3E-08	--	--	3E-08	NA	--	0.04	--	0.04
			Chromium VI	--	2E-07	--	--	2E-07	Respiratory	--	--	--	--
			Chemical Total	--	2E-07	--	--	2E-07		- -	0.04	- -	0.04
		Exposure Point Total						2E-07					0.04
	Exposure Medium Total							2E-07					0.04
Medium Total								4E-07					0.07
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	2E-07	--	2E-08	--	2E-07	Skin, CVS	0.03	--	0.002	0.03
			Chemical Total	2E-07	--	2E-08	--	2E-07		0.03	--	0.002	0.03
		Exposure Point Total						2E-07					0.03
	Exposure Medium Total							2E-07					0.03
	Air	SWMU 22	Arsenic	--	3E-08	--	--	3E-08	NA	--	0.03	--	0.03
			Chemical Total	--	3E-08	--	--	3E-08		- -	0.03	- -	0.03
		Exposure Point Total						3E-08					0.03
	Exposure Medium Total							3E-08					0.03
Medium Total								2E-07					0.06
Receptor Total							Receptor Risk Total	6E-07				Receptor HI Total	0.1

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	3E-06	--	6E-07	--	4E-06	Skin, CVS	0.02	--	0.003	0.02
			Chromium VI	2E-07	--	- -	--	2E-07	None Specified	--	--	--	--
			Chemical Total	3E-06	--	6E-07	--	4E-06		0.02	--	0.003	0.02
		Exposure Point Total						4E-06					0.02
	Exposure Medium Total							4E-06					0.02
	Air	SWMU 22	Arsenic	--	1E-09	--	--	1E-09	NA	--	0.00006	--	0.00006
			Chromium VI	--	7E-09	--	--	7E-09	Respiratory	--	--	--	--
			Chemical Total	--	8E-09	--	--	8E-09		- -	0.00006	- -	0.00006
		Exposure Point Total						8E-09					0.00006
	Exposure Medium Total							8E-09					0.00006
Medium Total								4E-06					0.02
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	2E-06	--	4E-07	--	2E-06	Skin, CVS	0.01	--	0.003	0.01
			Chemical Total	2E-06	--	4E-07	--	2E-06		0.01	--	0.003	0.01
		Exposure Point Total						2E-06					0.01
	Exposure Medium Total							2E-06					0.01
	Air	SWMU 22	Arsenic	--	1E-09	--	--	1E-09	NA	--	0.00005	--	0.00005
			Chemical Total	--	1E-09	--	--	1E-09		- -	0.00005	- -	0.00005
		Exposure Point Total						1E-09					0.00005
	Exposure Medium Total							1E-09					0.00005
Medium Total								2E-06					0.01
Receptor Total							Receptor Risk Total	6E-06				Receptor HI Total	0.03

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	2E-07	--	4E-08	--	2E-07	Skin, CVS	0.003	--	0.0006	0.004
			Chromium VI	5E-08	--	- -	--	5E-08	None Specified	0.0001	--	--	0.0001
			Chemical Total	3E-07	--	4E-08	--	3E-07		0.003	--	0.0006	0.004
		Exposure Point Total						3E-07					0.004
	Exposure Medium Total							3E-07					0.004
	Air	SWMU 22	Arsenic	--	3E-11	--	--	3E-11	NA	--	0.000003	--	0.000003
			Chromium VI	--	4E-10	--	--	4E-10	Respiratory	--	--	--	--
			Chemical Total	--	4E-10	--	--	4E-10		- -	0.000003	- -	0.000003
		Exposure Point Total						4E-10					0.000003
	Exposure Medium Total							4E-10					0.000003
Medium Total								3E-07					0.004
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	2E-07	--	3E-08	--	2E-07	Skin, CVS	0.002	--	0.0005	0.003
			Chemical Total	2E-07	--	3E-08	--	2E-07		0.002	--	0.0005	0.003
		Exposure Point Total						2E-07					0.003
	Exposure Medium Total							2E-07					0.003
	Air	SWMU 22	Arsenic	--	2E-11	--	--	2E-11	NA	--	0.000003	--	0.000003
			Chemical Total	--	2E-11	--	--	2E-11		- -	0.000003	- -	0.000003
		Exposure Point Total						2E-11					0.000003
	Exposure Medium Total							2E-11					0.000003
Medium Total								2E-07					0.003
Receptor Total							Receptor Risk Total	5E-07				Receptor HI Total	0.007

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	6E-07	--	1E-07	--	7E-07	Skin, CVS	0.02	--	0.003	0.02
			Chromium VI	3E-07	--	- -	--	3E-07	None Specified	--	--	--	--
			Chemical Total	9E-07	--	1E-07	--	1E-06		0.02	--	0.003	0.02
		Exposure Point Total						1E-06					0.02
	Exposure Medium Total							1E-06					0.02
	Air	SWMU 22	Arsenic	--	4E-11	--	--	4E-11	NA	--	0.000006	--	0.000006
			Chromium VI	--	9E-10	--	--	9E-10	Respiratory	--	--	--	--
			Chemical Total	--	9E-10	--	--	9E-10		- -	0.000006	- -	0.000006
		Exposure Point Total						9E-10					0.000006
	Exposure Medium Total							9E-10					0.000006
Medium Total								1E-06					0.02
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	5E-07	--	9E-08	--	6E-07	Skin, CVS	0.01	--	0.002	0.01
			Chemical Total	5E-07	--	9E-08	--	6E-07		0.01	--	0.002	0.01
		Exposure Point Total						6E-07					0.01
	Exposure Medium Total							6E-07					0.01
	Air	SWMU 22	Arsenic	--	3E-11	--	--	3E-11	NA	--	0.000005	--	0.000005
			Chemical Total	--	3E-11	--	--	3E-11		- -	0.000005	- -	0.000005
		Exposure Point Total						3E-11					0.000005
	Exposure Medium Total							3E-11					0.000005
Medium Total								6E-07					0.01
Receptor Total							Receptor Risk Total	2E-06				Receptor HI Total	0.03

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	3E-07	--	1E-07	--	4E-07	Skin, CVS	0.002	--	0.0007	0.003
			Chromium VI	4E-08	--	- -	--	4E-08	None Specified	--	--	--	--
			Chemical Total	3E-07	--	1E-07	--	4E-07		0.002	--	0.0007	0.003
		Exposure Point Total						4E-07					0.003
	Exposure Medium Total							4E-07					0.003
	Air	SWMU 22	Arsenic	--	1E-10	--	--	1E-10	NA	--	0.000006	--	0.000006
			Chromium VI	--	1E-09	--	--	1E-09	Respiratory	--	--	--	--
			Chemical Total	--	1E-09	--	--	1E-09		- -	0.000006	- -	0.000006
		Exposure Point Total						1E-09					0.000006
	Exposure Medium Total							1E-09					0.000006
Medium Total								4E-07					0.003
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	2E-07	--	8E-08	--	3E-07	Skin, CVS	0.001	--	0.0005	0.002
			Chemical Total	2E-07	--	8E-08	--	3E-07		0.001	--	0.0005	0.002
		Exposure Point Total						3E-07					0.002
	Exposure Medium Total							3E-07					0.002
	Air	SWMU 22	Arsenic	--	1E-10	--	--	1E-10	NA	--	0.000005	--	0.000005
			Chemical Total	--	1E-10	--	--	1E-10		- -	0.000005	- -	0.000005
		Exposure Point Total						1E-10					0.000005
	Exposure Medium Total							1E-10					0.000005
Medium Total								3E-07					0.002
Receptor Total							Receptor Risk Total	7E-07				Receptor HI Total	0.005

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	9E-07	--	2E-07	--	1E-06					
			Chromium VI	3E-07	--	- -	--	3E-07					
			Chemical Total	1E-06	--	2E-07	--	1E-06					
		Exposure Point Total						1E-06					
	Exposure Medium Total							1E-06					
	Air	SWMU 22	Arsenic	--	1E-10	--	--	1E-10					
			Chromium VI	--	2E-09	--	--	2E-09					
			Chemical Total	--	2E-09	--	--	2E-09					
		Exposure Point Total						2E-09					
	Exposure Medium Total							2E-09					
Medium Total								1E-06					
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	7E-07	--	2E-07	--	9E-07					
			Chemical Total	7E-07	--	2E-07	--	9E-07					
		Exposure Point Total						9E-07					
	Exposure Medium Total							9E-07					
	Air	SWMU 22	Arsenic	--	1E-10	--	--	1E-10					
			Chemical Total	--	1E-10	--	--	1E-10					
		Exposure Point Total						1E-10					
	Exposure Medium Total							1E-10					
Medium Total								9E-07					
Receptor Total							Receptor Risk Total	2E-06					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.7.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	9E-06	--	7E-07	--	1E-05	Skin, CVS	0.2	--	0.02	0.2
			Chromium VI	4E-06	--	- -	--	4E-06	None Specified	0.01	--	--	0.01
			Chemical Total	1E-05	--	7E-07	--	1E-05		0.2	--	0.02	0.2
		Exposure Point Total						1E-05					0.2
	Exposure Medium Total							1E-05					0.2
	Air	SWMU 22	Arsenic	--	1E-09	--	--	1E-09	NA	--	0.0003	--	0.0003
			Chromium VI	--	4E-08	--	--	4E-08	Respiratory	--	--	--	--
			Chemical Total	--	4E-08	--	--	4E-08		- -	0.0003	- -	0.0003
		Exposure Point Total						4E-08					0.0003
	Exposure Medium Total							4E-08					0.0003
Medium Total								1E-05					0.2
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	7E-06	--	6E-07	--	8E-06	Skin, CVS	0.2	--	0.02	0.2
			Chemical Total	7E-06	--	6E-07	--	8E-06		0.2	--	0.02	0.2
		Exposure Point Total						8E-06					0.2
	Exposure Medium Total							8E-06					0.2
	Air	SWMU 22	Arsenic	--	1E-09	--	--	1E-09	NA	--	0.0002	--	0.0002
			Chemical Total	--	1E-09	--	--	1E-09		- -	0.0002	- -	0.0002
		Exposure Point Total						1E-09					0.0002
	Exposure Medium Total							1E-09					0.0002
Medium Total								8E-06					0.2
Receptor Total							Receptor Risk Total	2E-05				Receptor HI Total	0.4

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.8.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	4E-06	--	5E-07	--	5E-06	Skin, CVS	0.02	--	0.003	0.02
			Chromium VI	6E-07	--	- -	--	6E-07	None Specified	0.001	--	--	0.001
			Chemical Total	5E-06	--	5E-07	--	6E-06		0.02	--	0.003	0.02
		Exposure Point Total						6E-06					0.02
	Exposure Medium Total							6E-06					0.02
	Air	SWMU 22	Arsenic	--	6E-09	--	--	6E-09	NA	--	0.0003	--	0.0003
			Chromium VI	--	5E-08	--	--	5E-08	Respiratory	--	--	--	--
			Chemical Total	--	6E-08	--	--	6E-08		- -	0.0003	- -	0.0003
		Exposure Point Total						6E-08					0.0003
	Exposure Medium Total							6E-08					0.0003
Medium Total								6E-06					0.02
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	3E-06	--	4E-07	--	3E-06	Skin, CVS	0.02	--	0.002	0.02
			Chemical Total	3E-06	--	4E-07	--	3E-06		0.02	--	0.002	0.02
		Exposure Point Total						3E-06					0.02
	Exposure Medium Total							3E-06					0.02
	Air	SWMU 22	Arsenic	--	5E-09	--	--	5E-09	NA	--	0.0002	--	0.0002
			Chemical Total	--	5E-09	--	--	5E-09		- -	0.0002	- -	0.0002
		Exposure Point Total						5E-09					0.0002
	Exposure Medium Total							5E-09					0.0002
Medium Total								3E-06					0.02
Receptor Total							Receptor Risk Total	9E-06				Receptor HI Total	0.04

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.9.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	1E-05	--	1E-06	--	1E-05					
			Chromium VI	5E-06	--	- -	--	5E-06					
			Chemical Total	2E-05	--	1E-06	--	2E-05					
		Exposure Point Total						2E-05					
	Exposure Medium Total							2E-05					
	Air	SWMU 22	Arsenic	--	7E-09	--	--	7E-09					
			Chromium VI	--	9E-08	--	--	9E-08					
			Chemical Total	--	1E-07	--	--	1E-07					
		Exposure Point Total						1E-07					
	Exposure Medium Total							1E-07					
Medium Total								2E-05					
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	1E-05	--	1E-06	--	1E-05					
			Chemical Total	1E-05	--	1E-06	--	1E-05					
		Exposure Point Total						1E-05					
	Exposure Medium Total							1E-05					
	Air	SWMU 22	Arsenic	--	6E-09	--	--	6E-09					
			Chemical Total	--	6E-09	--	--	6E-09					
		Exposure Point Total						6E-09					
	Exposure Medium Total							6E-09					
Medium Total								1E-05					
Receptor Total							Receptor Risk Total	3E-05					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	6E-08	--	3E-09	--	6E-08	Skin, CVS	0.009	--	0.0005	0.01
			Chromium VI	5E-09	--	- -	--	5E-09	None Specified	--	--	--	--
			Chemical Total	7E-08	--	3E-09	--	7E-08		0.009	--	0.0005	0.01
		Exposure Point Total						7E-08					0.01
	Exposure Medium Total							7E-08					0.01
	Air	SWMU 22	Arsenic	--	2E-08	--	--	2E-08	NA	--	0.02	--	0.02
			Chromium VI	--	8E-08	--	--	8E-08	Respiratory	--	0.001	--	0.001
			Chemical Total	--	1E-07	--	--	1E-07		- -	0.02	- -	0.02
		Exposure Point Total						1E-07					0.02
	Exposure Medium Total							1E-07					0.02
Medium Total								2E-07					0.03
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	4E-08	--	3E-09	--	4E-08	Skin, CVS	0.007	--	0.0004	0.007
			Chemical Total	4E-08	--	3E-09	--	4E-08		0.007	--	0.0004	0.007
		Exposure Point Total						4E-08					0.007
	Exposure Medium Total							4E-08					0.007
	Air	SWMU 22	Arsenic	--	1E-08	--	--	1E-08	NA	--	0.01	--	0.01
			Chemical Total	--	1E-08	--	--	1E-08		- -	0.01	- -	0.01
		Exposure Point Total						1E-08					0.01
	Exposure Medium Total							1E-08					0.01
Medium Total								5E-08					0.02
Receptor Total							Receptor Risk Total	3E-07				Receptor HI Total	0.05

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.2.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	4E-07	--	2E-08	--	4E-07	Skin, CVS	0.008	--	0.0003	0.008
			Chromium VI	4E-08	--	- -	--	4E-08	None Specified	--	--	--	--
			Chemical Total	4E-07	--	2E-08	--	4E-07		0.01	--	0.0003	0.01
		Exposure Point Total						4E-07					0.01
	Exposure Medium Total							4E-07					0.01
	Air	SWMU 22	Arsenic	--	4E-10	--	--	4E-10	NA	--	0.00005	--	0.00005
			Chromium VI	--	2E-09	--	--	2E-09	Respiratory	--	--	--	--
			Chemical Total	--	2E-09	--	--	2E-09		- -	0.00005	- -	0.00005
		Exposure Point Total						2E-09					0.00005
	Exposure Medium Total							2E-09					0.00005
Medium Total								4E-07					0.01
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	3E-07	--	1E-08	--	3E-07	Skin, CVS	0.006	--	0.0002	0.006
			Chemical Total	3E-07	--	1E-08	--	3E-07		0.006	--	0.0002	0.006
		Exposure Point Total						3E-07					0.006
	Exposure Medium Total							3E-07					0.006
	Air	SWMU 22	Arsenic	--	4E-10	--	--	4E-10	NA	--	0.00004	--	0.00004
			Chemical Total	--	4E-10	--	--	4E-10		- -	0.00004	- -	0.00004
		Exposure Point Total						4E-10					0.00004
	Exposure Medium Total							4E-10					0.00004
Medium Total								3E-07					0.006
Receptor Total							Receptor Risk Total	7E-07				Receptor HI Total	0.02

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.3.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	5E-08	--	6E-09	--	6E-08	Skin, CVS	0.0007	--	0.00009	0.0008
			Chromium VI	1E-08	--	- -	--	1E-08	None Specified	--	--	--	--
			Chemical Total	6E-08	--	6E-09	--	7E-08		0.0007	--	0.00009	0.001
		Exposure Point Total						7E-08					0.001
	Exposure Medium Total							7E-08					0.001
	Air	SWMU 22	Arsenic	--	7E-12	--	--	7E-12	NA	--	0.0000008	--	0.0000008
			Chromium VI	--	1E-10	--	--	1E-10	Respiratory	--	--	--	--
			Chemical Total	--	1E-10	--	--	1E-10		- -	0.000001	- -	0.000001
		Exposure Point Total						1E-10					0.000001
	Exposure Medium Total							1E-10					0.000001
Medium Total								7E-08					0.001
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	4E-08	--	5E-09	--	5E-08	Skin, CVS	0.0006	--	0.00007	0.0007
			Chemical Total	4E-08	--	5E-09	--	5E-08		0.0006	--	0.00007	0.0007
		Exposure Point Total						5E-08					0.0007
	Exposure Medium Total							5E-08					0.0007
	Air	SWMU 22	Arsenic	--	6E-12	--	--	6E-12	NA	--	0.0000006	--	0.0000006
			Chemical Total	--	6E-12	--	--	6E-12		- -	0.0000006	- -	0.0000006
		Exposure Point Total						6E-12					0.0000006
	Exposure Medium Total							6E-12					0.0000006
Medium Total								5E-08					0.0007
Receptor Total							Receptor Risk Total	1E-07				Receptor HI Total	0.002

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.4.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk: Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Non-Carcinogenic Hazard Quotient: Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	5E-08	--	4E-09	--	5E-08	Skin, CVS	0.004	--	0.0003	0.004
			Chromium VI	3E-08	--	- -	--	3E-08	None Specified	--	--	--	--
			Chemical Total	8E-08	--	4E-09	--	8E-08		0.004	--	0.0003	0.004
		Exposure Point Total						8E-08					0.004
	Exposure Medium Total							8E-08					0.004
	Air	SWMU 22	Arsenic	--	3E-12	--	--	3E-12	NA	--	0.000002	--	0.000002
			Chromium VI	--	9E-11	--	--	9E-11	Respiratory	--	0.0000001	--	0.0000001
			Chemical Total	--	9E-11	--	--	9E-11		- -	0.000002	- -	0.000002
		Exposure Point Total						9E-11					0.000002
	Exposure Medium Total							9E-11					0.000002
Medium Total								8E-08					0.004
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	4E-08	--	3E-09	--	4E-08	Skin, CVS	0.003	--	0.0002	0.003
			Chemical Total	4E-08	--	3E-09	--	4E-08		0.003	--	0.0002	0.003
		Exposure Point Total						4E-08					0.003
	Exposure Medium Total							4E-08					0.003
	Air	SWMU 22	Arsenic	--	2E-12	--	--	2E-12	NA	--	0.000001	--	0.000001
			Chemical Total	--	2E-12	--	--	2E-12		- -	0.000001	- -	0.000001
		Exposure Point Total						2E-12					0.000001
	Exposure Medium Total							2E-12					0.000001
Medium Total								4E-08					0.003
Receptor Total							Receptor Risk Total	1E-07				Receptor HI Total	0.01

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.5.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	2E-08	--	1E-09	--	2E-08	Skin, CVS	0.0004	--	0.00003	0.0004
			Chromium VI	3E-09	--	- -	--	3E-09	None Specified	--	--	--	--
			Chemical Total	2E-08	--	1E-09	--	2E-08		0.0004	--	0.00003	0.0004
		Exposure Point Total						2E-08					0.0004
	Exposure Medium Total							2E-08					0.0004
	Air	SWMU 22	Arsenic	--	1E-11	--	--	1E-11	NA	--	0.000002	--	0.000002
			Chromium VI	--	8E-11	--	--	8E-11	Respiratory	--	0.0000001	--	0.0000001
			Chemical Total	--	9E-11	--	--	9E-11		- -	0.000002	- -	0.000002
		Exposure Point Total						9E-11					0.000002
	Exposure Medium Total							9E-11					0.000002
Medium Total								2E-08					0.0004
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	2E-08	--	1E-09	--	2E-08	Skin, CVS	0.0004	--	0.00002	0.0004
			Chemical Total	2E-08	--	1E-09	--	2E-08		0.0004	--	0.00002	0.0004
		Exposure Point Total						2E-08					0.0004
	Exposure Medium Total							2E-08					0.0004
	Air	SWMU 22	Arsenic	--	8E-12	--	--	8E-12	NA	--	0.000001	--	0.000001
			Chemical Total	--	8E-12	--	--	8E-12		- -	0.000001	- -	0.000001
		Exposure Point Total						8E-12					0.000001
	Exposure Medium Total							8E-12					0.000001
Medium Total								2E-08					0.0004
Receptor Total							Receptor Risk Total	4E-08				Receptor HI Total	0.001

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.6.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Future
Receptor Population: Recreational Users
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	7E-08	--	5E-09	--	8E-08					
			Chromium VI	3E-08	--	- -	--	3E-08					
			Chemical Total	1E-07	--	5E-09	--	1E-07					
		Exposure Point Total						1E-07					
	Exposure Medium Total							1E-07					
	Air	SWMU 22	Arsenic	--	1E-11	--	--	1E-11					
			Chromium VI	--	2E-10	--	--	2E-10					
			Chemical Total	--	2E-10	--	--	2E-10					
		Exposure Point Total						2E-10					
	Exposure Medium Total							2E-10					
Medium Total								1E-07					
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	6E-08	--	4E-09	--	6E-08					
			Chemical Total	6E-08	--	4E-09	--	6E-08					
		Exposure Point Total						6E-08					
	Exposure Medium Total							6E-08					
	Air	SWMU 22	Arsenic	--	1E-11	--	--	1E-11					
			Chemical Total	--	1E-11	--	--	1E-11					
		Exposure Point Total						1E-11					
	Exposure Medium Total							1E-11					
Medium Total								6E-08					
Receptor Total							Receptor Risk Total	2E-07					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.7.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	1E-06	--	3E-08	--	1E-06	Skin, CVS	0.08	--	0.003	0.08
			Chromium VI	5E-07	--	- -	--	5E-07	None Specified	--	--	--	--
			Chemical Total	2E-06	--	3E-08	--	2E-06		0.1	--	0.003	0.1
		Exposure Point Total						2E-06					0.1
	Exposure Medium Total							2E-06					0.1
	Air	SWMU 22	Arsenic	--	3E-10	--	--	3E-10	NA	--	0.0002	--	0.0002
			Chromium VI	--	1E-08	--	--	1E-08	Respiratory	--	0.00001	--	0.00001
			Chemical Total	--	1E-08	--	--	1E-08		- -	0.0002	- -	0.0002
		Exposure Point Total						1E-08					0.0002
	Exposure Medium Total							1E-08					0.0002
Medium Total								2E-06					0.1
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	8E-07	--	3E-08	--	8E-07	Skin, CVS	0.06	--	0.002	0.06
			Chemical Total	8E-07	--	3E-08	--	8E-07		0.06	--	0.002	0.06
		Exposure Point Total						8E-07					0.06
	Exposure Medium Total							8E-07					0.06
	Air	SWMU 22	Arsenic	--	3E-10	--	--	3E-10	NA	--	0.0001	--	0.0001
			Chemical Total	--	3E-10	--	--	3E-10		- -	0.0001	- -	0.0001
		Exposure Point Total						3E-10					0.0001
	Exposure Medium Total							3E-10					0.0001
Medium Total								8E-07					0.06
Receptor Total							Receptor Risk Total	3E-06				Receptor HI Total	0.2

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.8.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	4E-07	--	1E-08	--	4E-07	Skin, CVS	0.008	--	0.0003	0.008
			Chromium VI	5E-08	--	- -	--	5E-08	None Specified	--	--	--	--
			Chemical Total	5E-07	--	1E-08	--	5E-07		0.01	--	0.0003	0.01
		Exposure Point Total						5E-07					0.01
	Exposure Medium Total							5E-07					0.01
	Air	SWMU 22	Arsenic	--	1E-09	--	--	1E-09	NA	--	0.0002	--	0.0002
			Chromium VI	--	8E-09	--	--	8E-09	Respiratory	--	0.00001	--	0.00001
			Chemical Total	--	9E-09	--	--	9E-09		- -	0.0002	- -	0.0002
		Exposure Point Total						9E-09					0.0002
	Exposure Medium Total							9E-09					0.0002
Medium Total								5E-07					0.01
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	3E-07	--	1E-08	--	3E-07	Skin, CVS	0.006	--	0.0002	0.006
			Chemical Total	3E-07	--	1E-08	--	3E-07		0.006	--	0.0002	0.006
		Exposure Point Total						3E-07					0.006
	Exposure Medium Total							3E-07					0.006
	Air	SWMU 22	Arsenic	--	9E-10	--	--	9E-10	NA	--	0.0001	--	0.0001
			Chemical Total	--	9E-10	--	--	9E-10		- -	0.0001	- -	0.0001
		Exposure Point Total						9E-10					0.0001
	Exposure Medium Total							9E-10					0.0001
Medium Total								3E-07					0.006
Receptor Total							Receptor Risk Total	8E-07				Receptor HI Total	0.02

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.9.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 22	Arsenic	1E-06	--	4E-08	--	1E-06					
			Chromium VI	6E-07	--	- -	--	6E-07					
			Chemical Total	2E-06	--	4E-08	--	2E-06					
		Exposure Point Total						2E-06					
	Exposure Medium Total							2E-06					
	Air	SWMU 22	Arsenic	--	1E-09	--	--	1E-09					
			Chromium VI	--	2E-08	--	--	2E-08					
			Chemical Total	--	2E-08	--	--	2E-08					
		Exposure Point Total						2E-08					
	Exposure Medium Total							2E-08					
Medium Total								2E-06					
Subsurface Soil	Subsurface Soil	SWMU 22	Arsenic	1E-06	--	4E-08	--	1E-06					
			Chemical Total	1E-06	--	4E-08	--	1E-06					
		Exposure Point Total						1E-06					
	Exposure Medium Total							1E-06					
	Air	SWMU 22	Arsenic	--	1E-09	--	--	1E-09					
			Chemical Total	--	1E-09	--	--	1E-09					
		Exposure Point Total						1E-09					
	Exposure Medium Total							1E-09					
Medium Total								1E-06					
Receptor Total							Receptor Risk Total	3E-06					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

APPENDIX F

SUPPORTING DOCUMENTATION FOR THE ECOLOGICAL RISK ASSESSMENT

This appendix presents a discussion of the different chemical classes detected at the sites, including toxicity information, potential food chain and trophic transfer, and bioaccumulation potential.

Explosives

Some of the more common explosives include nitroaromatic compounds such as 2,4,6-trinitrotoluene, hexahydro-1,3,5-trinitro-1,3,5-triazine, octahydro-1,3,5,7-tetranitro-1,3,5-tetrazocine, N-methyl-N,2,4,6-tetranitroaniline, and associated by-products and degradation products that may have been released to the environment during manufacturing and load, assembly, and pack processes at military facilities (Talmage et al., 1999). These explosives are moderately to highly toxic to freshwater organisms, with chronic screening values generally less than 1 mg/L, although some of the screening values are low because of the conservative methods used to develop them based on an absence of data (Talmage et al., 1999). Available data indicate that none of the compounds are expected to bioconcentrate (Talmage et al., 1999). Most of the explosives do not appear to be highly toxic to mammals. Terrestrial reference values (TRVs) are greater than 1 mg/kg-day.

Explosives have little to moderate potential to adsorb to soil and sediment (Talmage et al., 1999). Therefore, explosives will have moderate to high mobility in soils and sediment, and most of the explosives will be found in the water column (Talmage et al., 1999).

Metals

Many metals occur naturally at various concentrations in the surface water and sediment primarily to chemical weathering of rocks and fallout from volcanoes. Most metals are toxic to aquatic (i.e., fish, invertebrates) and terrestrial (i.e., plants, invertebrates, vertebrates) ecological receptors above certain concentrations, with some metals being more toxic at lower concentrations than others. Also, different chemical forms of the metals may be more toxic than others. For example, hexavalent chromium is typically more toxic than trivalent chromium, and methylmercury is more toxic than inorganic mercury. In addition, the toxicity of several metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) to aquatic receptors in freshwater systems decreases with increasing water hardness.

References:

Talmage, Sylvia S., Dennis M. Opresko, Christopher J. Maxwell, Christopher J.E. Welsh, F. Michael Cretella, Patricia H. Reno, and F. Bernard Daniel, 1999. "Nitroaromatic Munition Compounds: Environmental Effects and Screening Values." Rev. Environmen. Contam. Toxicol. 161:1-156.

The following sections present the receptor profiles for the representative herbivorous, invertivorous, and piscivorous receptors chosen for food chain modeling at SWMU 22. The majority of the information for the profiles was obtained from the Wildlife Exposure Factors Handbook (USEPA, 1993). The data for the incidental soil ingestion rates were obtained from the U.S. EPA Ecological Soil Screening Guidance, Attachment 4-1 (USEPA, 2007).

The food and water ingestion rates are listed in g/g (of body weight)-day on a wet weight basis but were converted to dry weight for the ERA using the exposure factors presented below. The home ranges are presented in hectares in USEPA (1993) but were converted to acres by multiplying the number of hectares by 2.471. The only exception is the kingfisher's home range, which is presented in km of shoreline. Also note that the estimated percent of soil/sediment in the diets are listed in dry weight.

Short-Tailed Shrew (*Blarina brevicauda*)

Shrews inhabit a wide variety of habitats and are common in areas with abundant vegetative cover. They need cool, moist habitats because of their high metabolic and water-loss rates. The short-tailed shrew is primarily carnivorous, eating insects and other invertebrates such as earthworms, slugs, and snails.

The adult body weight for the short-tailed shrew in various habitats ranged from 0.01525 to 0.01921 kg with an average of 0.0169 kg. The listed food ingestion rates for shrews are between 0.43 and 0.96 g/g-day (wet-weight). The food ingestion rate in kg/day was calculated as shown on Table 2 of this Appendix. The food ingestion rate was then multiplied by 0.16 in the food chain model, which is the percent solids of worms (Sample et al., 1997) to convert the ingestion rate from a wet-weight value to a dry-weight value. The incidental soil ingestion rate was calculated by multiplying the ingestion rate by the percentage of soil that is incidentally ingested (3% for conservative food chain model and 0.9% for the average food chain model) from USEPA (2007). 3% is the 90^{th} percentile value and 0.9% is the 50^{th} percentile value from USEPA (2007). The only available home range for the shrew (0. 9699 acres) was calculated using data from a tamarack bog in Manitoba (only value available).

American Woodcock (*Scolopax minor*)

Woodcocks inhabit both woodlands and abandoned fields, particularly those with rich and moderately to poorly drained loamy soils, which tend to support abundant earthworm populations. They feed primarily on invertebrates found in moist upland soils by probing the soil with their long prehensile-tipped bill. Earthworms are their preferred diet, but seeds and other plant matter may also be consumed.

The adult body weight for the woodcock ranges from 0.166 to 0.213 kg with an average of 0.190 kg. The listed food ingestion rates for the woodcock are between 0.73 and 1.0 g/g-day (wet-weight). The food ingestion rate in kg/day was calculated as shown in Table 2 of this Appendix. The food ingestion rate was then multiplied by 0.16 in the food chain model, which is the percent solids of worms (Sample et al., 1997) to convert the ingestion rate from a wet-weight value to a dry-weight value. The incidental soil ingestion rate was calculated by multiplying the ingestion rate by the percentage of soil that is incidentally ingested (assumed 16.4% for conservative food chain model and 6.4% for the average food chain model) from USEPA (2007). 16.4% is the 90th percentile value and 6.4% is the 50th percentile value from USEPA (2007).

The range of home range sizes for the woodcock is 7.66 to 182 acres with an average home range of 61 acres.

Meadow Vole (*Microtus pennsylvanicus*)

Meadow voles inhabit grassy fields, marshes, and bogs; however, they prefer fields with more grass, more cover, and fewer woody plants. They typically consume green succulent vegetation, sedges, seeds, roots, bark, fungi, insects, and animal matter. However, green succulent vegetation makes up the majority of their diet.

The adult body weight for the vole ranges from 0.0329 to 0.0391 kg with an average of 0.0366 kg. The only listed food ingestion rates for voles range from 0.30 to 0.35 g/g-day (wet-weight), with an average of 0.325 g/g-day. The food ingestion rate in kg/day was calculated as shown in Table 2 of this Appendix. The food ingestion rate was then multiplied by 0.15 in the food chain model, which is the percent solids of plant foliage (USEPA, 2007), to convert the ingestion rate from a wet-weight value to a dry-weight value. The incidental soil ingestion rate was calculated by multiplying the ingestion rate by the percentage of soil that is incidentally ingested (assumed 3.2% for conservative food chain model and 1.2% for the average food chain model) from USEPA (2007). 3.2% is the 90th percentile value and 1.2% is the 50th percentile value from USEPA (2007).

The range of home range sizes for the meadow vole is 0.0297 to 1.06 acres with an average home range of 0.16 acres.

Northern Bobwhite Quail (*Colinus virginianus*)

Bobwhite quails inhabit grasslands, idle fields, pastures, and large clumps of grasses. Bobwhite quails forage in areas with open vegetation, some bare ground, and light litter. Seeds from weeds, woody plants, and grasses comprise the majority of an adult's diet, although green vegetation has been found to dominate the diet of this species in winter in the southern areas of the United States.

The adult body weight for the bobwhite quail ranges from 0.162 to 0.186 kg with an average of 0.177 kg. The listed food ingestion rates for quails range from 0.067 to 0.093 g/g-day (wet-weight), with an average of 0.082 g/g-day. The food ingestion rate in kg/day was calculated as shown on Table 2 of this Appendix. The food ingestion rates were already dry-weight values. The incidental soil ingestion rate was calculated by multiplying the ingestion rate by the percentage of soil that is incidentally ingested (assumed 13.9% for conservative food chain model and 6.1% for the average food chain model) from USEPA (2007). 13.9% is the 90th percentile value and 6.1% is the 50th percentile value for the mourning dove from USEPA (2007).

The home range for the quail ranges from 16 to 41 acres with an average home range of 29 acres.

<u>Belted Kingfisher *Ceryle alcyon)*</u>

Belted kingfishers are typically found along rivers, streams, and the edges of lakes and ponds. They are also common along seacoasts and estuaries. They prefer water that is free of thick vegetation and overhanging trees that obscure the view of the water. Because kingfishers eat primarily fish that swim near the surface or in shallow water, they require relatively clear water to see and catch their prey. Although kingfishers feed predominantly on fish, they have been known to consume crayfish, crabs, mussels, lizards, frogs, toads, small snakes, turtles, insects, salamanders, newts, young birds, mice, and berries.

Based on data from Michigan, Pennsylvania, Ohio, and Minnesota, the adult body weights range from 0.136 to 0.170 kg, with an average of 0.152 kg. The listed food ingestion rates, based on data from Michigan, ranges from 0.41 to 0.5 g/g-day (wet-weight). The water ingestion rate is estimated as 0.11 g/g-day. The food and water ingestion rates in kg/day and L/day, respectively, were calculated as shown in Table 2 of this Appendix. The food ingestion rates were then multiplied by 0.25, which is the percent solids of fish (Sample et al., 1997) to convert the ingestion rate from a wet-weight value to a dry-weight value. The incidental sediment ingestion rate of was calculated by multiplying the ingestion rate by the percentage of sediment that is incidentally ingested (3.3 percent). The 3.3 percent is based on the incidental sediment ingestion rate of a mallard (Beyer, 1994), which also consumes aquatic organisms, because an incidental sediment ingestion rate was not available for the kingfisher.

The home range for the kingfisher ranges from 0.39 to 2.185 km of shoreline, based on data from streams in Pennsylvania and Ohio.

<u>Mink (Mustela vison)</u>

Minks are the most abundant and widespread carnivorous mammals in North America. They are found associated with every type of aquatic habitat including waterways such as rivers, streams, lakes, ditches, swamps, marshes, and backwater areas. Minks prefer irregular shorelines and tend to use brushy or wooded cover adjacent to the water, where prey is abundant and downfall and debris provide den sites. Mammals are minks' most important prey year round in many parts of their range, but they also hunt aquatic species such as fish, amphibians, and crustaceans.

The adult body weight for the mink in various habitats ranged from 0.55 to 1.734 kg with an average of 1.103 kg. The listed food ingestion rates for minks range from 0.12 to 0.22 g/g-day (wet-weight). The water ingestion rates range from 0.028 to 0.11 g/g-day. The food and water ingestion rates in kg/day and L/day, respectively, were calculated as shown in Table 2 of this Appendix. The food ingestion rates were then multiplied by 0.25, which is the percent solids of fish (Sample et al., 1997) to convert the ingestion rate from a wet-weight value to a dry-weight value. The incidental sediment ingestion rate of was calculated by multiplying the ingestion rate by the percentage of sediment that is incidentally ingested (9.4 percent). The 9.4 percent is based on the incidental sediment ingestion rate of a raccoon (Beyer, 1994), which also consumes aquatic organisms, because an incidental sediment ingestion rate was not available for the mink.

The home range for the mink in riverine areas ranged from 19.3 to 50.4 acres, with an average of 34.85 acres.

References:

Beyer, N., E. Connor, and S. Gerould. 1994. Estimates of Soil Ingestion by Wildlife. Journal of Wildlife Management 58(2) pp. 375-382.

Sample, B.E., M.S. Aplin, R.A. Efroymson, G.W., Suter II, and C.J.E. Welsh. 1997. Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants. Oak Ridge National Laboratory. October. ORNL/TM-13391.

USEPA (USEnvironmental Protection Agency), 1993. Wildlife Exposure Factors Handbook. U.S. Environmental Protection Agency. Office of Research and Development. Washington, D.C. December 1993. EPA/600/R-93/187a.

USEPA, 2007. Guidance for Developing Ecological Soil Screening Level, Attachment 4-1, Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. Office of Solid Waste and Emergency and Response. OSWER Directive 9285.7-55. April.

TABLE 1

EXPOSURE PARAMETERS FOR THE TERRESTRIAL WILDLIFE MODEL
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Species/Exposure Inputs	Conservative Inputs Values	Conservative Inputs Units	Average Inputs Values	Average Inputs Units	Source
Meadow Vole					
Body Weight = BW	3.290E-02	kg	3.663E-02	kg	USEPA, 1993
Food Ingestion Rate = If	1.920E-03	kg/day	1.785E-03	kg/day	USEPA, 1993
Water Ingestion Rate = Iw	7.700E-03	L/day	6.400E-03	L/day	USEPA, 1993
Soil Ingestion Rate - Is	6.144E-05	kg/day	2.142E-05	kg/day	Beyer, 1993
Home Range = HR	Assume 100% on site		1.640E-01	acres	USEPA, 1993
Short-Tailed Shrew					
Body Weight = BW	1.525E-02	kg	1.687E-02	kg	USEPA, 1993
Food Ingestion Rate = If	2.592E-03	kg/day	1.648E-03	kg/day	USEPA, 1993
Water Ingestion Rate = Iw	4.280E-03	L/day	3.760E-03	L/day	USEPA, 1993
Soil Ingestion Rate - Is	7.776E-05	kg/day	1.483E-05	kg/day	Beyer, 1993
Home Range = HR	Assume 100% on site		9.700E-01	acres	USEPA, 1993
American Woodcock					
Body Weight = BW	1.660E-01	kg	1.895E-01	kg	USEPA, 1993
Food Ingestion Rate = If	3.032E-02	kg/day	2.526E-02	kg/day	USEPA, 1993
Water Ingestion Rate = Iw	2.130E-02	L/day	1.900E-02	L/day	USEPA, 1993
Soil Ingestion Rate - Is	4.972E-03	kg/day	1.617E-03	kg/day	Beyer, 1993
Home Range = HR	Assume 100% on site		6.133E+01	acres	USEPA, 1993
Bobwhite Quail					
Body Weight = BW	1.620E-01	kg	1.770E-01	kg	USEPA, 1993
Food Ingestion Rate = If	1.640E-02	kg/day	1.440E-02	kg/day	USEPA, 1993
Water Ingestion Rate = Iw	2.310E-02	L/day	1.840E-02	L/day	USEPA, 1993
Soil Ingestion Rate - Is	2.280E-03	kg/day	8.784E-04	kg/day	Beyer, 1993
Home Range = HR	Assume 100% on site		2.860E+01	acres	USEPA, 1993
Mink					
Body Weight = BW	5.500E-01	kg	1.020E+00	kg	USEPA, 1993
Food Ingestion Rate = If	5.608E-02	kg/day	4.015E-02	kg/day	USEPA, 1993
Water Ingestion Rate = Iw	1.907E-01	L/day	8.050E-02	L/day	USEPA, 1993
Sediment Ingestion Rate = Is	5.271E-03	kg/day	3.774E-03	kg/day	USEPA, 2005
Home Range = HR	Assume 100% on site		3.484E+01	acres	USEPA, 1993
Belted Kingfisher					
Body Weight = BW	1.360E-01	kg	1.520E-01	kg	USEPA, 1993
Food Ingestion Rate = If	1.895E-02	kg/day	1.723E-02	kg/day	USEPA, 1993
Water Ingestion Rate = Iw	1.870E-02	L/day	1.670E-02	L/day	USEPA, 1993
Sediment Ingestion Rate = Is	6.254E-04	kg/day	5.684E-04	kg/day	Beyer, 1994
Home Range = HR	Assume 100% on site		1.160E+00	km-radius	USEPA, 1993

Notes:
The exposure factors were derived as presented in Table 2 of this Appendix.

The soil/sediment ingestion rates were calculated by multiplying the food ingestion rates by the following incidental soil/sediment ingestion rates:

Receptor	Conservative	Average	Source
Bobwhite quail	13.9%	6.1%	1, 2
Meadow Vole	3.2%	1.2%	1
American woodcock	16.4%	6.4%	1
Short-tailed Shrew	3%	0.9%	1
Mink	9.4%	9.4%	3, 4
Belted Kingfisher	3.3%	3.3%	3, 5

1 - USEPA (U.S. Environmental Protection Agency), 2007. Guidance for Developing Ecological Soil Screening Level, Attachment 4-1, Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. Office of Solid Waste and Emergency and Response. OSWER Directive 9285.7-55. April.
2 - Based on the mourning dove.
3 - Beyer, N., E. Connor, and S. Gerould. 1994. Estimates of Soil Ingestion by Wildlife. Journal of Wildlife Management 58(2) pp. 375-382.
4 - Based on the raccoon.
5 - Based on the mallard.

TABLE 2

CALCULATION OF EXPOSURE PARAMETERS FOR SURROGATE WILDLIFE RECEPTORS
SWMU 22- LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Exposure Parameters	Meadow Vole		Short-Tailed Shrew		American Woodcock	Bobwhite Quail		Belted Kingfisher	Mink
Body Weights (g)	32.9		17.61	16.87	168	180	181	150	1734
	39.1		17.33	15.58	209	168	183	136	974
	35.5		19.21	15.7	166	162	179	158	1040
	39		17.4	15.25	212	175	175	147	1233
					169	178	183.2	148	550
					213	179	185.5	170	586
						180	173		
						162.8	180.4		
Minimum	***32.9***		***15.25***		***166***	***162***		***136***	***550***
Maximum	***39.1***		***19.21***		***213***	***186***		***170***	***1734***
Average	***36.6***		***16.87***		***190***	***177***		***152***	***1019.5***
Food Ingestion	0.3		0.49	0.77	1.0	0.067	0.079	0.5	0.13
Rate (g/g-day) (1)	0.35		0.62	0.55	0.77	0.072	0.093	0.41	0.12
			0.43	0.96	0.73	0.09	0.089		0.16
			0.52	0.54					0.22
Minimum	***0.3***		***0.43***		***0.73***	***0.067***		***0.41***	***0.12***
Maximum	***0.35***		***0.96***		***1.0***	***0.093***		***0.5***	***0.22***
Average	***0.325***		***0.61***		***0.8***	***0.082***		***0.455***	***0.1575***
Food Ingestion Rate (kg/day)									
Conservative	***1.28E-02***		***1.62E-02***		***1.90E-01***	***1.64E-02***		***0.0758***	***0.2243***
Average	***1.19E-02***		***1.03E-02***		***1.58E-01***	***1.44E-02***		***0.0689***	***0.1606***
Conversion from wet weight to dry weight	***0.15 (3)***		***0.16 (4)***		***0.16 (4)***	***None (5)***		**0.25(6)**	**0.25(6)**
Water Ingestion	0.14	0.21	0.223		0.1	0.115	0.1	0.11	0.11
Rate (g/g-day) (1)					0.1	0.106	0.131		0.099
						0.093	0.101		0.028
						0.086	0.102		
						0.11	0.1		
Minimum	***0.14***		***0.223***		***0.1***	***0.086***		***0.11***	***0.028***
Maximum	***0.21***		***0.223***		***0.1***	***0.131***		***0.11***	***0.11***
Average	***0.175***		***0.223***		***0.1***	***0.104***		***0.110***	***0.079***
Water Ingestion Rate (L/day)									
Conservative	***7.69E-03***		***4.28E-03***		***2.13E-02***	***2.31E-02***		***0.0187***	***0.1907***
Average	***6.41E-03***		***3.76E-03***		***1.90E-02***	***1.84E-02***		***0.0167***	***0.0805***
Home Range (Ha)(2)	0.43	0.1	0.3925		4.5	7.6		2.185	7.8
	0.02	0.04			32.4	16.7		1.028	20.4
	0.01	0.03			3.1	6.4		1.03	
	0.01	0.01			73.6	15.6		0.39	
	0.04	0.06			10.5				
	0.02	0.03							
	0.05	0.08							
	0.06	0.06							
Minimum (acres)	***0.0297***		***0.97***		***7.7***	***16***		***0.39***	***19***
Maximum (acres)	***1.06***		***0.97***		***182***	***41***		***2.19***	***50***
Average (acres)	***0.16***		***0.97***		***61***	***29***		***1.16***	***35***

Notes:
Source of data is USEPA (1993). If values from several studies are available, they are given. The minimum, maximum, and average values are derived from these studies.

Footnotes:
(1) - Ingestion Rates (kg/day or L/day) (if more than 1 ingestion rate is available)
- Conservative value = Max Ingestion Rate (g/g-day) * Avg. Body Weight
- Average value = Avg. Ingestion Rate (g/g-day) * Avg. Body Weight

Ingestion Rates (L/day) (if only 1 ingestion rate is available)
- Conservative value = Ingestion Rate (g/g-day) * Max. Body Weight
- Average value = Ingestion Rate (g/g-day) * Avg. Body Weight

(2) - The home range units for the Belted Kingfisher are kilometers of shoreline instead of hectares or acres.
(3) - Percent solids in vegetation
(4) - Percent solids in earthworms
(5) - Food items on dry weight basis
(6) - Percent solids in fish

This attachment presents the bioaccumulation factors (BAFs) that were used in the food chain models. The following sources of BAFs were used in the ecological risk assessment for most of the chemicals:

- Plant and Soil Invertebrate BAFs: EPA Guidance for Developing Ecological Soil Screening Levels, Attachment 4-1 (USEPA, 2007).

- Plant BAFs (metals): Empirical Model for the Uptake of Inorganic Chemicals from Soil by Plants (ORNL, 1998a).

- Soil Invertebrate BAFs: Development and Validation of Bioaccumulation Models for Earthworms (Sample et al., 1998).

- Sediment Invertebrate BSAFs: Biota Sediment Accumulation Factors for Invertebrates (ORNL, 1998b).

Table 3 of this Appendix presents the BAFs/BSAFs that were used in the food-chain models for the individual constituents that were detected at SWMU 22. Note that dry weight BAFs were used for this ERA. A default value of 1.0 was used for the BAF/BSAF if chemical-specific data were not available.

The EPA Guidance for Developing Ecological Soil Screening Levels (Eco SSLs) was the source of the BAFs for some of the chemicals. The majority of these BAFs are regression equations that are used to calculate the tissue concentration from the soil concentration.

Fish BSAFs for metals were not available from USEPA (2004), so BSAFs from ORNL (1998b) for sediment invertebrates were used to estimate tissue concentrations of metals in food items of piscivorous birds and mammals.

References

ORNL (Oak Ridge National Laboratory). 1998a. Empirical Model for the Uptake of Inorganic Chemicals from Soil by Plants. BJC/OR-133. September.

ORNL. 1998b. Biota Sediment Accumulation Factors for Invertebrates: Review and recommendations for the Oak Ridge Reservation. BJC/OR-112. August.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W., Suter II, and T.L. Ashwood. 1998. Development and Validation of Bioaccumulation Models for Earthworms. Oak Ridge National Laboratory. June. ES/ER/TM-220.

USEPA (U.S. Environmental Protection Agency), 2004. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Volume 1:National Sediment Quality Survey: Second Edition. Office of Science and Technology. Washington, D.C. EPA 823-R-04-007. November.

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TABLE 3

TERRESTRIAL FOOD CHAIN MODEL - BAF/BSAF VALUES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Chemical	Plant Bioaccumulation Factors			Earthworm Bioaccumulation Factors			Sediment Invertebrate/Fish Bioaccumulation Factors		
	Conservative	Average		Conservative	Average		Conservative	Average	
Inorganics									
ARSENIC	0.03752		(1)	EXP(0.706*LN(C)-1.421)		(1)	0.69	0.143	(4)
CADMIUM	EXP(0.546*LN(C)-0.475)		(1)	EXP(0.795*LN(C)+2.114)		(1)	7.99	0.6	(4)
CHROMIUM	0.041		(1)	0.306		(1)	0.47	0.1	(4)
LEAD	EXP(0.561*LN(C)-1.328)		(1)	EXP(0.807*LN(C)-0.218)		(1)	0.61	0.071	(4)
MERCURY	5	0.652	(2)	EXP(0.3369*LN(C)+0.0781)		(3)	2.868	1.136	(4)
SELENIUM	EXP(1.104*LN(C)-0.677)		(1)	EXP(0.733*LN(C)-0.075)		(1)	1		
SILVER	0.014		(1)	2.045		(1)	1		

Notes:
A default value of 1.0 was assigned to chemicals with unknown BAFs. No footnotes are listed by these values.

Footnotes:

1 - USEPA (2007). Several tissue concentration will be calculated using regression equations (where C is the soil concentration) from USEPA (2007), Attachment 4-1, Tables 4a (for inorganics).
2 - ORNL (September, 1998). Conservative value is 90th percentile; average value is median value.
3 - Sample et al. (February, 1998).
4 - ORNL (August, 1998). Conservative value is 90th percentile; average value is median value.

Sources:
ORNL (Oak Ridge National Laboratory). 1998. Empirical Model for the Uptake of Inorganic Chemicals from Soil by Plants. BJC/OR-133. September.
ORNL, 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. BJC/OR-112. August.
Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W., Suter II, and T.L. Ashwood. 1998. Development and Validation of Bioaccumulation Models for Earthworms. Oak Ridge National Laboratory. February. ES/ER/TM-220.
USEPA, 2007. Guidance for Developing Ecological Soil Screening Level, Attachment 4-1, Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. Office of Solid Waste and Emergency and Response. OSWER Directive 9285.7-55. April.

TABLE 4

TOXICITY REFERENCE VALUES
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

PARAMETER	Mammal		Bird	
	NOAEL	LOAEL	NOAEL	LOAEL
Inorganics				
Arsenic	1.04	4.55	2.24	4.51
Cadmium	0.77	6.9	1.47	6.35
Chromium	2.40	58.17	2.66	15.63
Lead	4.7	30.2	1.63	9.70
Mercury	0.032	0.16	0.0064	0.064
Selenium	0.143	0.661	0.29	0.819
Silver	6.02	118.6	2.02	60.47

The sources of these NOAELS and LOAELS are presented in the table titled "Sources and Endpoints for NOAELS and LOAELS for Terrestrial Wildlife" in this appendix.

The NOAELS and LOAELS in the source table were divided by 10 if a subchronic study was the basis for the value. Also, if only a NOAEL was available, the value was multiplied by 10 to estimate the LOAEL. If only a LOAEL was available, the value was divided by 10 to estimate the NOAEL.

TABLE 5

SOURCES AND ENDPOINTS FOR NOAELS AND LOAELS FOR TERRESTRIAL WILDLIFE
SWMU 22 - LEAD AZIDE POND
NSA CRANE
CRANE, INDIANA

Parameters	Concentration (mg/kg-day)	Endpoint	Effect	Chronic/ Subchronic	Species	Primary Reference	Source of Reference
Inorganics							
Arsenic	4.51	LOAEL	reproduction & growth	chronic	birds	USEPA, 2005	
Arsenic	4.55	LOAEL	reproduction & growth	chronic	mammals	USEPA, 2005	
Arsenic	2.24	NOAEL	reproduction & growth	chronic	chicken	USEPA, 2005	
Arsenic	1.04	NOAEL	reproduction & growth	chronic	dog	USEPA, 2005	
Cadmium	6.35	LOAEL	reproduction & growth	chronic	birds	USEPA, 2005	
Cadmium	6.9	LOAEL	reproduction & growth	chronic	mammals	USEPA, 2005	
Cadmium	1.47	NOAEL	reproduction & growth	chronic	birds	USEPA, 2005	
Cadmium	0.77	NOAEL	reproduction & growth	chronic	rat	USEPA, 2005	
Chromium(III)	15.63	LOAEL	reproduction & growth	chronic	birds	USEPA, 2008	
Chromium(III)	58.17	LOAEL	reproduction & growth	chronic	mammals	USEPA, 2008	
Chromium(III)	2.66	NOAEL	reproduction & growth	chronic	birds	USEPA, 2008	
Chromium(III)	2.4	NOAEL	reproduction & growth	chronic	mammals	USEPA, 2008	
Lead	9.7	LOAEL	reproduction & growth	chronic	birds	Spec Pro, Inc and Exponent, Inc., 2009	
Lead	30.2	LOAEL	reproduction & growth	chronic	mammals	Spec Pro, Inc and Exponent, Inc., 2009	
Lead	1.63	NOAEL	reproduction & growth	chronic	chicken	USEPA, 2005	
Lead	4.7	NOAEL	reproduction & growth	chronic	rat	USEPA, 2005	
Mercury	0.064	LOAEL	reproductive	chronic	mallard duck	Heinz, 1979	Sample et.al., 1996
Mercury	0.16	LOAEL	reproductive	chronic	rat	Verschuuren et al., 1976	Sample et.al., 1996
Mercury	0.032	NOAEL	reproductive	chronic	rat	Verschuuren et al., 1976	Sample et.al., 1996
Selenium	0.819	LOAEL	reproduction & growth	chronic	birds	USEPA, 2007	
Selenium	0.661	LOAEL	reproduction & growth	chronic	mammals	USEPA, 2007	
Selenium	0.29	NOAEL	reproduction & growth	chronic	chicken	USEPA, 2007	
Selenium	0.143	NOAEL	reproduction & growth	chronic	pig	USEPA, 2007	
Silver	60.47	LOAEL	reproduction & growth	chronic	birds	USEPA, 2006	
Silver	118.62	LOAEL	reproduction & growth	subchronic*	mammals	USEPA, 2006	
Silver	2.02	NOAEL	reproduction & growth	subchronic*	turkey	USEPA, 2006	
Silver	6.02	NOAEL	reproduction & growth	chronic	pig	USEPA, 2006	

Notes:
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
The LOAELs used for several metals were calculated as the geometric mean of growth and reproduction data from the Ecological Soil Screening Levels (U.S. EPA, 2005, 2007, 2008).
References for the NOAELS and LOAELs are presented in this Attachment and Titled "TRV Source and Endpoint References".
* Value has been adjusted for chronic effects.

SOURCES AND ENPOINTS FOR NOAELS AND LOAELS FOR TERRESTRIAL WILDLIFE

Heinz, G. H. 1979. “Methyl Mercury: Reproductive and Behavioral Effects on Three Generations of Mallard Ducks.” *J. Wildl. Mgmt*. 43: 394-401.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory. June. ES/ER/TM-86/R3.

Spec Pro, Inc. and Exponent, Inc. 2009. Baseline Ecological Assessment Settling Ponds and Spoils Disposal Areas Site, Badger Army Ammunition Plant, Baraboo, Wisconsin. Appendix E3 – Selection of Toxicity Reference Values. October.

USEPA (U.S. Environmental Protection Agency), 2005. Ecological Soil Screening Level for Arsenic, Interim Final. Office of Emergency and Remedial Response. OSWER Directive 9285.7-62. March.

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USEPA, 2007. Ecological Soil Screening Level for Selenium, Interim Final. Office of Emergency and Remedial Response. OSWER Directive 9285.7-72. July.

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Verschuuren, H. G., R. Kroes, E. M. Den Tonkelaar, J. M. Berkvens, P. W. Helleman, A. G. Rauws, P. L. Schuller, and G. J. Van Esch. 1976. “Toxicity of Methyl Mercury Chloride in Rats. II. Reproduction Study.” *Toxicol*. 6: 97-106.

CHEMICAL CONCENTRATIONS IN SURFACE SOIL AND TISSUE
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Surface Soil Concentrations (mg/kg)				Surface Water Concentrations (mg/L)				Earthworm Bioaccumulation Factors		Earthworm Concentrations (mg/kg)		Plant Bioaccumulation Factors		Plant Concentrations (mg/kg)	
	Maximum Detection	Average of All Results	Average of Positive Results	Average (1)	Maximum Detection	Average of All Results	Average of Positive Results	Average(1)	Conservative	Average	Maximum Detection	Average	Conservative	Average	Maximum Detection	Average
INORGANICS																
CADMIUM	7.80E-01	2.21E-01	2.21E-01	2.21E-01	1.70E-03	2.81E-04	5.35E-04	2.81E-04	Regression equation from Eco SSL		6.80E+00	2.49E+00	Regression equation from Eco SSL		5.43E-01	2.73E-01
LEAD	3.17E+01	1.01E+01	1.01E+01	1.01E+01	9.60E-03	2.75E-03	4.25E-03	2.75E-03	Regression equation from Eco SSL		1.31E+01	5.20E+00	Regression equation from Eco SSL		1.84E+00	9.71E-01
MERCURY	6.00E-01	5.05E-02	9.74E-02	5.05E-02	1.00E-04	6.99E-05	8.38E-05	6.99E-05	Regression - Sample et al., (1998)		9.10E-01	3.95E-01	5.00E+00	6.52E-01	3.00E+00	3.29E-02

1 - Average concentration is the mean concentration of all samples, using 1/2 the detection limit for non-detects, unless the value is greater than the maximum concentration. In that case, the average concentration is the mean of the positive detections.

MEADOW VOLE - TIER 1 INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SURFACE SOIL
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Max Soil Conc. (mg/kg)	Max SW Conc. (mg/L)	Vegetation Conc. (mg/kg)	Dose (mg/kg/d) from: Soil	Surface Water	Veget.	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	LOAEL
INORGANICS											
CADMIUM	7.80E-01	1.70E-03	5.43E-01	1.46E-03	3.98E-04	3.17E-02	3.35E-02	7.70E-01	6.90E+00	4.36E-02	4.86E-03
LEAD	3.17E+01	9.60E-03	1.84E+00	5.92E-02	2.25E-03	1.08E-01	1.69E-01	4.70E+00	3.02E+01	3.59E-02	5.59E-03
MERCURY	6.00E-01	1.00E-04	3.00E+00	1.12E-03	2.34E-05	1.75E-01	1.76E-01	3.20E-02	1.60E-01	5.51E+00	1.10E+00

Cells are shaded if the value is greater than 1.0

Body Weight = (BW)	3.29E-02	kg
Food Ingestion Rate = (If)	1.92E-03	kg/day
Water Ingestion Rate = (Iw)	7.70E-03	L/day
Soil Ingestion Rate = (Is)	6.14E-05	kg/day
Home Range = (HR)	Assume 100% on site	
Contaminated Area = (CA)	Assume equal to home range	

Dose (soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Dose (water) = (Cw * Iw)(H)/BW
Cv = Contaminant concentration in vegetation
Cs = Contaminant concentration in soil
Cw = Contaminant concentration in water
Total Dose = Dose (soil) + Dose (vegetation) + Dose (water)
H=CA/HR (Assume = to 1)

Conc = Concentration
LOAEL = Lowest Observed Adverse Effects Concentration
NOAEL = No Observed Adverse Effects Concentration
SW = Surface Water

MEADOW VOLE - TIER 2, STEP 3A INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SURFACE SOIL
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Average Soil Conc. (mg/kg)	Avg SW Conc. (mg/L)	Vegetation Conc. (mg/kg)	Dose (mg/kg/d) from: Soil	Surface Water	Veget.	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	LOAEL
INORGANICS											
CADMIUM	2.21E-01	2.81E-04	2.73E-01	1.29E-04	4.90E-05	1.33E-02	1.35E-02	7.70E-01	6.90E+00	1.75E-02	1.95E-03
LEAD	1.01E+01	2.75E-03	9.71E-01	5.92E-03	4.80E-04	4.73E-02	5.37E-02	4.70E+00	3.02E+01	1.14E-02	1.78E-03
MERCURY	5.05E-02	6.99E-05	3.29E-02	2.95E-05	1.22E-05	1.61E-03	1.65E-03	3.20E-02	1.60E-01	5.15E-02	1.03E-02

Body Weight = (BW)	3.66E-02	kg
Food Ingestion Rate = (If)	1.79E-03	kg/day
Water Ingestion Rate = (Iw)	6.40E-03	L/day
Soil Ingestion Rate = (Is)	2.14E-05	kg/day
Home Range = (HR)	1.64E-01	acres
Contaminated Area = (CA)	Assume equal to home range	

Dose (soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Dose (water) = (Cw * Iw)(H)/BW
Cv = Contaminant concentration in vegetation
Cs = Contaminant concentration in soil
Cw = Contaminant concentration in water
Total Dose = Dose (soil) + Dose (vegetation) + Dose (water)
H=CA/HR (Assume = to 1)

Conc = Concentration
LOAEL = Lowest Observed Adverse Effects Concentration
NOAEL = No Observed Adverse Effects Concentration
SW = Surface Water

BOBWHITE QUAIL - TIER 1 INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SURFACE SOIL
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Max Soil Conc. (mg/kg)	Max SW Conc. (mg/L)	Vegetation Conc. (mg/kg)	Dose (mg/kg/d) from: Soil	Surface Water	Veget.	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	LOAEL
INORGANICS											
CADMIUM	7.80E-01	1.70E-03	5.43E-01	1.10E-02	2.42E-04	5.50E-02	6.62E-02	1.47E+00	6.35E+00	4.5E-02	1.0E-02
LEAD	3.17E+01	9.60E-03	1.84E+00	4.46E-01	1.37E-03	1.87E-01	6.34E-01	1.63E+00	9.70E+00	3.9E-01	6.5E-02
MERCURY	6.00E-01	1.00E-04	3.00E+00	8.44E-03	1.43E-05	3.04E-01	3.12E-01	6.40E-03	6.40E-02	4.9E+01	4.9E+00

Cells are shaded if the value is greater than 1.0

Body Weight = (BW)	1.62E-01	kg
Food Ingestion Rate = (If)	1.64E-02	kg/day
Water Ingestion Rate = (Iw)	2.31E-02	L/day
Soil Ingestion Rate = (Is)	2.28E-03	kg/day
Home Range = (HR)	Assume 100% on site	
Contaminated Area = (CA)	Assume equal to home range	

Dose (soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Dose (water) = (Cw * Iw)(H)/BW
Cv = Contaminant concentration in vegetation
Cs = Contaminant concentration in soil
Cw = Contaminant concentration in water
Total Dose = Dose (soil) + Dose (vegetation) + Dose (water)
H=CA/HR (Assume = to 1)

Conc = Concentration
LOAEL = Lowest Observed Adverse Effects Concentration
NOAEL = No Observed Adverse Effects Concentration
SW = Surface Water

BOBWHITE QUAIL - TIER 2, STEP 3A INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SURFACE SOIL
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Average Soil Conc. (mg/kg)	Avg SW Conc. (mg/L)	Vegetation Conc. (mg/kg)	Dose (mg/kg/d) from: Soil	Surface Water	Veget.	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	LOAEL
INORGANICS											
CADMIUM	2.21E-01	2.81E-04	2.73E-01	1.10E-03	2.92E-05	2.22E-02	2.33E-02	1.47E+00	6.35E+00	1.6E-02	3.7E-03
LEAD	1.01E+01	2.75E-03	9.71E-01	5.02E-02	2.85E-04	7.90E-02	1.29E-01	1.63E+00	9.70E+00	7.9E-02	1.3E-02
MERCURY	5.05E-02	6.99E-05	3.29E-02	2.51E-04	7.27E-06	2.68E-03	2.94E-03	6.40E-03	6.40E-02	4.6E-01	4.6E-02

Body Weight = (BW)	1.77E-01	kg
Food Ingestion Rate = (If)	1.44E-02	kg/day
Water Ingestion Rate = (Iw)	1.84E-02	L/day
Soil Ingestion Rate = (Is)	8.78E-04	kg/day
Home Range = (HR)	2.86E+01	acres
Contaminated Area = (CA)	Assume equal to home range	

Dose (soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Dose (water) = (Cw * Iw)(H)/BW
Cv = Contaminant concentration in vegetation
Cs = Contaminant concentration in soil
Cw = Contaminant concentration in water
Total Dose = Dose (soil) + Dose (vegetation) + Dose (water)
H=CA/HR (Assume = to 1)

Conc = Concentration
LOAEL = Lowest Observed Adverse Effects Concentration
NOAEL = No Observed Adverse Effects Concentration
SW = Surface Water

SHORT-TAILED SHREW - TIER 1 INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SURFACE SOIL
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Max Soil Conc. (mg/kg)	Max SW Conc. (mg/L)	Invertebrate Conc. (mg/kg)	Dose (mg/kg/d) from: Soil	Surface Water	Invert.	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	LOAEL
INORGANICS											
CADMIUM	7.80E-01	1.70E-03	6.80E+00	3.98E-03	4.79E-04	1.16E+00	1.16E+00	7.70E-01	6.90E+00	1.5E+00	1.7E-01
LEAD	3.17E+01	9.60E-03	1.31E+01	1.62E-01	2.71E-03	2.22E+00	2.39E+00	4.70E+00	3.02E+01	5.1E-01	7.9E-02
MERCURY	6.00E-01	1.00E-04	9.10E-01	3.06E-03	2.82E-05	1.55E-01	1.58E-01	3.20E-02	1.60E-01	4.9E+00	9.9E-01

Cells are shaded if the value is greater than 1.0

Body Weight = (BW)	1.53E-02	kg	Dose (soil) = (Cs * Is)(H)/BW
Food Ingestion Rate = (If)	2.59E-03	kg/day	Dose (invertebrate) = (Ci * If)(H)/BW
Water Ingestion Rate = (Iw)	4.30E-03	L/day	Dose (water) = (Cw * Iw)(H)/BW
Soil Ingestion Rate = (Is)	7.78E-05	kg/day	Ci = Contaminant concentration in invertebrate
Home Range = (HR)	Assume 100% on site		Cs = Contaminant concentration in soil
Contaminated Area = (CA)	Assume equal to home range		Cw = Contaminant concentration in water
			Total Dose = Dose (soil) + Dose (invertebrate) + Dose (water)
			H=CA/HR (Assume = to 1)

Conc = Concentration
LOAEL = Lowest Observed Adverse Effects Concentration
NOAEL = No Observed Adverse Effects Concentration
SW = Surface Water

SHORT-TAILED SHREW - TIER 2, STEP 3A INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SURFACE SOIL
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Average Soil Conc. (mg/kg)	Avg SW Conc. (mg/L)	Invertebrate Conc. (mg/kg)	Dose (mg/kg/d) from:			Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients	
				Soil	Surface Water	Invert.				NOAEL	LOAEL
INORGANICS											
CADMIUM	2.21E-01	2.81E-04	2.49E+00	1.94E-04	6.32E-05	2.44E-01	2.44E-01	7.70E-01	6.90E+00	3.2E-01	3.5E-02
LEAD	1.01E+01	2.75E-03	5.20E+00	8.90E-03	6.18E-04	5.08E-01	5.18E-01	4.70E+00	3.02E+01	1.1E-01	1.7E-02
MERCURY	5.05E-02	6.99E-05	3.95E-01	4.44E-05	1.57E-05	3.86E-02	3.87E-02	3.20E-02	1.60E-01	1.2E+00	2.4E-01

Cells are shaded if the value is greater than 1.0

Body Weight = (BW)	1.69E-02	kg	Dose (soil) = (Cs * Is)(H)/BW
Food Ingestion Rate = (If)	1.65E-03	kg/day	Dose (invertebrate) = (Ci * If)(H)/BW
Water Ingestion Rate = (Iw)	3.80E-03	L/day	Dose (water) = (Cw * Iw)(H)/BW
Soil Ingestion Rate = (Is)	1.48E-05	kg/day	Ci = Contaminant concentration in invertebrate
Home Range = (HR)	9.70E-01	acres	Cs = Contaminant concentration in soil
Contaminated Area = (CA)	Assume equal to home range		Cw = Contaminant concentration in water
			Total Dose = Dose (soil) + Dose (invertebrate) + Dose (water)
			H=CA/HR (Assume = to 1)

Conc = Concentration
LOAEL = Lowest Observed Adverse Effects Concentration
NOAEL = No Observed Adverse Effects Concentration
SW = Surface Water

AMERICAN WOODCOCK - TIER 1 INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SURFACE SOIL
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Max Soil Conc. (mg/kg)	Max SW Conc. (mg/L)	Invertebrate Conc. (mg/kg)	Dose (mg/kg/d) from:			Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients	
				Soil	Surface Water	Invert.				NOAEL	LOAEL
INORGANICS											
CADMIUM	7.80E-01	1.70E-03	6.80E+00	2.34E-02	2.18E-04	1.24E+00	1.27E+00	1.47E+00	6.35E+00	8.6E-01	2.0E-01
LEAD	3.17E+01	9.60E-03	1.31E+01	9.50E-01	1.23E-03	2.39E+00	3.34E+00	1.63E+00	9.70E+00	2.0E+00	3.4E-01
MERCURY	6.00E-01	1.00E-04	9.10E-01	1.80E-02	1.28E-05	1.66E-01	1.84E-01	6.40E-03	6.40E-02	2.9E+01	2.9E+00

Cells are shaded if the value is greater than 1.0

Body Weight = (BW)	1.66E-01	kg	Dose (soil) = (Cs * Is)(H)/BW
Food Ingestion Rate = (If)	3.03E-02	kg/day	Dose (invertebrate) = (Ci * If)(H)/BW
Water Ingestion Rate = (Iw)	2.13E-02	L/day	Dose (water) = (Cw * Iw)(H)/BW
Soil Ingestion Rate = (Is)	4.97E-03	kg/day	Ci = Contaminant concentration in invertebrate
Home Range = (HR)	Assume 100% on site		Cs = Contaminant concentration in soil
Contaminated Area = (CA)	Assume equal to home range		Cw = Contaminant concentration in water
			Total Dose = Dose (soil) + Dose (invertebrate) + Dose (water)
			H=CA/HR (Assume = to 1)

Conc = Concentration
LOAEL = Lowest Observed Adverse Effects Concentration
NOAEL = No Observed Adverse Effects Concentration
SW = Surface Water

AMERICAN WOODCOCK - TIER 2, STEP 3A INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SURFACE SOIL
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Average Soil Conc. (mg/kg)	Avg SW Conc. (mg/L)	Invertebrate Conc. (mg/kg)	Dose (mg/kg/d) from: Soil	Surface Water	Invert.	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	LOAEL
INORGANICS											
CADMIUM	2.21E-01	2.81E-04	2.49E+00	1.88E-03	2.81E-05	3.32E-01	3.34E-01	1.47E+00	6.35E+00	2.3E-01	5.3E-02
LEAD	1.01E+01	2.75E-03	5.20E+00	8.63E-02	2.75E-04	6.94E-01	7.81E-01	1.63E+00	9.70E+00	4.8E-01	8.0E-02
MERCURY	5.05E-02	6.99E-05	3.95E-01	4.31E-04	7.01E-06	5.27E-02	5.32E-02	6.40E-03	6.40E-02	8.3E+00	8.3E-01

Body Weight = (BW)	1.90E-01	kg	Dose (soil) = (Cs * Is)(H)/BW	Conc = Concentration
Food Ingestion Rate = (If)	2.53E-02	kg/day	Dose (invertebrate) = (Ci * If)(H)/BW	LOAEL = Lowest Observed Adverse Effects Concentration
Water Ingestion Rate = (Iw)	1.90E-02	L/day	Dose (water) = (Cw * Iw)(H)/BW	NOAEL = No Observed Adverse Effects Concentration
Soil Ingestion Rate = (Is)	1.62E-03	kg/day	Ci = Contaminant concentration in invertebrate	SW = Surface Water
Home Range = (HR)	6.13E+01	acres	Cs = Contaminant concentration in soil	
Contaminated Area = (CA)	Assume equal to home range		Cw = Contaminant concentration in water	
			Total Dose = Dose (soil) + Dose (invertebrate) + Dose (water)	
			H=CA/HR (Assume = to 1)	

CHEMICAL CONCENTRATIONS IN SEDIMENT, SURFACE WATER, AND TISSUE
SWMU 22
NSA CRANE
CRANE, INDIANA

Chemical	Sediment Concentrations (mg/kg)				Surface Water Concentrations (mg/L)				Fish/Invertebrate Bioaccumulation Factors		Fish/Invertebrate Concentrations (mg/kg)	
	Maximum Detection	Overall Average	Average of Positive Detections	Average (1)	Maximum Detection	Overall Average	Average of Positive Detections	Average Concentration(1)	Conservative	Average	Maximum Detection	Average
Inorganics												
ARSENIC	1.47E+01	4.06E+00	4.06E+00	4.06E+00	1.50E-03	4.17E-04	5.80E-04	4.17E-04	6.90E-01	1.43E-01	1.01E+01	5.81E-01
CADMIUM	8.80E-01	2.69E-01	2.69E-01	2.69E-01	1.70E-03	2.81E-04	5.35E-04	2.81E-04	7.99E+00	6.00E-01	7.03E+00	1.61E-01
CHROMIUM	1.39E+01	7.45E+00	7.45E+00	7.45E+00	3.00E-03	9.24E-04	9.24E-04	9.24E-04	4.68E-01	1.00E-01	6.51E+00	7.45E-01
LEAD	2.00E+01	9.68E+00	9.68E+00	9.68E+00	9.60E-03	2.75E-03	4.25E-03	2.75E-03	6.07E-01	7.10E-02	1.21E+01	6.87E-01
MERCURY	2.60E-01	4.45E-02	1.01E-01	4.45E-02	1.00E-04	6.99E-05	8.38E-05	6.99E-05	2.87E+00	1.14E+00	7.46E-01	5.06E-02
SELENIUM	6.10E-01	1.84E-01	1.84E-01	1.84E-01	5.60E-04	1.47E-04	2.12E-04	1.47E-04	1.00E+00	1.00E+00	6.10E-01	1.84E-01
SILVER	2.50E-02	2.03E-02	2.17E-02	2.03E-02	3.20E-05	3.56E-05	3.20E-05	3.20E-05	1.00E+00	1.00E+00	2.50E-02	2.03E-02

Invertebrate BSAFs used for inorganics

1 - Average concentration is the mean concentration of all samples, using 1/2 the detection limit for non-detects, unless the value is greater than the maximum concentration. In that case, the average concentration is the mean of the positive detections.

BELTED KINGFISHER - TIER 1 INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION -SEDIMENT
SWMU 22
NSA CRANE, CRANE, INDIANA

Chemical	Max Sed. Conc. (mg/kg)	Max SW Conc. (mg/L)	Max Fish Conc. (mg/kg)	Dose (mg/kg/d) from: Sediment	Surface Water	Fish	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	LOAEL
Inorganics											
ARSENIC	1.47E+01	1.50E-03	1.01E+01	6.76E-02	2.06E-04	1.41E+00	1.48E+00	2.24E+00	4.51E+00	6.6E-01	3.3E-01
CADMIUM	8.80E-01	1.70E-03	7.03E+00	4.05E-03	2.34E-04	9.80E-01	9.84E-01	1.47E+00	6.35E+00	6.7E-01	1.5E-01
CHROMIUM	1.39E+01	3.00E-03	6.51E+00	6.39E-02	4.13E-04	9.06E-01	9.71E-01	2.66E+00	1.56E+01	3.7E-01	6.2E-02
LEAD	2.00E+01	9.60E-03	1.21E+01	9.20E-02	1.32E-03	1.69E+00	1.78E+00	1.63E+00	9.70E+00	1.1E+00	1.8E-01
MERCURY	2.60E-01	1.00E-04	7.46E-01	1.20E-03	1.38E-05	1.04E-01	1.05E-01	6.40E-03	6.40E-02	1.6E+01	1.6E+00
SELENIUM	6.10E-01	5.60E-04	6.10E-01	2.80E-03	7.70E-05	8.50E-02	8.79E-02	2.90E-01	8.19E-01	3.0E-01	1.1E-01
SILVER	2.50E-02	3.20E-05	2.50E-02	1.15E-04	4.40E-06	3.48E-03	3.60E-03	2.02E+00	6.05E+01	1.8E-03	6.0E-05

Cells are shaded if the value is greater than 1.0

Body Weight = (BW)	1.36E-01	kg	Dose (sediment) = (Cs * Is)(H)/BW	Conc = Concentration
Food Ingestion Rate = (If)	1.90E-02	kg/day	Dose (fish) = (Cf * If)(H)/BW	LOAEL = Lowest Observed Adverse Effects Concentration
Water Ingestion Rate = (Iw)	1.87E-02	L/day	Dose (water) = (Cw * Iw)(H)/BW	NOAEL = No Observed Adverse Effects Concentration
Sediment Ingestion Rate = (Is)	6.25E-04	kg/day	Cf = Contaminant concentration in fish	
Home Range = (HR)	Assume 100% on site		Cs = Contaminant concentration in sediment	
Contaminated Area = (CA)	Assume equal to home range		Total Dose = Dose (sediment) + Dose (water) + Dose (fish)	
			H=CA/HR (Assume = to 1)	

BELTED KINGFISHER - TIER 2, STEP 3A INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SEDIMENT
SWMU 22
NSA CRANE, CRANE, INDIANA

Chemical	Avg Sediment Conc. (mg/kg)	Avg SW Conc. (mg/L)	Avg Fish Conc. (mg/kg)	Dose (mg/kg/d) from: Sediment	Surface Water	Fish	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	LOAEL
Inorganics											
ARSENIC	4.06E+00	4.17E-04	5.81E-01	1.52E-02	4.58E-05	6.59E-02	8.11E-02	2.24E+00	4.51E+00	3.6E-02	1.8E-02
CADMIUM	2.69E-01	2.81E-04	1.61E-01	1.01E-03	3.08E-05	1.83E-02	1.93E-02	1.47E+00	6.35E+00	1.3E-02	3.0E-03
CHROMIUM	7.45E+00	9.24E-04	7.45E-01	2.78E-02	1.01E-04	8.44E-02	1.12E-01	2.66E+00	1.56E+01	4.2E-02	7.2E-03
LEAD	9.68E+00	2.75E-03	6.87E-01	3.62E-02	3.02E-04	7.79E-02	1.14E-01	1.63E+00	9.70E+00	7.0E-02	1.2E-02
MERCURY	4.45E-02	6.99E-05	5.06E-02	1.66E-04	7.68E-06	5.73E-03	5.90E-03	6.40E-03	6.40E-02	9.2E-01	9.2E-02
SELENIUM	1.84E-01	1.47E-04	1.84E-01	6.88E-04	1.61E-05	2.09E-02	2.16E-02	2.90E-01	8.19E-01	7.4E-02	2.6E-02
SILVER	2.03E-02	3.20E-05	2.03E-02	7.59E-05	3.52E-06	2.30E-03	2.38E-03	2.02E+00	6.05E+01	1.2E-03	3.9E-05

Cells are shaded if the value is greater than 1.0

Body Weight = (BW)	1.52E-01	kg	Dose (sediment) = (Cs * Is)(H)/BW
Food Ingestion Rate = (If)	1.72E-02	kg/day	Dose (fish) = (Cf * If)(H)/BW
Water Ingestion Rate = (Iw)	1.67E-02	L/day	Dose (water) = (Cw * Iw)(H)/BW
Sediment Ingestion Rate = (Is)	5.68E-04	kg/day	Cf = Contaminant concentration in fish
Home Range = (HR)	1.16E+00	km-radius	Cs = Contaminant concentration in sediment
Contaminated Area = (CA)	Assume equal to home range		Total Dose = Dose (sediment) + Dose (water) + Dose (fish)
			H=CA/HR (Assume = to 1)

Conc = Concentration
LOAEL = Lowest Observed Adverse Effects Concentration
NOAEL = No Observed Adverse Effects Concentration

MINK - TIER 1 INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SEDIMENT
SWMU 22
NSA CRANE, CRANE, INDIANA

Chemical	Max Sed. Conc. (mg/kg)	Max SW Conc. (mg/L)	Max Fish Conc. (mg/kg)	Dose (mg/kg/d) from: Sediment	Dose (mg/kg/d) from: Surface Water	Dose (mg/kg/d) from: Fish	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	Hazard Quotients LOAEL
Inorganics											
ARSENIC	1.47E+01	1.50E-03	1.01E+01	1.41E-01	5.20E-04	1.03E+00	1.18E+00	1.04E+00	4.55E+00	1.1E+00	2.6E-01
CADMIUM	8.80E-01	1.70E-03	7.03E+00	8.43E-03	5.89E-04	7.17E-01	7.26E-01	7.70E-01	6.90E+00	9.4E-01	1.1E-01
CHROMIUM	1.39E+01	3.00E-03	6.51E+00	1.33E-01	1.04E-03	6.63E-01	7.97E-01	2.40E+00	5.82E+01	3.3E-01	1.4E-02
LEAD	2.00E+01	9.60E-03	1.21E+01	1.92E-01	3.33E-03	1.24E+00	1.43E+00	4.70E+00	3.02E+01	3.0E-01	4.7E-02
MERCURY	2.60E-01	1.00E-04	7.46E-01	2.49E-03	3.47E-05	7.60E-02	7.86E-02	3.20E-02	1.60E-01	2.5E+00	4.9E-01
SELENIUM	6.10E-01	5.60E-04	6.10E-01	5.85E-03	1.94E-04	6.22E-02	6.82E-02	1.43E-01	6.61E-01	4.8E-01	1.0E-01
SILVER	2.50E-02	3.20E-05	2.50E-02	2.40E-04	1.11E-05	2.55E-03	2.80E-03	6.02E+00	1.19E+02	4.7E-04	2.4E-05

Cells are shaded if the value is greater than 1.0

Body Weight = (BW)	5.50E-01	kg	Dose (sediment) = (Cs * Is)(H)/BW	Conc = Concentration
Food Ingestion Rate = (If)	5.61E-02	kg/day	Dose (fish) = (Cf * If)(H)/BW	LOAEL = Lowest Observed Adverse Effects Concentration
Water Ingestion Rate = (Iw)	1.91E-01	L/day	Dose (water) = (Cw * Iw)(H)/BW	NOAEL = No Observed Adverse Effects Concentration
Sediment Ingestion Rate = (Is)	5.27E-03	kg/day	Cf = Contaminant concentration in fish	
Home Range = (HR)	Assume 100% on site		Cs = Contaminant concentration in sediment	
Contaminated Area = (CA)	Assume equal to home range		Total Dose = Dose (sediment) + Dose (water) + Dose (fish)	
			H=CA/HR (Assume = to 1)	

MINK - TIER 2, STEP 3A INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION - SEDIMENT
SWMU 22
NSA CRANE, CRANE, INDIANA

Chemical	Avg Sediment Conc. (mg/kg)	Avg SW Conc. (mg/L)	Avg Fish Conc. (mg/kg)	Dose (mg/kg/d) from: Sediment	Surface Water	Fish	Total Dose (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Hazard Quotients NOAEL	LOAEL
Inorganics											
ARSENIC	4.06E+00	4.17E-04	5.81E-01	1.50E-02	3.29E-05	2.29E-02	3.80E-02	1.04E+00	4.55E+00	3.6E-02	8.3E-03
CADMIUM	2.69E-01	2.81E-04	1.61E-01	9.95E-04	2.22E-05	6.35E-03	7.37E-03	7.70E-01	6.90E+00	9.6E-03	1.1E-03
CHROMIUM	7.45E+00	9.24E-04	7.45E-01	2.76E-02	7.29E-05	2.93E-02	5.69E-02	2.40E+00	5.82E+01	2.4E-02	9.8E-04
LEAD	9.68E+00	2.75E-03	6.87E-01	3.58E-02	2.17E-04	2.70E-02	6.31E-02	4.70E+00	3.02E+01	1.3E-02	2.1E-03
MERCURY	4.45E-02	6.99E-05	5.06E-02	1.65E-04	5.52E-06	1.99E-03	2.16E-03	3.20E-02	1.60E-01	6.8E-02	1.4E-02
SELENIUM	1.84E-01	1.47E-04	1.84E-01	6.81E-04	1.16E-05	7.24E-03	7.94E-03	1.43E-01	6.61E-01	5.5E-02	1.2E-02
SILVER	2.03E-02	3.20E-05	2.03E-02	7.51E-05	2.53E-06	7.99E-04	8.76E-04	6.02E+00	1.19E+02	1.5E-04	7.4E-06

Cells are shaded if the value is greater than 1.0

Body Weight = (BW)	1.02E+00	kg	Dose (sediment) = (Cs * Is)(H)/BW
Food Ingestion Rate = (If)	4.02E-02	kg/day	Dose (fish) = (Cf * If)(H)/BW
Water Ingestion Rate = (Iw)	8.05E-02	L/day	Dose (water) = (Cw * Iw)(H)/BW
Sediment Ingestion Rate = (Is)	3.77E-03	kg/day	Cf = Contaminant concentration in fish
Home Range = (HR)	3.48E+01	km-radius	Cs = Contaminant concentration in sediment
Contaminated Area = (CA)	Assume equal to home range		Total Dose = Dose (sediment) + Dose (water) + Dose (fish)
			H=CA/HR (Assume = to 1)

Conc = Concentration
LOAEL = Lowest Observed Adverse Effects Concentration
NOAEL = No Observed Adverse Effects Concentration