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NSWC CRANE
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Resource Conservation and Recovery Act Facility Investigation Report

for

SWMUs 4 (McComish Gorge), 5 (Old Burn Pit), 9 (Pesticide Control/R-150 Tank Area), and 10 (Rockeye)

Naval Surface Warfare Center Crane Division

Crane, Indiana

Volume II of IV - Text (Section 5 through References)

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ACRONYM LIST

2,4-D	2,4-Dichlorophenoxyacetic acid
2-ADNT	2-Amino-4,6-dinitrotoluene
4-ADNT	4-Amino-2,6-dinitrotoluene
AET	Apparent Effects Threshold
Ah	Aryl hydrocarbon
AMSL	Above Mean Sea Level
ANOVA	Analysis of Variance
ARCS	Assessment and Remediation of Contaminated Sediment
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BAF	Bioaccumulation Factor
BCF	Bioconcentration Factor
BERA	Baseline Ecological Risk Assessment
bgs	Below Ground Surface
BSAF	Biota-Sediment Accumulation Factor
CAAA	Crane Army Ammunition Activity
CASCO	Central Ammunition Supply Control Office
CCME	Canadian Council of Ministers of the Environment
CDD	Chlorinated dibenzo-p-dioxins
CDF	Chlorinated dibenzofurans
CDI	Chronic Daily Intake
CEC	Cation Exchange Capacity
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
COC	Chain of Custody Form
COCs	Chemical of Concern
COPC	Chemical of Potential Concern
CRAVE	Carcinogenic Risk Assessment Verification Endeavor
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
CTO	Contract Task Order
DAF	Dilution and Attenuation Factor

DI	Deionized
DO	Dissolved Oxygen
DPT	Direct-Push Technology
DQI	Data Quality Indicators
DQO	Data Quality Objectives
EC	Effects Concentration or Environment Canada
Eco-SSL	Ecological Soil Screening Level
EDQL	Ecological Data Quality Level
EEQ	Ecological Effects Quotient
EMR	Environmental Monitoring Report
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ESL	Ecological Screening Level
ESV	Ecological Screening Value
FCM	Food Chain Model
FID	Flame Ionization Detector
FOD	Frequency of Detection
FOL	Field Operations Leader
FSP	Field Sampling Plan
g	gram
GIS	Geographic Information System
gpm	Gallons Per Minute
HASP	Health and Safety Plan
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
HSA	Hollow-Stem Auger
HSWA	Hazardous and Solid Waste Amendments
IA	Installation Assessment
IAS	Initial Assessment Study
ICP	Inductively Coupled Plasma
ICR	Incremental Cancer Risk
IDEM	Indiana Department of Environmental Management

IDW	Investigation Derived Waste
IEUBIK	Integrated Exposure Uptake Biokinetic
ILCR	Incremental Lifetime Cancer Risk
IRIS	Integrated Risk Information System
kg	kilograms
L	liter
LC	Lethal Concentration
LCS	Laboratory Control Sample
LEL	Lowest-Effect Level
LOAELs	Lowest-Observed-Adverse-Effects Levels
LOEC	Lowest Observed Effect Concentration
LOGC	Lowest Observed Effects Concentration
µg	micrograms
MATC	Maximum Acceptable Toxicant Concentration
MCL	Maximum Contaminant Levels
MENVIQ	Ministere de l'Environnement du Quebec
MEQ	milliequivalence
MET	Minimal Effect Threshold
mg	milligrams
MI	Mobility Index
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NACIP	Navy Assessment and Control of Installation Pollutants
NAD	Naval Ammunition Depot
NAD	North American Datum
NCEA	National Center for Environmental Assessment
NEC	No Effect Concentration
NECC	Nutrient and Energy Cycling Check
NEESA	Naval Energy and Environmental Support Agency
NEL	No-Effect Level
ng	nanograms
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NOAELs	No-Observed-Adverse-Effects Levels
NOEC	No Observed Effect Concentration
NSWC	Naval Surface Warfare Center

NTUs	Nephelometric Turbidity Units
OESA	Ordnance Environmental Support Agency
OMOE	Ontario Ministry of Environment and Energy
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
ORNL	Oak Ridge National Laboratory
ORP	Oxidation Reduction Potential
OSWER	Office of Solid Waste and Emergency Response
PAET	Probable Apparent Effects Threshold
PAHs	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PEC	Probable-Effects Concentration
PEL	Probable-Effects Level
PID	Photoionization Detector
POC	Particulate Organic Carbon
PPE	Personal Protective Equipment
ppm	parts per million
PRG	Preliminary Remedial Goal
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
RQD	Rock Quality Designation
SCS	Soil Conservation Service
SCV	Secondary Chronic Value
SD	Sediment
SdSL	Sediment Screening Level
SEL	Severe-Effect Level
SERA	Screening-Level Ecological Risk Assessment
SMCL	Secondary Maximum Contaminant Level
SOP	Standard Operating Procedure

SQAL	Sediment Quality Advisory Level
SQB	Sediment Quality Benchmark
SQG	Soil Quality Guideline
SSL	Soil Screening Level
SSSL	Surface Soil Screening Level
SVOC	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
SWSL	Surface Water Screening Level
TAL	Target Analyte List
TCDD	Tetrachlorodibenzo-p-dioxin
TCDF	Tetrachlorodibenzofuran
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TEC	Threshold-Effects Concentration
TEF	Toxic Equivalence Factors
TEL	Threshold-Effects Level
TEQ	Toxicity Equivalent
TET	Toxic Effect Threshold
TIC	Tentatively Identified Compound
TNT	2,4,6-Trinitrotoluene
TOC	Total Organic Carbon
TOM	Task Order Manager
TPH	Total Petroleum Hydrocarbons
TRV	Toxicity Reference Value
TRW	Technical Review Workgroup
TSD	Treatment, storage or disposal
TtNUS	Tetra Tech NUS, Inc.
U.S. ACE	U.S. Army Corps of Engineers
U.S. EPA	U.S. Environmental Protection Agency
UCL	Upper Confidence Limit
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
UTL	Upper Tolerance Level
VOC	Volatile Organic Compound
WES	Waterways Experiment Station
WP	Work Plan

WQC	Water Quality Criteria
WQS	Water Quality Standards

5.0 SWMU 5

This section describes the SWMU 5 (Old Burn Pit) site investigation, physical characterization, nature and extent of contamination, human and ecological risk assessments, and conclusions. References to other sections of this RFI report are provided for relevant background information and general data evaluation procedures.

5.1 BACKGROUND INFORMATION

Section 1.4.2 contains a description of the Old Burn Pit. Section 1.5.2 contains a description of historical data collection activities. Section 1.6.2 summarizes information on constituents found in environmental media that may be attributable to historical operations at SWMU 5. These constituents of concern were used as the basis for the SWMU 5 site investigation described in this section.

5.2 SITE INVESTIGATION

The primary objective of the field investigation was to collect field and laboratory data to evaluate the potential risks for human and ecological receptors identified in the CSM discussed in Section 5.6 and 5.7. Figure 5-1 includes the sample locations. Table 5-1 summarizes the sampling and analysis program for SWMU 5.

As depicted on Table 5-1, environmental samples collected from the site were analyzed for a comprehensive field and laboratory analytical program. Field parameters were collected for ground water and surface water samples. Typical water-quality indicator parameters, such as turbidity, were collected in the field. Soil samples were screened for VOCs using monitoring equipment (PID).

Soil, sediment, surface water, and ground water samples were collected and analyzed for the full list of Appendix IX constituents (VOCs, SVOCs, pesticides, PCBs, inorganics), as well as other miscellaneous inorganics. Surface water samples were also analyzed for total and dissolved inorganics, hardness, and TSS, and sediment samples were analyzed for TOC to assist in assessing the potential risks for ecological receptors. Additionally, soil characteristic parameters (CEC, pH, and TOC) were collected to determine the likelihood of the potential fate and transport of contaminants at the site (and the potential for risks outside the site boundaries). Ground water samples were not analyzed for dissolved inorganics since low-flow sampling procedures were used to minimize sample turbidity.

As noted previously, Figure 5-1 illustrates the sampling locations for the field investigation at the Old Burn Pit. The rationale for the collection of these samples is as follows:

- Surface/subsurface soils (Borings) (16): Three soil borings were placed in the burn pit. Five soil borings were placed in the gully north of the burn pit where residual ash and metal debris were buried. Collocated surface (8) and subsurface (7) soil samples were obtained at each of these locations for a total of 15 soil samples. At one location (SB08), it was not possible to collect a subsurface soil sample. A sample was obtained from the surface (0 to 2 feet bgs) and at a subsurface depth (not greater than 10 feet bgs). As detailed in the final paragraph of Section 3.2.1 of the Field Sampling Plan located in Attachment A of the RFI Work Plan, potentially up to four additional soil sample locations were proposed for SWMU 5. This provisional soil sampling was proposed as a way to refine the northern boundary of the site based on a site reconnaissance. During the site reconnaissance there was insufficient evidence of disposal activities to warrant sampling at the provisional locations.

- Ground water (15): Twelve of the existing monitoring wells (05-01 through 05-04, 05-06 through 05-09, 05-13, 05-15, 05-16, and 05-19) at the site were sampled. Three new monitoring wells were installed and sampled during this field effort. Well 05T01, located at the southeastern site boundary, was used in conjunction with well 05-01 to evaluate ground water quality upgradient of the burn pit and burial area. Well 05T03 was installed on the western boundary of the site to evaluate ground water quality immediately downgradient of the site. Well 05T02 was installed south of the site to evaluate the impact of the paleostream channel on ground water migration.

- Surface water and sediment (5): Collocated surface and sediment samples were collected from five locations. One location, 05SW/SD01, is outside the northern boundary of the site in the unnamed tributary and was sampled to evaluate upstream conditions. Three locations were sampled outside near the western (05SW/SD03 and 05SW/SD04) and southern (05SW/SD05) site boundaries in unnamed tributaries. These locations address downstream conditions. One location (05SW/SD02) was used to monitor stream conditions in the gully at the site. This sample was located in an unnamed tributary at the gully northwest of the burn pit.

Section 2 contains details of field sampling procedure and field documentation.

The data collected during the field investigation were used to assess potential risks for human and ecological receptors exposed to site media under current and/or future land use. A description of how the data obtained during the field investigation were managed prior to the risk assessment is presented in

Section 3.1. General methodologies and techniques used to calculate potential risks for the site are provided in Sections 3.3 (human health) and 3.4 (ecological).

5.3 PHYSICAL CHARACTERISTICS

5.3.1 Topography/Hydrology

The topography at the Old Burn Pit consists of undulating terrain dissected by many small drainageways. Surface runoff from the Old Burn Pit drains into Culpepper Branch Creek, a tributary of Furst Creek. Several dendrital drainageways exist in the northern portion of the SWMU that convey surface water from the northeast to the west, toward a stream that flows through a culvert beneath the road and railroad tracks that form the western border of the SWMU. The stream joins with several other streams to form a larger tributary stream that flows south ultimately discharging into the Culpepper Branch. Another drainageway is located in the southwest corner of the SWMU that flows southwest toward Culpepper Branch.

5.3.2 Geology

Most of SWMU 5 is situated in the dissected alluvial valley of Culpepper Branch Creek. Soils representing two depositional environments have been mapped at the SWMU by Kvale, 1992, including residual soil derived from the Pennsylvanian in the SWMU area and alluvium in the floodplain along the south flowing tributary stream to Culpepper Branch Creek located west of the SWMU. Glacial outwash has also been mapped both southeast and further west of the SWMU.

Two hydrogeologic cross-sections have been developed for the Old Burn Pit at locations shown on Figures 5-2, 5-3, and 5-4. Borings shown on these figures consist of those installed by TtNUS and three historical borings installed by the US Army Corps of Engineers (USACE). The USACE installed Borings were 05/03-1, 05/03-2, 05/03-4, and 05/03-5. The encountered subsurface materials included fill, natural unconsolidated materials, and the Pennsylvanian bedrock. The fill was encountered in borings in the north-central portion of the SWMU and extended to a maximum depth of 10 feet bgs. The fill consisted of glass, metal, wood, metal, and ash mixed with sand and silt. Natural unconsolidated materials underlie the fill and exist at the ground surface where the fill is not present. The natural unconsolidated materials consist predominantly of fine materials including varying amounts of clay, silt, and sand derived from Pennsylvanian bedrock. The natural unconsolidated materials extend to approximately 45 feet bgs, where Pennsylvanian bedrock consisting of shale was encountered in borings (05/03-01 and 05/03-04) advanced to this depth.

5.3.3 Hydrogeology

Ground water is present beneath the Old Burn Pit at depths from less than 5 feet bgs in low areas near surface water bodies. Depth to ground water increases to greater than 20 feet in depth at the higher elevations. Ground water exists in the natural unconsolidated materials and was not found in the fill. Shallow ground water flow direction in the natural unconsolidated materials is generally to the northwest toward a tributary of Culpepper Branch and to the southwest toward Culpepper Branch, as shown in Figure 5-5. The gradient of the potentiometric surface is about 0.04. Information on ground water in the deeper bedrock at this SWMU is unknown since no wells are installed in the bedrock. Monitoring well construction details for this SWMU are included on Table 2-2.

5.4 NATURE AND EXTENT OF CONTAMINATION

Soil (surface and subsurface), ground water, surface water, and sediment samples were collected from SWMU 5 and analyzed for the presence of site-related contamination during the investigation phase of this RFI. Based on analytical data obtained during this investigation, the nature and extent of contamination in the soil, ground water, surface water, and sediment at SWMU 5 are discussed on a matrix-specific basis in the following subsections.

Soil samples at each SWMU were classified according to the soil types defined in the NSWC Crane Basewide Soil Background Study (TtNUS, January 2001). Each soil type is defined by the characteristics of soil parent material (depositional environment), depth (surface or subsurface), and grain size (sand, silt, or clay). The soil types were gathered into soil groups that reflect different classifications of soil throughout NSWC Crane. SWMU surface soils are classified as Group 3 and subsurface soils are classified as Groups 8 and 9. The following are descriptions of these soil types:

- Group 3 - Alluvial, Mississippian, and Pennsylvanian Surface Soil
- Group 8 - Pennsylvanian Subsurface Clay and Silt
- Group 9 - Pennsylvanian Subsurface Sand

Metal concentrations in each soil group from a given SWMU were compared to metal concentrations from the corresponding background soil group. These comparisons used the entire data set from the background study for a given soil group and all SWMU samples of the corresponding soil group. The outcome of each comparison was a classification of each metal at a given SWMU as being statistically determined to be either elevated or not elevated relative to background concentrations, unless the data indicates that the contaminants (e.g., laboratory related) are from non-site related sources.

No background samples were collected for ground water, surface water, and sediment; however, at least one upgradient sample per medium was collected. These upgradient samples are treated as background and direct comparisons to these upgradient values are discussed in the ground water, surface water, and sediment sections.

The SWMUs 4, 5, 9, and 10 work plan (TtNUS August 2000a) provides a tabular summary and text discussing historical analytical results for SWMU 5 media. These data are not included in this nature and extent discussion because they were not used in the risk assessment. However, some relevant discussion from the work plan is referenced in this nature and extent discussion for SWMU 5.

5.4.1 Surface Soil

As explained in Table 5-1 and Section 5.2, eight surface soil samples were collected to evaluate the nature and extent of contamination. All eight surface soil samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, Appendix IX dioxins/furans, TAL metals (plus tin), and cyanide. Additionally, one surface soil sample was analyzed for CEC, pH, and TOC.

Table 5-2 presents a summary of the results reported for compounds detected in the surface soil samples collected from SWMU 5. Table 5-3 presents a summary of descriptive statistics for surface soil detections including range of detections, frequency of detection, location of maximum, and comparison to background. Appendix E-1.2 contains a copy of the entire analytical database for SWMU 5 surface soil. Figures 5-6 and 5-7 present a geographical depiction of organic and inorganic detections in surface soil, respectively. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R5DQL) on the tag at the affected sampling location shows this on Figure 5-7. If an inorganic chemical was detected at a particular location and the site data set for that chemical was elevated as compared to the corresponding background data set (Soil Group 3), the result was flagged with "BACK" at all locations where samples from Soil Group 3 were collected. If "BACK" does not appear next to the result for an inorganic chemical, it means that the chemical was detected at that location but the chemical concentrations for that soil group are not elevated relative to background concentrations.

Volatile Organic Compounds

Eight VOCs (1,1-dichloroethene, benzene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride) were detected in the surface soil samples. The detected VOCs are common solvents and gasoline-related compounds. 1,1–Dichloroethene, benzene, trans-1,2-dichloroethene, and vinyl chloride were detected in sample 05SB060102 only, at concentrations of 13 µg/kg, 5 µg/kg, 29 µg/kg, and 5 µg/kg, respectively. Cis-1,2-Dichloroethene and tetrachloroethene were detected in samples 05SB060102 and 05SB080102. Concentrations of cis-1,2-dichloroethene were 8 µg/kg to 2,800 µg/kg, with the maximum detection in sample 05SB060102. Concentrations of tetrachloroethene were 3 µg/kg to 7 µg/kg, with the maximum detection in sample 05SB060102. Methylene chloride was detected in samples 05SB020102, 05SB030102, and 05SB080102, each at a concentration of 4 µg/kg in each. Trichloroethene was the most frequently detected VOC. Trichloroethene was detected in samples 05SB030102 (4 µg/kg), 05SB050102 (7 µg/kg), 05SB060102 (5,100 µg/kg), 05SB070102 (360 µg/kg), and 05SB080102 (1,200 µg/kg). All detected VOCs, except methylene chloride, were detected in sample 05SB060102. Additionally, the maximum detected concentrations of all VOCs, except methylene chloride, were found in sample 05SB060102. Samples 05SB050102, 05SB060102, 05SB070102, and 05SB080102 all yielded detectable concentrations of VOCs; these samples are all located in the north-central portion of SWMU 5, within approximately 250 feet of each other.

Sample 05SB040002 was collected in the vicinity of the most upgradient ground water well (05-01) location; this sample did not contain any VOCs. Sample 05SB080002, the most downgradient soil boring with respect to groundwater flow, yielded detectable concentrations of cis-1,2-dichloroethene (8 µg/kg), methylene chloride (4 µg/kg), tetrachloroethene (3 µg/kg), and trichloroethene (1,200 µg/kg). As noted above, trichloroethene was detected frequently and, in 2 samples (05SB060102 and 05SB080002), at concentrations in excess of 1,000 µg/kg. Concentrations of trichloroethene in excess of 1,000 µg/kg indicate that some disposal actions have occurred. The presence of the other chlorinated hydrocarbons such as vinyl chloride may be attributable to natural degradation of tetrachloroethene and trichloroethene.

Methylene chloride is a common environmental laboratory solvent. It was detected in three of eight samples and at a low concentration (i.e., 4 µg/kg). The concentrations of methylene chloride are similar to those found in laboratory blanks. See Section 3.1.4.2 for a detailed discussion of methylene chloride found in laboratory blanks.

Semivolatile Organic Compounds

Seventeen PAHs and bis(2-ethylhexyl) phthalate were detected in surface soil samples. Bis(2-ethylhexyl) phthalate was detected in samples 05SB050002 and 05SB060002 at concentrations of 3,400 µg/kg and 930 µg/kg, respectively. Maximum detected concentrations of the 17 PAHs ranged from 16 µg/kg (acenaphthene) to 2,400 µg/kg (pyrene). PAHs were detected in from one to seven surface soil samples. Analysis of sample 05SB050002 yielded the maximum detectable concentrations of 14 of the 17 detected PAHs. The majority of the PAHs were detected in samples 05SB010002, 05SB020002, 05SB030002, 05SB050002, 05SB060002, and 05SB070002.

Acenaphthylene (16 µg/kg) was detected in sample 05SB030002. Acenaphthene and fluorene were detected in samples 05SB010002, 05SB050002, and 05SB060002. Naphthalene and 2-methylnaphthalene were detected in samples 05SB010002, 05SB020002, 05SB030002, 05SB050002, and 05SB060002. Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and phenanthrene were detected in samples 05SB010002, 05SB020002, 05SB030002, 05SB050002, 05SB060002, and 05SB070002. Benzo(b)fluoranthene, fluoranthene, and pyrene were detected in samples 05SB010002, 05SB020002, 05SB030002, 05SB050002, 05SB060002, 05SB070002, and 05SB080002.

The maximum detected concentrations of anthracene (340 µg/kg), benzo(a)anthracene (950 µg/kg), benzo(a)pyrene (820 µg/kg), benzo(b)fluoranthene (790 µg/kg), benzo(g,h,i)perylene, (350 µg/kg), benzo(k)fluoranthene (670 µg/kg), chrysene (910 µg/kg), dibenzo(a,h)anthracene (180 µg/kg), fluoranthene (2,200 µg/kg), fluorene (110 µg/kg), indeno(1,2,3-cd)pyrene (360 µg/kg), phenanthrene (1,700 µg/kg), and pyrene (2,400 µg/kg) were found in sample 05SB050002. Sample 05SB010002 contained the maximum detected concentration of acenaphthylene and the second highest concentrations of 10 of 17 of the detected PAHs. PAHs were detected in all samples across the site except sample 05SB040002, which did not contain detectable PAH concentrations. As shown in Figure 5-6, sample 05SB050002 was collected in the north-central portion of the site and sample 05SB010002 was collected in the vicinity of the former burn pit. The PAHs may be related to site burning operations because PAHs are typical by-products of incomplete combustion.

Pesticides/PCBs

4,4'-DDE was the only pesticide detected in the surface soil samples. 4,4'-DDE was detected in sample 05SB080002 (6.7 µg/kg). This sample is located in the main gully, which is in the northwestern portion of

SWMU 5. The nature of typical pesticide usage, the low concentration (i.e., less than 10 µg/kg), and the infrequent detection could reflect topical applications of pesticides.

Additionally, according to the work plan for SWMUs 4, 5, 9, and 10 (TtNUS, August 2000a) in the context of historical pesticide detections at SWMU 5, pesticides may not be site related constituents, but may, in fact, be attributable to Basewide insect control measures.

Aroclor 1254 was detected in samples 05SB050002 (220 µg/kg), 05SB060002 (150 µg/kg), 05SB070002 (100 µg/kg), and 05SB080002 (240 µg/kg). These samples are all located in the northern portion of the site in the vicinity of the main gully. The presence of Aroclors in surface soil are likely to be a result of past site disposal/burning activities.

Herbicides

The herbicides 2,4,5-T and pentachlorophenol were detected at SWMU 5. 2,4,5-T was detected in samples 05SB060002 (10 µg/kg) and 05SB080002 (16 µg/kg). Pentachlorophenol was detected in samples 05SB020002 (2.7 µg/kg), 05SB030002 (2.4 µg/kg), 05SB050002 (12 µg/kg), 05SB060002 (4.5 µg/kg), and 05SB070002 (5.8 µg/kg). As shown in Figure 5-6, the locations of these samples are scattered across SWMU 5. According to the work plan for SWMUs 4, 5, 9, and 10 (TtNUS, August 2000a), in reference to historical herbicide detections, it was common practice to treat areas alongside roadways with a mixture of herbicides and waste fuel oils, which could be a potential non-site-related source of herbicides.

Dioxins/Furans

Seventeen dioxin/furan congeners were detected in the eight surface soil samples analyzed; analytical results for seven mixtures were also reported. Concentrations of the hepta-, hexa-, and penta-chlorinated congeners ranged from 0.28 ng/kg (1,2,3,6,7,8-HxCDF in 05SB040002) to 541 ng/kg (1,2,3,6,7,8-HpCDF 05SB060002). Concentrations of OCDD ranged from 415 ng/kg to 5,050 ng/kg, with the maximum in sample 05SB080002. Concentrations of OCDF ranged from 8.5 ng/kg to 313 ng/kg, with the maximum in sample 05SB060002. Ten of the 17 detected dioxin/furan congeners were detected in seven or all eight of the surface soil samples. All 17 congeners were detected in sample 05SB060002. Sixteen of the 17 detected congeners were present in sample 05SB050002. Fifteen of the 17 detected congeners were found in sample 05SB070002. Maximum detected concentrations of 16 of the 17 detected congeners occurred in sample 05SB060002. Consequently, sample 05SB040002 contained the fewest dioxin/furan congener detections.

Sample locations 05SB05, 05SB06, and 05SB07 contained the greatest concentrations of dioxin/furan congeners. These locations are in the northern portion of the site, just north of the main gully. The 2,3,7,8-TCDD toxicity equivalents (TEQs) ranged from 0.68 ng/kg (05SB040002) to 226 ng/kg (05SB060002). Dioxin/furan compounds are often found in environmental media as a result of natural (e.g., forest fires) and anthropogenic activities (i.e., they are by-products of various combustion and chemical processes). The octa- and hepta-chlorinated congeners are generally detected more frequently in background environmental media samples and at higher concentrations than the tetra-, penta-, and hexa-chlorinated congeners. The concentrations detected in these surface soil samples are likely to be attributable to burning processes carried out at SWMU 5. The 2,3,7,8-TCDD TEQs reported from locations 05SB01 (6.5 ng/kg), 05SB02 (4.3 ng/kg), 05SB04 (0.68 ng/kg), and 05SB08 (6.11 ng/kg) are similar to background soil concentrations reported in the literature; however, concentrations in the remaining samples are in excess of background literature. [The arithmetic mean TEQ concentration detected in soil samples representing background conditions in the United States is estimated to be 8 ng/kg (ATSDR, 1997).]

Metals

Twenty metals were detected in the surface soil samples. Beryllium, sodium, selenium, and thallium were not detected in any of these surface soil samples. Of the 20 detected metals, aluminum, arsenic, cobalt, magnesium, manganese, nickel, and vanadium were detected in all eight samples at concentrations statistically determined to be similar to background concentrations. Potassium was also detected at concentrations statistically determined to be similar to background concentrations; however, only five samples yielded detectable potassium concentrations. Three of the detected metals (calcium, magnesium, and potassium) are considered to be essential nutrients and will not be discussed any further.

Barium, chromium, copper, iron, lead, mercury, and zinc were all detected in all eight samples at concentrations statistically determined to exceed background. The maximum detected concentrations of these metals, except mercury, were found in sample 05SB060002. The maximum detected concentration of mercury occurred in sample 05SB010002. Barium was detected at concentrations ranging from 74.7 mg/kg to 2,020 mg/kg. Chromium concentrations ranged from 10.4 mg/kg to 112 mg/kg. Copper was detected at concentrations ranging from 11.7 mg/kg to 1,520 mg/kg. Iron was detected at concentrations ranging from 15,600 mg/kg to 105,000 mg/kg. Lead was detected at concentrations ranging from 15.2 mg/kg to 16,900 mg/kg. Mercury concentrations ranged from 0.04 mg/kg to 0.43 mg/kg. Zinc was detected at concentrations ranging from 26.6 mg/kg to 5,100 mg/kg.

Concentrations of barium, copper, iron, lead, and zinc were generally one order of magnitude larger in sample 05SB060002 than in the other surface soil samples.

Antimony, cadmium, silver, and tin were detected in samples at concentrations statistically determined to exceed background. Silver was detected in samples 05SB030002 (2.8 mg/kg), 05SB060002 (7.5 mg/kg), and 05SB070002 (1.8 µg/kg). Antimony and tin were detected in every sample except 05SB040002. Concentrations of antimony ranged from 3.2 mg/kg to 301 mg/kg; the maximum concentration was in sample 05SB060002. Concentrations of tin ranged from 13.2 mg/kg to 849 mg/kg, the maximum concentration in sample 05SB080002. Cadmium was detected in six of eight samples. Concentrations of cadmium ranged from 1.6 mg/kg to 31.1 mg/kg, with the maximum occurring in sample 05SB060002.

As shown in Figure 5-7, metals detections in surface soils are frequent and are spatially distributed across the entire site. Sample 05SB040002 contained the fewest metals and at concentrations lower than those found at the other locations. All 20 metals were detected in sample 05SB060002. Metals concentrations in sample 05SB060002 were in most cases one order of magnitude higher than concentrations detected in all the remaining samples, which would be consistent with the observation that metal shavings were present in that sample. The concentrations of several metals (antimony, barium, cadmium, chromium, copper, lead, silver, and zinc) were high enough to suggest that location 05SB060002 might be a hot spot. According to the Work Plan for Risk Assessment at SWMUs 4, 5, 9, and 10 (TtNUS, August 2000a), the site is littered with metals debris and decomposing drums.

Miscellaneous Parameters

Cyanide was not detected in surface soil samples. The TOC in sample 05SB040002 was 1,700 mg/kg. The CEC of sample 05SB040002 was 13 MEQ/100 g. The pH of sample 05SB060002 was 5.1, which is slightly acidic.

5.4.2 Subsurface Soil

As detailed in Table 5-1 and Section 5.2, 14 subsurface soil samples were collected at seven locations to evaluate the nature and extent of contamination. All seven subsurface soil samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, Appendix IX dioxin/furans, TAL Metals (plus tin), and cyanide. Additionally, three subsurface soil samples were analyzed for CEC, pH, and TOC.

Table 5-4 presents a summary of the positive results reported for compounds detected in the subsurface soil samples collected from SWMU 5. Table 5-5 presents a summary of descriptive statistics for positive subsurface soil detections including: range of detections, frequency of detection, location of maximum, and comparison to background. Because two different soil groups comprise subsurface soil at this SWMU, the table displays an exceedance of background concentrations if either soil group exceeded its respective background values. Figures described below indicate background exceedances for soil group-specific background comparisons. Appendix E-1.2 contains a copy of the entire analytical database for SWMU 5 subsurface soil. Figures 5-8 and 5-9 present a geographical depiction of organic and inorganic detections in subsurface soil, respectively. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion , a flag (e.g., R5DQL) on the tag map at the affected sampling location is shown on the figure. If an inorganic chemical was detected at a particular location and the site data set for that chemical was elevated as compared to the corresponding background data set (Soil Group 8 or 9), the result was flagged with "BACK" at all locations where samples from that soil group were collected. If "BACK" does not appear next to the result for an inorganic chemical, it means that the chemical was detected at that location but the chemical concentrations for that soil group are not elevated relative to background concentrations.

Volatile Organic Compounds

Twelve VOCs (1,1-dichloroethane, acetone, benzene, chloroethane, cis-1,2-dichloroethene, ethylbenzene, methylene chloride, toluene, trans-1,2-dichloroethene, trichloroethene, vinyl chloride, and xylenes) were detected in the subsurface soil samples. Most of the detected VOCs are common solvents and gasoline-related compounds. 1,1–Dichloroethane, chloroethane, ethylbenzene, toluene, and trans-1,2-dichloroethene were detected in sample 05SB030507 only at concentrations of 140 µg/kg, 48 µg/kg, 19 µg/kg, 27 µg/kg, and 7 µg/kg, respectively. Acetone, benzene, and xylenes were detected in samples 05SB030507 and 05SB050608. Concentrations of acetone ranged from 48 µg/kg to 54 µg/kg, with the maximum detection occurring in sample 05SB030507. Concentrations of benzene ranged from 3 µg/kg to 17 µg/kg with the maximum detection in sample 05SB030507. Concentrations of xylenes ranged from 10 µg/kg to 61 µg/kg, with the maximum detection in sample 05SB030507. Methylene chloride was detected in samples 05SB030507 and 05SB040204 at concentrations of 42 µg/kg and 4 µg/kg, respectively. Trichloroethene was detected in samples 05SB030507, 05SB060608, and 05SB070608 at concentrations of 9 µg/kg, 13 µg/kg, 9 µg/kg, respectively. Cis-1,2-dichloroethene and vinyl chloride were detected in samples 05SB010810, 05SB030507, 05SB050608, and 05SB060608. Concentrations of cis-1,2-dichloroethene ranged from 5 µg/kg to 130 µg/kg with the maximum occurring in sample 05SB010810. Concentrations of vinyl chloride ranged from 7 µg/kg to 160 µg/kg with the maximum occurring in sample 05SB060608.

All 12 detected VOCs were present in sample 05SB030507, and the maximum detected concentrations of nine of these 12 detected VOCs were found in this same sample. Four of the 12 detected VOCs were present in sample 05SB050608. Three of the 12 detected VOCs were present in sample 05SB060608. Sample 05SB030507 is located in the immediate vicinity of the old burn pit, and samples 05SB050608 and 05SB060608 are located just north of the main gully where burn pit ash was buried, these samples are also located within 100 feet of each other.

Sample 05SB040002 was collected in the vicinity of the most upgradient ground water well (05-01), and this sample contained only methylene chloride at a concentration of 4 µg/kg. Sample 05SB070608, was collected in a downgradient location with respect to ground water flow, yielded only a detectable concentration of trichloroethene (9 µg/kg). As noted above, trichloroethene was detected frequently in surface soil and in some instances at concentrations in excess of 1,000 µg/kg. In subsurface soil, trichloroethene was also detected but not as frequently nor at the elevated concentrations noted in surface soil. However, several natural degradation products of tetrachloroethene and trichloroethene (i.e., cis-1,2-dichloroethene and vinyl chloride) were detected frequently and, in some instances, at concentrations in excess of 50 µg/kg. Concentrations of cis-1,2-dichloroethene and vinyl chloride were elevated in both the vicinity of the burn pit and in the vicinity of the main gully in which burn pit ash was disposed. These chlorinated hydrocarbons are likely to be attributable to past disposal and burning activities at SWMU 5. Concentrations of methylene chloride are likely to be attributable to laboratory blank contamination, see Section 3.1.4.2 for a detailed explanation.

Semivolatile Organic Compounds

Seventeen PAHs, 4-methylphenol, and bis(2-ethylhexyl) phthalate were detected in subsurface soil samples. Bis(2-ethylhexyl) phthalate was detected in samples 05SB020406 (940 µg/kg), 05SB030507 (1,600 µg/kg), 05SB050608 (1,110 µg/kg), and 05SB060608 (1,900 µg/kg). 4-Methylphenol was detected in samples 05SBSB020406 (460 µg/kg) and 05SB060608 (770 µg/kg). Maximum detected concentrations of the 17 PAHs ranged from 45 µg/kg (acenaphthene) to 3,100 µg/kg (pyrene). PAHs were detected in from one to six of seven subsurface soil samples. Analysis of sample 05SB040204 yielded no detectable PAHs. Analysis of sample 05SB070608 yielded the maximum detectable concentrations of nine of the 17 detected PAHs. PAHs were most frequently detected in samples 05SB020406, 05SB050608, 05SB060608, and 05SB070608.

Dibenzo(a,h)anthracene (130 µg/kg) was detected in sample 05SB070608 only. Benzo(k)fluoranthene was detected in samples 05SB020406 and 05SB070608, at concentrations of 50 µg/kg and 530 µg/kg,

respectively. Fluorene and anthracene were detected in three of seven samples at maximum concentrations of 84 µg/kg and 89 µg/kg, respectively. 2-Methylnaphthalene, chrysene, phenanthrene, and pyrene were detected in samples 05SB020406, 05SB030507, 05SB050608, 05SB060608, and 05SB070608. Phenanthrene and pyrene were also detected in 05SB010810. Fluorene and benzo(b)fluoranthene were detected in samples 05SB010810, 05SB020406, 05SB050608, 05SB060608, and 05SB070608. Acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, and naphthalene were detected in samples 05SB020406, 05SB050608, 05SB060608, and 05SB070608.

The maximum detected concentrations of anthracene (89 µg/kg), benzo(a)anthracene (730 µg/kg), benzo(a)pyrene (650 µg/kg), benzo(b)fluoranthene (960 µg/kg), benzo(g,h,i)perylene, (260 µg/kg), benzo(k)fluoranthene (530 µg/kg), dibenzo(a,h)anthracene (130 µg/kg), fluoranthene (830 µg/kg), and indeno(1,2,3-cd)pyrene (240 µg/kg) were found in sample 05SB070608. Maximum detected concentrations of 2-methylnaphthalene (2,500 µg/kg), chrysene (1,500 µg/kg), naphthalene (1,200 µg/kg), phenanthrene (2,800 µg/kg), and pyrene (3,100 µg/kg) were found in sample 05SB030507. PAHs were detected in all samples across the site except sample 05SB040002, which did not contain detectable PAH concentrations. Sample 05SB010810 contained very few PAHs [i.e., benzo(b)fluoranthene, fluoranthene, phenanthrene, and pyrene]. In general the concentrations of PAHs in surface and subsurface soil were similar. In surface soil, the concentrations of PAHs were found at location 05SB05 (near the main gully where burn pit ash was buried), and in subsurface soil the concentrated PAH detections were found at 05SB03 (located near the former burn pit) and 05SB07 (located near the main gully). These sample locations are illustrated in Figure 5-8. The PAHs may be related to site burning operations as PAHs are typical by-products of incomplete combustion and would be expected in the vicinity of the burn pit and the ash burial area. PAHs were not detected in a sample collected in the vicinity of the most upgradient ground water well. Sample 05SB070608 was collected in the vicinity of the most downgradient ground water well.

Pesticides/PCBs

4,4'-DDD, dieldrin, and methoxychlor were the only pesticides detected in the subsurface soil samples. 4,4'-DDD was detected in sample 05SB020406 (8 µg/kg). Dieldrin was detected in sample 05SB050608 (7.4 µg/kg). Methoxychlor was detected in samples 05SB060608 and 05SB070608 at concentrations of 28 µg/kg and 49 µg/kg, respectively. These samples are located near the former burn pit and near the main gully. These pesticide compounds were not detected in surface soil.

Aroclor 1254 was detected in samples 05SB060608 and 05SB070608 at concentrations of 670 µg/kg and 150 µg/kg, respectively. Aroclor 1260 was detected in sample 05SB050608 at a concentration of 640 µg/kg. These samples are all located in the northern portion of the site in the vicinity of the main gully. Aroclor 1254 was also detected in surface soil. The presence of Aroclors in subsurface soil is likely to be a result of past site disposal and burning activities.

Herbicides

Pentachlorophenol was the only herbicide detected in SWMU 5 subsurface soil. Pentachlorophenol was detected in samples 05SB010810 (1.5 µg/kg), 05SB020406 (3.0 µg/kg), 05SB050608 (2.4 µg/kg), 05SB060608 (3.3 µg/kg), and 05SB070608 (4.8 µg/kg). As shown in Figure 5-8, the locations of these samples are scattered across SWMU 5.

Dioxins/Furans

Seventeen dioxin/furan congeners were detected in the seven subsurface soil samples that were analyzed; analytical results for seven mixtures were also reported. Concentrations of the hepta-, hexa-, and penta-chlorinated congeners ranged from 0.22 ng/kg (2,3,4,7,8-PeCDF in 05SB040810) to 1,590 ng/kg (1,2,3,4,6,7,8-HpCDF 05SB030507). Concentrations of OCDD ranged from 58.1 ng/kg to 1,760 ng/kg with the maximum in 05SB070608. Concentrations of OCDF ranged from 0.26 ng/kg to 477 ng/kg with the maximum in 05SB070608. Five of the 17 detected dioxin/furan congeners were detected in six or seven of the seven subsurface soil samples. All 17 congeners were detected in samples 05SB030507 and 05SB070608. Twelve of the 17 detected congeners were present in samples 05SB020406 and 05SB060608. Eight of the 17 detected congeners were found in samples 05SB010810 and 05SB0400204. Sample 05SB050608 contained the fewest dioxin/furan detections (five of 17 congeners). Maximum detected concentrations of 10 of the 17 detected congeners occurred in sample 05SB030507, and seven of the 17 congeners occurred in sample 05SB070608.

Sample locations 05SB03 and 05SB07 contained the greatest concentrations of dioxin/furan congeners. Location 05SB03 is in the vicinity of the former burn pit, and 05SB07 is located in the northern portion of the site just north of the main gully. The 2,3,7,8-TCDD TEQs ranged from 0.81 ng/kg (05SB040204) to 464 ng/kg (05SB030507). Dioxin/furan compounds are often found in environmental media as a result of natural (e.g., forest fires) and anthropogenic activities (i.e., they are by-products of various combustion and chemical processes). The octa- and hepta-chlorinated congeners are generally detected more frequently in background environmental media samples and at higher concentrations than the tetra-, penta-, and hexa chlorinated congeners. The concentrations detected in these subsurface soil samples

are likely to be attributable to burning processes carried out at SWMU 5. The 2,3,7,8-TCDD TEQs reported from locations 05SB01 (0.98 ng/kg), 05SB04 (0.81 ng/kg), 05SB05 (9.2 ng/kg), and 05SB02 (10.8 ng/kg) are similar to background soil concentrations reported in the literature; however concentrations in the remaining samples are in excess of background literature. [The arithmetic mean TEQ concentration detected in soil samples representing background conditions in the United States is estimated to be 8 ng/kg (ATSDR, 1987).]

Metals

Twenty-one metals were detected in the subsurface soil samples. Beryllium, selenium, and thallium were not detected in any of these subsurface soil samples. Of the 21 detected metals, aluminum, cobalt, magnesium, and vanadium were detected in all seven samples at concentrations statistically determined to be similar to background concentrations. Potassium was also detected at concentrations statistically determined to be similar to background concentrations; however, only five samples yielded detectable potassium concentrations. Additionally, four of the detected metals (calcium, magnesium, sodium, and potassium) are considered to be essential nutrients and will not be discussed any further.

Barium, chromium, copper, iron, lead, manganese, nickel, and zinc were all detected in all seven samples at concentrations statistically determined to exceed background. The maximum detected concentrations of arsenic, chromium, copper, lead, and zinc were found in sample 05SB060608. The maximum detected concentrations of barium, iron, manganese, and nickel were found in sample 05SB030507. Arsenic was detected at concentrations ranging from 2.9 mg/kg to 12.2 mg/kg. Barium concentrations ranged from 30.3 mg/kg to 1,430 mg/kg. Chromium was detected at concentrations ranging from 5.7 mg/kg to 110 mg/kg. Copper concentrations ranged from 8.1 mg/kg to 6,370 mg/kg. Iron was detected at concentrations ranging from 11,400 mg/kg to 72,900 mg/kg. Lead was detected at concentrations ranging from 8.2 mg/kg to 2,860 mg/kg. Manganese concentrations ranged form 157 mg/kg to 1,070 mg/kg. Nickel concentrations ranged from 8.8 mg/kg to 50.5 mg/kg. Zinc was detected at concentrations ranging from 25.9 mg/kg to 3,010 mg/kg. Maximum detected concentrations of metals found in samples 05SB060608 and 05SB030507 were generally one order of magnitude larger than in the other subsurface soil samples.

Antimony, cadmium, mercury, silver, and tin were detected in several samples at concentrations statistically determined to exceed background. Silver was detected in samples 05SB0200406 (1.7 mg/kg), 05SB030507 (16.1 mg/kg), 05SB060608 (2.7 mg/kg), and 05SB070608 (3.8 mg/kg). Cadmium, mercury, and tin were detected in five of seven samples. Cadmium concentrations ranged from 1.8 mg/kg to 27.9 mg/kg. The mercury concentrations in all samples were less than 1 mg/kg, except

in sample 05SB050608, which contained 93.2 mg/kg of mercury. Tin concentrations ranged from 14 mg/kg to 324 mg/kg. Antimony was detected in every sample except 05SB040204. Concentrations of antimony ranged from 0.9 mg/kg to 208 mg/kg, with the maximum concentration in sample 05SB060608.

Maximum detected concentrations of antimony, arsenic, chromium, copper, lead, tin, and zinc were found in sample 05SB060608. Maximum detected concentrations for barium, cadmium, cobalt, iron, manganese, nickel, silver, and vanadium were found in sample 05SB030507. The maximum detected concentration of aluminum was found in sample 05SB040204, and the maximum detected concentration of mercury was found in sample 05SB050608. As shown in Figure 5-9, metals detections are frequent and are spatially distributed across the entire site; samples collected near the main gully (05BS050608 and 05SB060608) and the old burn pit (samples 05SB020406 and 05SB030507) contained higher concentrations than the remainder of the samples. Sample 05SB040204 contained the fewest metals and at concentrations lower than those found at the other locations. All 21 metals were detected in samples 05SB020406 and 05SB060608. Mercury and lead detections in samples 05BS050608 and 05SB060608 were high enough to suggest these locations might be hot spots. According to the Work Plan for Risk Assessment at SWMUs 4, 5, 9, and 10 (TtNUS, August 2000a), the site is littered with metals debris and decomposing drums.

Miscellaneous Parameters

Cyanide was not detected in subsurface soil samples. The TOCs ranged from 1,500 mg/kg to 23,000 mg/kg. The CECs ranged from 3.2 MEQ/100 g to 11 MEQ/100 g. The pHs ranged from 7.2 to 7.6, which is neutral.

5.4.3 Ground Water

As detailed in Table 5-1 and Section 5.2, 14 ground water samples were collected to evaluate the nature and extent of contamination. All ground water samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, Appendix IX dioxin/furans, total TAL metals (plus tin), and cyanide. Samples 05GW0301 and 05GW1301 were analyzed for dissolved TAL Metals. Sample 05GW0101 was collected and it is the SWMU 5 upgradient ground water sample.

Table 5-6 presents a summary of the positive results reported for compounds detected in the ground water samples collected from SWMU 5. Table 5-7 presents a summary of descriptive statistics for positive ground water detections, including range of detections, frequency of detection, location of

maximum, and comparison to upgradient concentrations. Appendix E.1.2 includes a copy of the entire analytical database for SWMU 5 ground water. Figure 5-10 presents a geographical depiction of organic and inorganic detections in ground water. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R9TAP) on the tag map at the affected sampling location is shown on the figure. If a detected organic or inorganic chemical concentration at a particular location exceeded the upgradient concentration, this was indicated with a "UP" flag at the affected location. If "UP" does not appear on the tag map it means the chemical was detected at that location, but the concentration was less than the upgradient concentration.

Volatile Organic Compounds

Chloroform and cis-1,2-dichloroethene were each detected in these SWMU 5 ground water samples. Chloroform was detected in sample 05GWT0101 at a concentration of 1 µg/L. Cis-1,2-dichloroethene was detected in sample 05GW1501 at a concentration of 3 µg/L. No other VOCs were detected in SWMU 5 ground water samples.

Sample 05GWT0101 is the southeastern most ground water sample location at SWMU 5. This location could, in addition to location 05GW01, be considered upgradient. No VOCs were detected in the site background sample 05GW0101. Chloroform was not detected in surface or subsurface soil samples.

Sample 05GW1501 is located in the western portion of the site, downgradient from surface and subsurface soil locations (e.g., 05SB060002) that contained significant concentrations of cis-1,2-dichloroethene and trichloroethene. At 3 µg/L, cis-1,2-dichloroethene was the only VOC detected in sample 05GW1501.

Semivolatile Organic Compounds

Bis(2-ethylhexyl) phthalate was detected in sample 05GW0801 at a concentration of 110 µg/L. Bis(2 ethylhexyl) phthalate was also detected in surface and subsurface soil locations, 05SB05 and 05SB06, at concentrations ranging from 930 µg/kg to 3,400 µg/kg. Well 05GW08 is downgradient of these soil boring locations. No other SVOCs were detected in SWMU 5 ground water.

Pesticides/PCBs

No pesticide/PCBs were detected in SWMU 5 ground water samples.

Herbicides

No herbicides were detected in SWMU 5 ground water samples.

Dioxin/Furans

OCDD, OCDF, 1,2,3,4,6,7,8-HpCDD, and 2,3,7,8-TCDD and analytical results for three mixtures were reported. OCDD was detected in 10 of 14 samples at concentrations ranging from 6.1 pg/L to 269 pg/L with the maximum in sample 05GW1301. OCDF was detected in sample 05GW1301 at a concentration of 6.8 pg/L. 1,2,3,4,6,7,8-HpCDD was detected in samples 05GW1301 and 05GW1501 at concentrations of 12.2 pg/L and 7.1 pg/L, respectively. 2,3,7,8-TCDD was detected in samples 05GW1501 and 05GWT0301 at concentrations of 6.3 pg/L and 11.3 pg/L, respectively.

The 2,3,7,8-TCDD TEQs ranged from 1.72 pg/L to 15.9 pg/L, with the maximum in sample 05GWT0301. The maximum 2,3,7,8-TCDD TEQ is below the federal MCL (30 pg/L). These compounds were also detected in surface and subsurface soil from this site, however, dioxin compounds are immobile in most soils and are not expected to leach into the ground water (ATSDR, 1987).

Metals

Aluminum, arsenic, barium, calcium, copper, iron, lead, magnesium, manganese, selenium, sodium, vanadium, and zinc were the only metals detected in these ground water samples. The maximum detected concentrations of all these aforementioned metals, except zinc, were in excess of their respective upgradient concentrations. Three of the detected metals (calcium, magnesium, and sodium) are considered to be essential nutrients and will not be discussed any further.

Copper, lead, vanadium and zinc were all detected in sample 05GW0301 at concentrations of 4.9 µg/L, 4.1 µg/L, 4.9 µg/L, and 25.5 µg/L, respectively. Selenium was also detected in only one sample, 05GWT0301, at a concentration of 1.4 µg/L.

Aluminum was detected in samples 05GW0301 (2,320 µg/L) and 05GW1301 (341 µg/L). Arsenic was detected in eight of 14 samples at concentrations ranging from 0.12 µg/L to 1.6 µg/L, with the maximum concentration in sample 05GW1501. Manganese was detected in ten of 14 samples at concentrations ranging from 18.3 µg/L to 2,270 µg/L, with the maximum in sample 05GW1501. Iron was detected in 13 of 14 samples at concentrations ranging from 150 µg/L to 4,440 µg/L, with the maximum in sample 05GW0301. Barium was detected in all 14 sample at concentrations ranging from 36.1 µg/L to 227 µg/L, with the maximum in sample 05GW0701.

Maximum detected concentrations of aluminum, copper, iron, lead, vanadium, and zinc occurred in sample 05GW0301. Maximum detected concentrations of arsenic and manganese were found in sample 05GW1501. The maximum detected concentration of barium was found in sample 05GW0701 and the maximum selenium as in 05GWT0301. Metal concentrations across SWMU 5 ground water are similar. As shown in Figure 5-10, there not does appear to be a pattern of metals contamination in the ground water. These metals were also detected in surface and subsurface soil samples at SWMU 5.

Samples 05GW0301 and 05GW1301 were also analyzed for dissolved metals. Barium, calcium, iron, magnesium, manganese, and sodium were detected in the dissolved samples. The concentrations of these metals were similar to the concentrations detected in the total analysis.

Miscellaneous Parameters

Cyanide was not detected in these ground water samples.

5.4.4 Surface water

As detailed in Table 5-1 and Section 5.2, four surface water samples were collected to evaluate the nature and extent of contamination. All surface water samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, Appendix IX dioxin/furans, total and dissolved TAL metals (plus tin), cyanide, hardness, and total suspended solids. Sample 05SW0101 was selected to represent the SWMU 5 upgradient surface water sample.

Table 5-8 presents a summary of the positive results reported for compounds detected in the surface water samples collected from SWMU 5. Table 5-9 presents a summary of descriptive statistics for positive surface water, detections including range of detections, frequency of detection, location of maximum, and comparison to upgradient sample concentrations. Appendix E.1-2 contains a copy of the entire analytical database for SWMU 5 surface water. Figure 5-11 presents a geographical depiction of organic and inorganic detections in surface water. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R9TAP) on the tag map at the affected sampling location is shown on the figure. If a detected organic or inorganic chemical concentration at a particular location exceeded the upgradient concentration, this was indicated with a "UP" flag at the affected location. If "UP" does not appear on the tag map it means the chemical was detected at that location, but the concentration was less than the upgradient concentration.

Volatile Organic Compounds

The VOCs 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride were detected in SWMU 5 surface water samples. 1,1-Dichloroethene was detected in sample 05SW0201 at a concentration of 2 µg/L. Trans-1,2-dichloroethene was detected in 05SW0201 (9 µg/L) and 05SW0301 (3 µg/L). Trichloroethene was detected in 05SW0201 (120 µg/L) and 05SW0301 (48 µg/L). Vinyl chloride was detected in 05SW0201 (85 µg/L) and 05SW0301 (18 µg/L). Cis-1,2-Dichloroethene was detected in samples 05SW0201 (290 µg/L), 05SW0301 (110 µg/L), and 05SW0501 (1 µg/L).

These VOCs were also detected in surface soil, subsurface soil, and ground water samples at SWMU 5. Maximum detected concentrations of VOCs were found in surface soil samples from locations 05SB06, 05SB07, and 05SB08 which are all located approximately within 250 feet of each other, and in sample 05SW0201. Sample 05SW0201 is located slightly northwest of these surface soil locations. Additionally, the ground water well 05GW15, which contained cis-1,2-dichloroethene at 3 µg/L, is located between sample locations 05SW02 and 05SW03.

It is unusual to find VOCs at these elevated concentrations (i.e., greater than 100 µg/L) in surface water samples. One would expect that VOCs would be diluted or would evaporate in a surface water environment. An explanation could be that a seep containing VOCs is discharging into the surface water. At the time the sample was collected the surface water was iced over. VOCs would have been prevented from volatilization by the ice.

Semivolatile Organic Compounds

Bis(2-ethylhexyl) phthalate was detected in sample 05SW0201 at a concentration of 2 µg/L. No other SVOCs were detected in SWMU 5 surface water. Bis(2-ethylhexyl) phthalate was also detected in surface soil, subsurface soil, or ground water samples within SWMU 5. Concentrations of this compound in surface and subsurface soil were in excess of 1,000 µg/kg and in some cases greater than 3,000 µg/kg. This occurrence of bis(2-ethylhexyl) phthalate may be the result of the high level of suspended solids in surface water sample 05SW0201.

Pesticides/PCBs

No pesticide/PCBs were detected in SWMU 5 surface water samples.

Herbicides

No herbicides were detected in SWMU 5 surface water samples.

Dioxin/Furans

No dioxin/furan congeners were detected in these surface water samples; however, one mixture (total PeCDD at 9.4 pg/L) was reported in sample 05SW0401. 2,3,7,8-TCDD TEQs are not calculated for mixtures. Doxins/furans were detected in surface soil, subsurface soil, sediment, and ground water from this site. It is likely that this total PeCDD detection can be attributed to suspended solids in this sample (15 mg/L).

Metals

As shown in Table 5-7, aluminum, antimony, arsenic, barium, calcium, copper, iron, magnesium, manganese, sodium, and zinc were the only metals detected in these surface water samples. The maximum detected concentrations of aluminum, antimony, arsenic, barium, calcium, copper, iron, magnesium, manganese, and zinc were in excess of respective upgradient concentrations. Three of the detected metals (calcium, magnesium, and sodium) are considered to be essential nutrients and will not be discussed any further. Aluminum and antimony were both detected in only one sample. Aluminum was detected in sample 05SW0401 at a concentration of 204 µg/L. Antimony was detected in sample 05SW0501 at a concentration of 1.3 µg/L. Copper and zinc were detected in two samples. Copper was detected in samples 05SW0201 and 05SW0501 at concentrations of 2.7 µg/L and 2.4 µg/L, respectively. Zinc was detected in samples 05SW0201 and 05SW0301 at concentrations of 19.5 µg/L and 19.9 µg/L, respectively. Manganese was detected in samples 05SW0101, 05SW0201, 05SW0301, and 05SW0401 at concentrations of 41.4 µg/L, 238 µg/L, 315 µg/L, and 105 µg/L. Arsenic was detected in all four surface water samples at concentrations ranging from 0.34 µg/L to 0.64 µg/L. Barium and iron were detected in all four surface water samples. Barium concentrations ranged from 68.3 µg/L to 184 µg/L, with the maximum in sample 05SW0501. Iron concentrations ranged from 284 µg/L to 1,520 µg/L with the maximum in sample 05SW0401.

As shown in Figure 5-10, sample 04SW0401, which was the most downgradient surface water sample collected within SWMU 5, yielded detectable metals results that were only slightly higher but still similar to those found in all SWMU 5 surface water samples. These same metals were also detected in surface soil, subsurface soil, and ground water samples at SWMU 5. Concentrations of dissolved iron and manganese increase in a downstream direction for sample locations 05SW01, 05SW02, and 05SW03, which lie along one drainage channel.

The samples were also analyzed for dissolved metals. Antimony, arsenic, barium, calcium, copper, iron, magnesium, manganese, sodium, and zinc were detected in the dissolved (filtered) sample. The concentrations and frequency of detection of these metals were similar to those found in the total (unfiltered) samples. Dissolved concentrations of antimony, arsenic, barium, calcium, copper, iron, magnesium, manganese, and zinc were all in excess of (dissolved) upgradient concentrations.

Miscellaneous Parameters

Cyanide was not detected. The hardness of these samples ranged from 38 mg/L to 230 mg/L, and the total suspended solids ranged from 2 mg/L to 52 mg/L. Sample 05SW0501 possessed the maximum hardness value of 230 mg/L. Sample 05SW0201 possessed the maximum total suspended solids value.

5.4.5 Sediment

As detailed in Tables 5-1 and 5-2, four sediment samples were collected to evaluate the nature and extent of contamination. All sediment samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, Appendix IX dioxin/furans, TAL metals (plus tin), cyanide, and TOC. Sample 05SD010006 was collected as the SWMU 5 upgradient sediment sample.

Table 5-10 presents a summary of the positive results reported for compounds detected in the sediment samples collected from SWMU 5. Table 5-11 presents a summary of descriptive statistics for positive sediment detections, including range of detections, frequency of detection, location of maximum, and comparison to upgradient sample location. Appendix E.1-2 contains a copy of the entire analytical database for SWMU 5 sediment. Figure 5-12 presents a geographical depiction of organic and inorganic detections in sediment, respectively. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R5DQL) on the tag map at the affected sampling location is shown on the figure. If a detected inorganic chemical concentration at a particular location exceeded the upgradient concentration, this was indicated with a "UP" flag at the affected location. If "UP" does not appear on the tag map it means the chemical was detected at that location, but the concentration was less than the upgradient concentration.

Volatile Organic Compounds

Cis-1,2-Dichloroethene, methylene chloride, and trichloroethene were the only VOCs detected in these sediment samples. Methylene chloride was detected in all four samples at concentrations ranging from

5 µg/kg to 8 µg/kg, with the maximum in 05SD040006. Cis-1,2-dichloroethene and trichloroethene were detected in sample 05SD020006 at concentrations of 1,000 µg/kg and 700 µg/kg, respectively. No other VOCs were detected. The detections of cis-1,2-dichloroethene and trichloroethene were collocated with surface water samples. The surface water sample from this location contained a high level of suspended solids. This location, 05SW/SD02, is also located downgradient of the surface soil sample that contained cis-1,2-dichloroethene and trichloroethene at concentrations in excess of 2,000 µg/kg. It appears that the presence of chlorinated VOCs is likely related to past site activities.

Methylene chloride was also detected at concentrations of 4 µg/kg to 8 µg/kg. This compound is considered a common laboratory contaminant, and the low concentrations (i.e., near the detection limit of 5 µg/L) found in these SWMU 5 sediments are similar to those concentrations commonly found in laboratory method blanks. Methylene chloride was detected in the upgradient sediment sample, which further indicates that the observed low concentrations of this chemical are probably laboratory contamination. Methylene chloride was also infrequently detected in surface and subsurface soil samples from SWMU 5.

Semivolatile Organic Compounds

As displayed in Table 5-11, 13 PAHs were detected in the four SWMU 5 sediment samples. No other semivolatile organic compounds were detected in these sediment samples. Maximum detected PAH concentrations of these 13 PAHs ranged from 16 µg/kg [dibenzo(a,h)anthracene and naphthalene] to 55 µg/kg (fluoranthene). The maximum detected concentration of nine of the 13 detected PAHs were found in sample 05SD050006. Sample 05SD040006 contained the fewest PAH detections (i.e., only fluoranthene at 16 µg/kg).

As shown in Table 5-10, sample 05SD010006 (the SWMU 5 background location) contained concentrations of PAHs ranging from 14 µg/kg (2-methylnaphthalene) to 960 µg/kg (fluoranthene). The PAHs detected in this upgradient location are one order of magnitude greater than those detected in the four sediment samples collected from within or hydrologically downgradient of SWMU 5. The source of PAHs at this upgradient location is not known but may be resultant of roadway runoff as PAHs are a component of vehicular exhaust and asphalt. Additionally, PAHs may have been transported (in the form or ashes or dust) and deposited via wind. Theoretically PAHs in the form of ashes or dust may originate from a source area that may be miles from the source of contamination.

Pesticides/PCBs

No pesticides were detected in SWMU 5 sediment samples.

Aroclor 1260 was detected at a concentration of 170 µg/kg in sample 05SD050006 but it was not detected in the most downgradient sample (05SD040006). No other PCBs were detected in SWMU 5 sediments. PCBs were also detected in surface soil locations 05SB05 and 05SB06 at similar concentrations. The presence of Aroclors in sediment is likely the result of past site disposal and burning activities.

Herbicides

The herbicides hexachlorophene and pentachlorophenol were detected in these sediments. Hexachlorophene was detected in sample 05SD040006 (3.1 µg/kg) but was not detected in any other media at SWMU 5. Pentachlorophenol was detected in sample 05SD050006 (6 µg/kg) but it was not detected in the most downgradient sample (05SD040006). Pentachlorophenol was also detected in surface and subsurface soil samples at concentrations similar to those found in sediment. As shown in Figure 5-12, sediment sample 05SD050006 is downgradient of surface and subsurface soil sample locations (05SB02 and 05SB03) that contained similar concentrations of pentachlorophenol.

Dioxins/Furans

Seventeen dioxin/furan congeners were detected in the four sediment samples that were analyzed; analytical results for two mixtures were also reported. Concentrations of the hepta-, hexa-, and penta-chlorinated congeners ranged from 0.5 ng/kg (1,2,3,4,7,8-HxCDD in 05SD040006) to 203 ng/kg (1,2,3,4,6,7,8-HpCDD in 05SD020006). As displayed in Table 5-11, concentrations of OCDD ranged from 1,160 ng/kg to 6,110 ng/kg with the maximum occurring in sample 05SD020002. Concentrations of OCDF ranged from 2.2 ng/kg to 223 ng/kg with the maximum occurring in sample 05SD020006. Eleven of the 17 detected dioxin/furan congeners were detected in all four of the sediment samples. All 17 congeners were detected in samples 05SD020006, 05SD030006, and 05SD050006. Maximum detected concentrations of 16 of the 17 detected congeners occurred in sample 05SD020006, which is located north of the main gully. Sample 05SD040006 contained the fewest dioxin/furan congener detections; this sample is the westernmost sediment sample at SWMU 5.

The 2,3,7,8-TCDD TEQs ranged from 2.5 ng/kg (05SD040006) to 18.3 ng/kg (05SD020006). It should be noted that dioxin/furan compounds are often found in environmental media as a result of natural (e.g., forest fires) and anthropogenic activities (i.e., they are by-products of various combustion and chemical

processes). The octa- and hepta-chlorinated congeners are generally detected more frequently in background environmental media samples and at higher concentrations than the tetra-, penta-, and hexa-chlorinated congeners. The concentrations detected in these sediment samples are likely to be attributable to burning processes carried out at SWMU 5. Dioxins/furans were detected in all media collected at SWMU 5.

As displayed in Table 5-10, the upgradient sediment location 05SD010006 contained positive results for several dioxin congeners. This may or may not be attributable to activities at SWMU 5. The dioxins are most probably present at this location due to deposition of ash from an airborne source (i.e., wind) that could theoretically be miles away from the sample location.

Metals

As shown on Table 5-9, 18 metals (aluminum, antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, vanadium, and zinc) were detected in the downgradient sediment samples. The maximum detected concentrations of aluminum, antimony, barium, cadmium, calcium, chromium, copper, lead, magnesium, manganese, mercury, vanadium, and zinc were in excess of respective upgradient concentrations. Three of the detected metals (calcium, magnesium, and potassium) are considered to be essential nutrients and will not be discussed any further. Cadmium was detected in sample 05SD050006 at a concentration of 2.5 mg/kg. Mercury was detected in samples 05SD020006 (0.04 mg/kg) and 05SD050006 (0.09 mg/kg). Antimony was detected in samples 05SD020006 (2.2 mg/kg), 05SD030006 (1.6 mg/kg), and 05SD050006 (5.8 mg/kg). The remainder of the detected metals were present in all samples. The maximum detected concentrations of 15 of the 18 detected metals were found in sample 05SD050006. Maximum detected concentrations of manganese and nickel were found in sample 05SD030006. The maximum detected concentration of cobalt was found in sample 05SD020006.

As shown in Figure 5-12, the concentrations of metals detected across SWMU 5 sediment are similar although sample 05SD050006 had the greatest concentrations of metals. The concentrations of metals detected in sediment samples collected within SWMU 5 (including the upgradient location) are within one order of magnitude of each other. Most of these metals were also detected in all other media samples at SWMU 5.

Miscellaneous Parameters

Cyanide was not detected in these sediment samples. The TOC ranged from 2,600 mg/kg (05SD030006) to 11,000 mg/kg (05SD040006) in these sediment samples.

5.4.6 Summary

The VOCs, 1,1-dichloroethene, benzene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride, were detected in surface soil samples at SWMU 5. Benzene, cis-1,2-dichloroethene, methylene chloride, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride were also detected in subsurface soil samples. In addition to these compounds, 1,1-dichloroethane, acetone, chloroethane, ethylbenzene, toluene, and xylenes (total) were also detected in subsurface soil samples. Chloroform (1 µ/L) and cis-1,2-dichloroethene (3 µg/L) were the only VOCs detected in ground water. The VOCs, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride were detected in surface water. Cis-1,2-Dichloroethene, methylene chloride, and trichloroethene were detected in sediment samples. The presence of VOCs in soil, ground water, surface water, and sediment suggests that VOCs are migrating from soils to surface water and sediment in nearby drainage channels and, to a lesser extent, migrating from soils to ground water.

The chlorinated VOCs, cis-1,2-dichloroethene, trichloroethene were detected in all media and vinyl chloride was detected in all media except sediment at SWMU 5. Surface soil displayed the most concentrated VOC results in the vicinity of 05SB06, 05SB07, and 05SB08, which were collected within 250 feet of each other and are located north of the main gully. There were also elevated concentrations of these compounds in subsurface soil samples taken from the 05SB03 and 05SB06 soil columns. Cis-1,2-dichloroethene was detected in ground water (well 05-15), and trichloroethene and vinyl chloride were detected in surface water at sampling location 05SW/SD02 which is downgradient (i.e., surface water flow is toward the west and southwest) of the main gully. Historical data discussed in the Risk Assessment work plan (TtNUS, August 2000a) also contained detectable concentrations of the same chlorinated VOCs. The VOC contamination at the soil borings 05SB06, 05SB07, and 05SB08 is not bounded to the north and west by soil samples of lesser VOC contamination because no soil samples were collected in those areas; however, the soil VOCs do not appear to be leaching to ground water even though these soil locations are hydraulically upgradient to other SWMU 5 areas to the north and west (Figure 5-5). The soils do appear to influence the presence of detectable VOC concentrations in sediment and surface water at locations 05SW/SD02 and 05SW/SD03. While VOC concentrations are not completely bounded in sediment and surface water, the VOC concentrations show a definite

decreasing trend toward the downgradient region. This indicates that the VOC source is near soil borings 05SB06, 05SB07, and 05SB08, and is most likely located closest to 05SB06 judging from this soil boring being located topographically higher than the other two. The fact that VOCs are unbounded will introduce additional uncertainties into the planned risk assessments, but should not prevent the completion of those assessments because the VOC concentrations do not suggest that any significant VOC sources has gone undetected. The HHRA presented in Section 5.6.1 and the ERA in Section 5.7.5 provide discussions regarding VOCs selected as COPCs for SWMU 5.

PAHs and phthalates were the only SVOCs detected in SMWU 5 environmental media. Several PAHs and bis(2-ethylhexyl) phthalate were detected in both surface and subsurface soil at similar concentrations (within the same order of magnitude). Bis 2-(ethylhexyl) phthalate was detected in a single ground water sample (05GW0801) at a concentration of 110 µg/L. No other SVOCs were detected in ground water. Bis(2-ethylhexyl) phthalate was detected in a single surface water sample (05SW0201) at a concentration of 2 µg/L. No other SVOCs were detected in surface water. Several PAHs were detected in several sediment samples at low concentrations (i.e., less than 60 µg/kg). No other SVOCs were detected in sediment samples. The upgradient (i.e., background) sediment sample location contained the most concentrated PAH results out of all SWMU 5 sediments, which could indicate other non-SWMU 5 sources. PAHs are detected in most SWMU 5 locations but are most concentrated in the vicinity of the main gully and the former burn pit. Because of this, the SVOCs are viewed to be sufficiently bounded to support the planned risk assessments. Historical data discussed in the SWMUs 4, 5, 9, and 10 work plan also contained detectable concentrations of PAHs and phthalates. The presence of PAHs may be related to site burning operations because PAHs are typical by-products of incomplete combustion. The HHRA presented in Section 5.6.1 and the ERA in Section 5.7.5 provide discussions regarding SVOCs selected as COPCs for SWMU 5.

The pesticide 4,4'-DDE was detected in one surface soil sample, 05SB080002. 4,4'-DDD, dieldrin, and methoxychlor were detected in one, one, and two of seven subsurface soil samples, respectively. The concentrations of these pesticides were low (i.e., less than 10 µg/kg), except methoxychlor in subsurface soil samples 05SB060608 (28 µg/kg) and 05SB070608 (49 µg/kg). No other pesticides were detected in SWMU 5 environmental media. There is no apparent pattern of pesticide contamination in SWMU 5 environmental media, and these pesticide concentrations are not bounded by concentrations at locations to the north and west that show decreasing trends in those directions. However, the frequencies of detection are low and the pesticide contaminants are viewed to be adequately represented by the reported concentrations. It should also be noted that historical data discussed in the SWMUs 4, 5, 9, and 10 work plan also contained detectable concentrations of pesticides. The HHRA presented in Section

5.6.1 and the ERA in Section 5.7.5 provide discussions regarding pesticides selected as COPCs for SWMU 5.

Aroclor 1254 was detected in four of eight surface soil samples at concentrations ranging from 100 µg/kg to 140 µg/kg. Aroclor 1254 and Aroclor 1260 were detected in several subsurface soil samples. Aroclor 1260 was detected in sediment sample 05SD050006 at 170 µg/kg. Otherwise, no other Aroclors were detected in SWMU 5 soil, ground water, surface water, or sediment. PCB detections are most concentrated in the area north of the main gully. Topography and spatial concentration trends suggest that any source of PCBs is near soil boring 05SB06. Because PCBs appear to be spatially localized further delineation of PCB contamination is not warranted even though they are not completely bounded. Historical data discussed in the SWMUs 4, 5, 9, and 10 work plan also contained detections of Aroclor 1254. The HHRA presented in Section 5.6.1 provides discussion regarding PCBs selected as COPCs for SWMU 5.

The herbicide compounds 2,4,5-T and pentachlorophenol were detected in several SWMU 5 surface soil samples. Pentachlorophenol was also detected in several SWMU 5 subsurface soil samples. Pentachlorophenol and hexachlorophene were detected in one sediment sample. Herbicides were not detected in ground water or surface water samples at SWMU 5. Pentachlorophenol was detected frequently in surface and subsurface soil samples across SWMU 5. These compounds were detected at low concentrations (i.e., less than 20 µg/kg). Historical data discussed in the SWMUs 4, 5, 9, and 10 work plan (TtNUS, August 2000a) also display herbicide detections at SWMU 5. The SWMUs 4, 5, 9, and 10 work plan also notes that it was common practice to treat areas alongside roadways with mixtures of herbicides. The HHRA presented in Section 5.6.1 provides discussion regarding herbicides selected as COPCs for SWMU 5. The 2,4,5-T concentrations are less than risk-based criteria (no flags on tag maps) and the pentachlorophenol concentrations, while they frequently exceed risk-based criteria, span a narrow concentration range in soil ($\leq$12 mg/kg) with most results less than 5 mg/kg. On this basis, further delineation of this chemical is not warranted.

Dioxin/furan compounds were detected in almost all surface soil, subsurface soil, and sediment samples. The majority of the soil 2,3,7,8-TCDD TEQs are in excess of background soil concentrations reported in the literature (the arithmetic mean TEQ concentration detected in soil samples representing background conditions in the United States is estimated to be 8 ng/kg). Only a few dioxin/furan compounds were detected in ground water samples; these compounds were not detected frequently. Only one dioxin/furan mixture was found in one surface water sample. Dioxin/furan detections were spatially distributed across the site. The most concentrated area of dioxin/furan contamination is in the vicinity of the old burn pit and just north of the main gully. This is consistent with knowledge of site operations because dioxins and

furans are products of combustion when sources of chlorine are present. Potential chlorine sources include chlorinated solvents, which have been detected in all of the environmental media at SWMU 5. The predominance of OCDD in the dioxin/furan mix is consistent with the combustion of wood, oil, or municipal solid waste (Navy, 2001). The concentrations detected in these sediment samples are likely to be attributable, at least in part to burning processes carried out at SWMU 5. Non site-related sources may have also contributed through airborne transport and deposition. Given that the greatest dioxin and furan concentrations have been associated with the likely source area at SWMU 5, there is no need to further delineate the extent of contaminants. The HHRA presented in Section 5.6.1 and the ERA in Section 5.7.5 provide discussions regarding pesticides selected as COPCs for SWMU 5.

Antimony concentrations in surface soil represent contamination that is most likely site-related because the observed concentrations exceed the background concentrations (Figure 5-7) and because they exceed the background surface soil UTL at some locations by approximately an order of magnitude or more (Table 3-28). Surface soil antimony concentrations exceed risk-based criteria at several locations (see Figure 5-7). The same is true of barium, chromium, copper, lead, mercury, and tin, although mercury contamination appears to be minimal. Zinc concentrations exceed background concentrations for surface Soil Group 3, but not by as large a degree as these other metals. Historical surface soil data at location 05/03-09 indicate significant metals contamination for several metals. With the exceptions of mercury and tin, the greatest concentrations of metal contaminants are located in surface soil at borings 05SB06 and 05SB02 with concentrations of each metal decreasing in an outward direction from those locations. While not all of the metal concentrations at the perimeter of the sampling pattern are comparable to background concentrations, the decreasing concentration pattern indicates that the bulk of the surface soil metals contamination is well bounded. Exceptions are discussed in the next paragraph.

The greatest surface soil concentrations of mercury appear in soil borings 05SB01 and 05SB03 at the southwestern perimeter of the sampling pattern (Figure 5-7). The greatest concentration of surface soil tin appears in soil boring 05SB08 located on the western perimeter of the sampling pattern and is unbounded by samples of lesser concentrations to the southwest, west, and northwest. However, the topography suggests that any migration in surface soils will occur in a direction that bounds the contamination because the perimeter of the sampling pattern is higher than the interior of the pattern (See Figure 1-8). In addition, most metals concentrations are well bounded in terms of greater concentrations giving way to lesser concentrations toward the sampling plan perimeter. The majority of greatest metal concentrations appear to have been located in the horizontal direction within a radius of approximately one hundred to two hundred feet.

A horizontal decrease in concentrations toward perimeter sampling locations also generally exists for subsurface soils, however, historical data indicate that metals concentrations increase in a northeasterly direction when the most recent data and the historical data are combined (USACE, 1998c). Thus subsurface metals contamination is generally well bounded laterally except in the northeasterly direction. Bounding of metal contaminants in the vertical direction is different (Figure 5-9). Metal contaminants in and around the Main Gully tend to exhibit greater concentrations in the surface than in the subsurface but metal contaminants in and around the Burn Pit tend to exhibit the opposite trend. Barium and antimony concentrations illustrate these trends on Figures 5-7 and 5-9. Copper is an exception in that the deeper samples tend to exhibit the greater concentrations in both the Main Gully and the Burn Pit, leading to the conclusion that copper contamination is not bounded in the vertical direction. The subsurface soil mercury concentration of 93.2 mg/kg at soil boring 05SB05 indicates a probable subsurface disposal because this concentration underlies a surface soil concentration of only 0.06 mg/kg. Other surface and subsurface soil mercury concentrations are much less than this concentration in both the recent and the historical data. Mercury contamination at that location is unbounded in the vertical direction. In summary, metals concentrations are well bounded in all but the northeasterly horizontal direction but the vertical bounding of metals is not as definitive, especially at the Burn Pit. Historical metals results at soil sampling locations 05/03-05 and 05/03-06 and the more recent analytical data indicate that metals concentrations are greater near the truck trailer park than they are near the Burn Pit or in the Burn Pit. It is clear that elevated concentrations of various metals to a depth of approximately eight feet bgs have been established. Additional bounding of soil metals contamination would be necessary for any future corrective actions. The measured metals concentrations are sufficient to support the planned risk assessments, although some uncertainties associated with the incomplete bounding of metals in soil exist.

Compared with metals detections in soil, a fewer number of metals were detected in ground water samples and even fewer in the filtered ground water samples. This indicates that a large fraction of the metals are associated at least in part with the suspended matter in the ground water.

Aluminum, arsenic, barium, calcium, copper, iron, lead, magnesium, manganese, selenium, sodium, and vanadium were present in ground water at concentrations in excess of upgradient concentrations at select locations (See Figure 5-10). Only barium, calcium, iron, magnesium, manganese, and sodium were detected in the filtered ground water samples. Calcium, magnesium, and sodium are not discussed further (except as warranted) because they are essential nutrients and do not pose health risks except at concentrations much greater than those observed at SWMU 5. Selenium is not discussed further because it was detected in just one well (05T03 at a low concentration of 1.4 µg/L). The site ground water arsenic concentrations are not consistent with soil arsenic concentrations. While down gradient

ground water concentrations are greater than the upgradient concentrations, the consistent spatial concentration pattern suggests that the observed ground water arsenic concentrations do not derive from site contamination. In particular, the SWMU 5 soil arsenic concentrations barely exceed upgradient concentrations and the ground water arsenic concentrations increase from the western edge of the SWMU toward the west in the downgradient direction. Ground water manganese concentrations show greater concentrations toward the northwest. Aluminum concentrations decrease from the center of SWMU 5 toward the downgradient direction. With the possible exception of manganese, all ground water metal contamination is well bounded by samples of lesser concentrations in the downgradient direction. Historical data show that the greatest manganese concentration observed previously (7,800 µg/L) was in well 05-08, which is in the northwestern portion of the SWMU (TtNUS 2000a). The manganese and other metal contamination is not bounded to the northwest of the SWMU boundary.

Antimony, barium, calcium, copper, iron, magnesium, manganese, and zinc were detected in surface water at concentrations exceeding the upstream concentration both in filtered and unfiltered surface water samples (Figure 5-11). Except for iron, these metals appear to be essentially all dissolved as evident from the results for filtered and unfiltered samples being comparable. No other surface water metal concentrations exceeded upgradient concentrations. Calcium and magnesium are not discussed further because they are essential nutrients. Antimony was detectable only at sampling location 05SW/SD05 at a value just 30 percent greater than the detection limit. This metal does not exceed a risk-base criterion and is not discussed further. Except for sampling location 05SW/SD05, surface water barium concentrations barely exceed the single upgradient location. This one elevated concentration could be an indication that barium surface water concentrations are not bounded but the concentration does not exceed any risk-based concentrations and is of little concern. Manganese and zinc concentrations exhibit an increasing trend in the downgradient direction, indicating that manganese and zinc are not bounded relative to upgradient concentrations, however the manganese is the only one of these two metals with concentrations exceeding risk based limits. Thus, the bounding of metals in surface water is generally good with the exception of manganese and zinc, and manganese is the only metal of significant concern in this regard. The elevated surface water manganese concentrations are collocated with elevated ground water manganese concentrations. Consideration to further delineation of manganese concentrations may be warranted. This is discussed further in Sections 5.6.1(human health risk assessment) and 5.7.5(ecological risk assessment).

Several metals were detected in sediments at concentrations exceeding upstream concentrations (Figure 5-12). Of these, calcium, magnesium, and potassium are not discussed because they are essential nutrients. The remaining metals in this category are aluminum, antimony, barium, cadmium, chromium, copper, lead, mercury, manganese, vanadium, and zinc. Copper, lead, and zinc are present at

concentrations that are at least two times the upstream concentration at sampling location 05SW/SD05; manganese is present at locations 05SW/SD02 and 05SW/SD03 at approximately two times the up stream concentration. Otherwise the downsteam metal concentrations appear to be only slightly elevated as compared to the upstream concentrations. With the exception of copper, lead, and zinc at sampling location 05SW/SD05, and manganese at locations 05SW/SD02 and 05SW/SD03, the observed sediment metal concentrations are likely to represent normal upgradient concentrations. This could not be demonstrated, however, because only one sediment upgradient sample was collected, so the conservative position was taken to consider metals with marginally elevated concentrations to be COPCs. Based on the spatial patterns displayed in Figure 5-12, all metals in sediment are well bounded in the downstream direction except for copper, lead, and zinc in the drainage channel associated with sampling location 05SW/SD05, and manganese in the channel associated with locations 05SW/SD02 and 05SW/SD03. However, the manganese does not exceed risk-based criteria at either of the locations. The exceedances of the upgradient concentration in the cases of copper, lead, and zinc are less than an order of magnitude and whether additional investigation of the exceedances would be warranted is open to question. Based on the above observations, it is not believed that additional delineation of metals in sediment would benefit the planned risk assessments. The elevated manganese concentrations occur in the same region as elevated surface water and ground water concentrations. This suggests a connection between these environmental media or a common source of the manganese.

The HHRA presented in Section 5.6.1 and the ERA in Section 5.7.5 provide discussions regarding metals selected as COPCs for SWMU 5.

5.5 CONTAMINANT FATE AND TRANSPORT

This section presents a brief overview of contaminant fate and transport issues at SWMU 5. This discussion focuses on some of the major types of contaminants found at the site.

The existing data for the site indicate that a release of hazardous constituents to the surrounding soil has occurred as a result of historical site operations (i.e., the burning of garbage, trash, and debris and placement of ash and residue in the gully north of the burn pit area). The historical data also indicate that residual contaminants in the soil have migrated to ground water via infiltration and percolation. Additional release mechanisms, which are also expected to contribute to the contaminant transport, include discharge of ground water to surface water and sediment (Culpepper Branch Creek), deposition via surface water runoff, and generation of fugitive dust and volatile emissions from soil.

The following classes of chemicals were detected in the media of concern at SWMU 5.

Soil - VOCs, PAHs, dioxins/furans, pesticides, PCBs, herbicides, and metals
Ground water - VOCs, dioxins/furans, and metals
Surface Water - VOCs, dioxins/furans, and metals
Sediment - VOCs, PAHs, dioxins/furans, pesticides, PCBs, herbicides, and metals

Fate and transport characteristics of these chemicals are briefly discussed in the following sections.

5.5.1 Volatile Organic Compounds

VOCs are typically considered to be fairly soluble and to have a low capacity for retention by soil organic carbon; therefore, these compounds are most frequently detected in ground water. These types of chemicals may migrate through the soil column after they are released by a spill event or by subsurface waste burial as infiltrating precipitation solubilizes them. Some portion of these chemicals is retained by the soil, but most of them will continue migrating downward until they reach the water table. At that time, migration is primarily lateral with the hydraulic gradient. They may have migrated to surface water and sediment, but attenuation and dilution factors, such as volatilization, have resulted in their disappearance.

Fourteen VOCs were detected in surface/subsurface soil samples at SWMU 5 but only two VOCs (chloroform and cis-1,2-dichloroethene) were detected in one of 14 ground water samples. The soil and ground water data indicate that, although VOCs are considered to be relatively mobile in the environment, little movement from soil to ground water has occurred at the site to date. Five chlorinated VOCs (1,1-DCE, cis/trans-1,2-DCE, TCE, and vinyl chloride) were detected in three of five surface water samples collected when the surface water was covered with ice. Because these compounds, especially vinyl chloride, volatilize rapidly from water, their presence in surface water is not expected. It is possible that there is an unidentified source of the VOCs in surface water (perhaps, ground water discharge).

5.5.2 Polycyclic Aromatic Hydrocarbons

PAHs are generally considered to be fairly immobile chemicals in the environment. They are large molecules with high organic carbon partition coefficients and low solubilities when compared to the volatile organics. These compounds, when found in the soil, generally do not migrate vertically to a great extent. Instead, they are more likely to adhere to soil particles and be removed from the site via surface runoff and erosional processes. Their absence in ground water is evidence of their immobility. Their presence in sediment may stem from surface erosion, but their absence in surface water is consistent with their low water solubilities and their ability to bind to soil and sediment.

5.5.3 Dioxins /Furans

The fate and transport characteristics of dioxins/furans are similar to those of PAHs. They generally do not migrate vertically to a great extent and tend to adhere to soil particles and to move via surface runoff and erosional processes. Their presence in sediment may stem from surface erosion, but their low frequency of detection in surface water is consistent with their low water solubilities and their ability to bind to soil and sediment. Because dioxins/furans have low solubilities in water, their presence in ground water samples at SWMU 5 is likely due to their adherence to particulate matter in the samples. However, a comparison of the concentrations of the dioxins detected in ground water at the site with published water solubilities indicates that they may be present in the dissolved phase as well.

5.5.4 Pesticides/Herbicides

Pesticides were widely used at NSWC Crane. Many of the detected compounds are no longer licensed for general sale and use in the United States. Therefore, it is assumed that much of what was detected at SWMU 5 is representative of past application for insect control.

Like PAHs, pesticides as a class of compounds are not considered to be very mobile in the environment. These chemicals, upon application or disposal, tend to remain affixed to soil particles. Migration of pesticides occurs primarily by erosion via the action of wind or water. Erosion accounts for their presence in sediment. Their absence in ground water and surface water is consistent with their ability to bind to soil and sediment and their low solubility in water.

5.5.5 Polychlorinated Biphenyls (PCBs)

PCBs are considered to be very persistent organic chemicals. Biodegradation is the only process known to transform PCBs under environmental conditions, and only the lighter compounds are measurably biodegraded. As with PAHs and pesticides, their absence in ground water and surface water is consistent with their ability to bind to soil and sediment and of their low solubility in water.

5.5.6 Inorganics

Because inorganics are frequently incorporated into the soil matrix and remain bound to particulate matter, they also migrate from the source areas via bulk movement processes (erosion). The larger particles (greater than 0.45 micron, which are removed via the filtration step prior to water analysis) are

not generally considered to be mobile in ground water. The metals detected in unfiltered ground water samples are likely to be representative of suspended soil material in the samples.

There are some instances, however, where these metals are found at such concentrations or in such form as to be able to migrate in solution. It is possible that industrial activities could saturate all available exchange sites in soil and result in a metal being mobilized. Metals are also more mobile under acidic conditions, which may exist in areas where plating-type activities have occurred. Finally, a metal solution may be utilized in some industrial applications. In these cases, it is possible for metals to migrate vertically through the soil column and reach the ground water.

5.6 HUMAN HEALTH RISK ASSESSMENT

This section presents the results of the human health risk assessment for SWMU 5. The risk evaluation was performed using the general methodologies presented in Section 3.3. Site-specific information regarding data evaluation (i.e., the selection of COPCs), exposure assessment, characterization of estimated potential human health risks, and specific uncertainties for the risk screening process for the site are contained in the following sections.

5.6.1 Selection of Chemicals of Potential Concern

A medium-specific discussion of the chemicals selected as COPCs for SWMU 5 is provided in this section.

5.6.1.1 Soil

This section presents the results of the COPC selection process for surface and subsurface soil. The COPC screening process and the results of the screening are presented in Tables 5-12 and 5-13 for surface soil and in Tables 5-14 and 5-15 for subsurface soil.

COPC Selection for Surface Soil

Three soil borings were placed in the burn pit and five soil borings were placed in the gully north of the burn pit where residual ash and metal debris were buried. The following chemicals were retained as COPCs for surface soil:

- Volatiles - 1,1-dichloroethene, benzene, cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, methylene chloride, and vinyl chloride.

- PAHs - benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene.
- Aroclor 1254.
- Pentachlorophenol.
- Dioxins/furans.
- Inorganics - antimony, barium, cadmium, chromium (total), copper, iron, lead, mercury, silver, and zinc.

COPC Selection for Surface/Subsurface Soil

Sixteen surface/subsurface soil samples were collected at SWMU 5 from depths of 2 to 10 feet bgs (the subsurface soil samples were collocated with the surface soil samples). The following chemicals were retained as COPCs for surface/subsurface soil:

- Volatiles - 1,1-dichloroethene, benzene, cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, methylene chloride, and vinyl chloride.
- PAHs - benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, 2-methylnaphthalene, and naphthalene.
- Dieldrin.
- PCBs - Aroclor 1254, Aroclor 1260.
- Pentachlorophenol.
- Dioxins/furans.
- Inorganics - antimony, arsenic, barium, cadmium, chromium(total), copper, iron, lead, manganese, mercury, nickel, silver, and zinc.

These constituents were identified as COPCs in surface and subsurface soil because maximum concentrations exceeded one or more of the human health risk screening levels for residential land use (i.e., U.S. EPA Region 9 risk-based screening levels for residential soil, U.S. EPA generic SSLs for migration to ground water, IDEM default closure levels for direct contact and migration to ground water, and representative basewide background concentrations). The maximum concentrations were also compared to U.S. EPA SSLs for migration from soil to air (inhalation). As shown in Tables 5-13 and 5-15, the maximum concentrations of all constituents were less than the inhalation SSLs. Therefore, potential risks from inhalation of chemicals detected in soil are expected to be minimal and this pathway was not evaluated further in the risk assessment. Chemicals present at concentrations greater than screening concentrations but within representative basewide background levels (aluminum, arsenic, and manganese in surface soil, and aluminum in surface/subsurface soil) are not considered to be site-related contaminants, were eliminated as COPCs, and were not carried through the quantitative risk assessment.

Migration from Soil to Ground water

As indicated in Tables 5-12, 5-13, 5-14, and 5-15, some constituents in soil were selected as COPCs because the maximum concentrations exceeded risk-based screening levels for residential soil exposure; some were selected as COPCs because they exceeded risk-based screening levels for residential soil and SSLs for migration to ground water; and some chemicals (1,1-dichloroethene, benzene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, vinyl chloride, naphthalene, 2-methylnaphthalene, dieldrin, pentachlorophenol, and silver) were selected because the maximum concentrations of these chemicals exceeded SSLs for migration to ground water only. Because the reported concentrations of these chemicals were less than the screening levels for direct contact with soil and U.S. EPA generic SSLs for inhalation, potential risks from direct exposure to these COPCs in soil are expected to be minimal. However, exceedances of U.S. EPA and IDEM migration to ground water SSLs may indicate the potential for chemicals to leach to ground water and impact water quality. Of the organic chemicals detected in soil at SWMU 5 that exceeded SSLs for migration from soil to ground water, only cis-1,2-dichloroethene was detected (in one of 14 samples) in ground water samples collected at the site. The soil and ground water data appear to indicate that little or no impact of contaminants in soil on ground water has occurred at the site. A discussion of the ground water data for SWMU 5 is provided in Section 5.6.1.2.

5.6.1.2 Ground water

Table 5-16 presents details of the COPC selection process for ground water. The COPC selection for ground water at SWMU 5 is based on analytical data for unfiltered ground water samples collected from

12 existing and three new monitoring wells installed at the site. One well, 05GW0101, located on the eastern portion of the site is upgradient of the site and was used as background for COPC selection. The following chemicals were retained as COPCs in ground water:

- Chloroform
- Bis(2-ethylhexyl) phthalate
- Dioxins/furans
- Inorganics - aluminum, arsenic, iron, and manganese

These constituents were identified as COPCs in ground water because the maximum concentrations exceeded one or more of the human health screening levels (i.e., U.S. EPA Region 9 risk-based screening concentrations, federal MCLs or SMCLs, and IDEM residential default closure levels for ground water). Two filtered samples (05GW0301-F and 05GW1301-F) were collected at the site and information provided by these samples indicates that the presence of turbidity (21 NTU in both samples) in the unfiltered sample may have affected the analytical results. For example, manganese was detected in unfiltered sample 05GW0301 at a concentration of 141 µg/L but was detected in the filtered sample at a concentration of 15.4 µg/L. Arsenic was not detected in the filtered samples and the concentrations of iron were much lower in the filtered samples than the concentrations in the unfiltered samples. This suggests that the metal concentrations may be elevated because of suspended particulate matter in the samples. Note that no chemicals were eliminated from the quantitative risk assessment on the basis of background because maximum concentrations in the site ground water samples were greater than concentrations in the upgradient well.

5.6.1.3 Surface Water

Table 5-17 summarizes the COPC selection process for surface water at SWMU 5. Four surface water samples were collected at the site. Two samples were collected in the western portion of the site, one sample (05SW0501) was collected from an unnamed tributary in the southern portion, and one sample (05SWD02) was sampled to monitor stream conditions in the gully at the site. This sample was located in an unnamed tributary at the gully northwest of the burn pit. One sample, 05SW0101, located on the northern portion of the site, was used as the upgradient location for COPC selection. Four filtered samples were also collected from the surface water locations. There is no significant difference between the filtered and unfiltered results, indicating that turbidity did not greatly impact the unfiltered sample results.

The following chemicals were retained as COPCs in surface water:

- Volatiles - 1,1-dichloroethene, cis-1,2-dichloroethene, trichloroethene, and vinyl chloride
- Inorganics - aluminum, arsenic, iron, and manganese

These constituents were identified as COPCs in surface water because the maximum concentrations exceeded one or more of the human health screening levels (i.e., U.S. EPA Region 9 risk-based screening concentrations, federal MCLs or SMCLs, and IDEM residential default closure levels for ground water) and concentrations in the upgradient sample. Note that the use of these criteria for surface water assumes that the surface water is used as a drinking source (i.e., potential receptors ingest 2 liters of water per day/350 days per year). Drinking water criteria are used because surface water criteria for human health are currently not available. The use of these criteria for screening and risk assessment is conservative because it is unlikely that the water in the creek or marshy area would ever be used as a source of drinking water. No constituents were eliminated as COPCs in surface water on the basis of background. Maximum site concentrations of arsenic were only slightly greater than the concentrations in the upgradient sample, and the concentrations of arsenic in the other samples were generally lower than the concentrations in the upgradient sample. It is therefore likely that the concentrations of arsenic are naturally occurring at the site.

5.6.1.4 Sediment

Table 5-18 summarizes the COPC selection process for sediment at SWMU 5. Five sediment samples (including the upgradient sample) collocated with the surface water samples were collected during the investigation. The following chemicals were retained as COPCs in sediment:

- Dioxins/furans
- Inorganics - aluminum, antimony, and manganese

These constituents were identified as COPCs in sediment because maximum concentrations exceeded U.S. EPA Region 9 risk-based screening levels for residential soil, IDEM default closure levels for direct contact, and concentrations in the upgradient sample (05SD010006). The use of the U.S. EPA Region 9 and IDEM risk-based concentrations for soil to evaluate COPC concentrations in sediment is conservative because these criteria were established assuming residential land use scenarios (e.g., routine daily contact with soils). However, it is anticipated that a human receptor would be exposed to the sediments in the streams and marshy areas of the site on a less frequent basis than is assumed for a typical residential exposure to soil. Consequently, the use of soil criteria for screening and risk estimation is likely to overestimate potential risks from exposure to sediment. Chemicals present at concentrations

greater than screening concentrations but less than concentrations in the upgradient sample (arsenic and iron) are not considered to be site-related contaminants, were eliminated as COPCs, and were not carried through the quantitative risk assessment.

5.6.2 Exposure Assessment

This section presents the exposure assessment for SWMU 5. The general exposure assessment approach and the exposure factors, which serve as the basis of the risk assessment, are provided in Section 3.3.3. Exposure point concentrations for chemicals of potential concern are summarized in Table 5-19.

5.6.2.1 Conceptual Site Model – SWMU 5

The CSM for the Old Burn Pit, which defines the contaminant source, transport mechanisms, exposure routes, and potential receptors for the site, is presented as Figure 5-13. Based on a review of the existing data for the site, a release of hazardous constituents to the surrounding soil has occurred as a result of historical site operations (i.e., the burning of garbage, trash, and debris and placement of ash and residue in the gully north of the burn pit area). The historical data also indicate that residual contaminants in the soil have migrated to ground water via infiltration and percolation. Additional release mechanisms, which are also expected to contribute to the contaminant transport, include discharge of ground water to surface water and sediment (Culpepper Branch Creek), deposition via surface water runoff, and generation of fugitive dust and volatile emissions from soil.

Current and likely future land use at the Old Burn Pit is expected to be limited. As mentioned previously, the site is currently inactive; no waste disposal activities occur at the site under current land use. All hazardous waste generated by NSWC Crane operations is disposed accordingly. All other refuse is disposed in NSWC Crane's sanitary landfill.

Based on the general scenarios and receptor classes identified in Section 3.3, the following potential receptors may be exposed to contaminated media at the site:

- Trespassers (ages 6 to 17 years) - Likely receptor under current and 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 (i.e., the site is not patrolled or enclosed by a fence). In addition, hunting activities are permitted at the base. Given that the site is near a forested area, hunters may trespass onto the site.

This receptor may be exposed to potentially contaminated surface soil, air, and surface water and sediment in Culpepper Branch Creek.

- Maintenance Workers - Likely receptor under future land use. This receptor may be exposed to potentially contaminated surface soil and air. Exposure to ground water at the site and surface water and sediment in Culpepper Branch Creek is not expected to occur.

- Construction Workers - Potential receptor under future land use. No construction activities are currently planned at the site. In addition, the shallow depth to ground water (as shallow as 4 feet bgs) and the topography of a majority of the site (i.e., the gully) would likely preclude development of the area. However, a small, short-term construction project, such as a utility installation, could result in exposure to potentially contaminated media. This receptor may be exposed to surface and subsurface soil, air, and ground water.

- Recreational Users - Potential receptor under future land use. If the facility were to close, the most likely scenario is that the property would be converted into a state park. This receptor may be exposed to potentially contaminated surface soil, air, and surface water and sediment in Culpepper Branch Creek.

- Residents - Potential receptor under future land use. As mentioned previously, development of the site would be unlikely because of the shallow depth to ground water and the nature of the site. However, other areas of the facility could be developed for residential purposes, if the facility were to close. Future residents may be exposed to potentially contaminated surface soil, air, ground water, and surface water and sediment in Culpepper Branch Creek. Although this scenario is highly unlikely, a future residential scenario is typically evaluated in the 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.

Table 5-19 presents a summary of the potentially complete and incomplete exposure pathways for potential receptors at SWMU 5. Details regarding the assumed receptor characteristics (intake rate, frequency and duration of exposure, body weight, etc.) are defined in Section 3.3, which presents the methodologies for the human health risk assessment.

As indicated in Section 3.3.3, the following exposure pathways are evaluated in the human health risk for SWMU 5.

- Ingestion of soil, sediment, ground water, and surface water
- Dermal contact with soil, sediment, ground water, and surface water
- Inhalation of air (transfers from soil to air)
- Inhalation of air (transfers from ground water to air for volatiles only)

Based on the human health risk screening presented in Table 5-13 (surface soil) and Table 5-15 (subsurface soil), exposure via inhalation of contaminants migrating from soil to air is not expected to be a significant exposure pathway. Maximum site concentrations do not exceed the available U.S. EPA generic SSLs for transfers from soil to air. In addition, a large portion of the site is overgrown with vegetation, which would limit emissions and mechanical suspension of soil particulates. Because one VOC, chloroform, was detected in ground water, the inhalation while showering pathway is quantified for hypothetical future residents in the risk assessment.

95% UCLs were used as the EPCs for surface/subsurface soil and ground water. Maximum detected concentrations were used as EPCs for surface soil, surface water, and sediment because the datasets consisted of fewer than 10 samples. The EPCs for those chemicals identified as COPCs in surface soil, subsurface soil, ground water, surface water, and sediment at SWMU 5 are presented in Table 5-20.

5.6.3 Risk Characterization.

This section contains a summary of the human health risk assessment for SWMU 5. Uncertainties associated with the risk estimates are discussed in Section 5.6.4. The methodology used to calculate the risks presented in this section is provided in Section 3.3. Quantitative risk estimates for potential human receptors are developed for those chemicals identified as COPCs. Potential noncarcinogenic and carcinogenic risks for the construction worker, maintenance worker, adult recreational user, adolescent trespasser, and future residents (adult and child) under the RME and CTE scenarios are summarized in Tables 5-21 and 5-22, respectively. The RAGS Part D Table 9s in Appendix G.3 provide the chemical-specific risks for each COPC and the total HIs for affected target organs. Risks for each receptor are summed across all applicable exposure routes. Example risk spreadsheets containing the detailed, chemical-specific risks are included in Appendix G.1. A discussion of the estimated noncarcinogenic and carcinogenic risks is provided in the remainder of this section.

Noncarcinogenic Risks – RME

Cumulative HIs for the maintenance worker, adult recreational user, and adolescent trespasser under the RME scenario are less than unity (1), indicating that no toxic effects are anticipated for these receptors

under the defined exposure conditions. Cumulative HIs for the construction worker, future adult, and child resident exceed unity.

The cumulative HI for the excavation worker is 3.7. The major contributor to this elevated HI is antimony (HI = 2.1) by incidental ingestion of surface/subsurface soil. Note that the construction worker was assumed to be exposed to the maximum concentration detected in soil (301 mg/kg) because the 95 percent lognormal UCL exceeded the maximum concentration. Antimony was detected in 13 of 15 surface/subsurface soil samples; the maximum concentration occurred in surface soil sample 05SB060002. This sample also contained the highest concentration of lead detected at the site (16,900 mg/kg). Lead-antimony alloy is used in the manufacture of storage batteries, lead shot, and lead electrodes, and elevated concentrations of antimony and lead in this sample may be the result of the disposal of scrap metal and debris that are known to have occurred at the site. The concentrations of antimony and lead were much lower in the other soil samples. Therefore, this sample may represent a hotspot at the site.

Cumulative HIs for the future adult and child residents are 5.6 and 27, respectively. These elevated risks result from exposure to antimony (adult HI = 1.0, child HI = 9.6) and iron (adult HI = 0.24, child HI = 2.2) in surface soil, and to manganese (adult HI = 2.9, child HI = 10) in ground water, primarily by ingestion.

The HIs calculated for the hypothetical future resident are subject to the following sources of uncertainty:

- Risks from exposure to manganese in ground water were based on the maximum detected concentration because the maximum concentration exceeded the 95% UCL. As discussed previously, the risk estimates are based on analytical results for unfiltered ground water samples. Based on results from the two filtered samples collected at the site, the presence of particulate matter in the unfiltered samples may have affected the analytical results.

- There is uncertainty associated with the toxicity criteria used to estimate potential risks for iron. The NCEA provisional RfD for iron, which is based on allowable daily intakes rather than adverse effect levels, was used to quantify risks from exposure to iron. Since the provisional RfDs are not based on adverse health effects, the risks associated with iron are likely to be overestimated.

- Potential receptors were assumed to be exposed to the maximum concentration of antimony detected in soil (301 mg/kg) because the 95 percent lognormal UCL exceeded the maximum concentration. The assumption of exposure to the maximum concentration results in an overestimation of risk. As previously noted, concentrations of antimony in the other soil samples were much less than the

maximum concentration (average concentration of antimony in the other samples is approximately 35 mg/kg).

- The residential ground water scenario assumes that ground water at the site is used as a source of domestic drinking water. However, because of the shallow depth to ground water and the nature of the site, it is unlikely that ground water at the site would be used as a source of potable water in the future.

The HIs associated with direct exposure to surface water and sediment at the site are minimal for all receptors (i.e., HIs are less than unity).

Carcinogenic Risks

Cumulative ILCRs for the construction worker, maintenance worker, adult recreational user, and adolescent trespasser are within the U.S. EPA target risk range, $1x10^{-6}$ to $1x10^{-4}$. The total residential ILCR (adult + child) is $8.6x10^{-4}$, which exceeds the target risk range.

The elevated carcinogenic risks for residents are primarily a result of exposure to dioxins/furans in soil and ground water (mainly by dermal contact) and to vinyl chloride in surface water. Dioxins/furans (total residential soil ILCR = $5.7x10^{-5}$ and total ground water ILCR = $4.1x10^{-4}$) account for approximately 55 percent of the total residential carcinogenic risk, and hypothetical future residential exposure to vinyl chloride in surface water (ILCR = $3.2x10^{-4}$) accounts for approximately 38 percent of the total risk.

The elevated potential carcinogenic risks calculated for the hypothetical future resident are subject to the following sources of uncertainty:

- The residential ground water scenario assumes that ground water at the site is used as a source of domestic drinking water. However, because of the shallow depth to ground water and the nature of the site, it is unlikely that residences would be constructed at the site. Therefore ground water at the site would be used as a source of potable water in the future.

- The risks from dermal exposure to dioxins/furans in ground water account for approximately 95 percent of the risks from dioxins/furans in ground water. Risks from dermal contact are an order of magnitude greater than risks from ingestion (note that risks from ingestion are within U.S. EPA's target risk range). Dermal risks from ground water were estimated by a U.S. EPA model (U.S. EPA, 2000) and may not reflect actual chemical intakes.

- Although the maximum concentrations of dioxins/furans in soil in terms of 2,3,7,8-TCDD TEQs (0.226 µg/kg in surface soil and 0.464 µg/kg in surface/subsurface soil) exceeded risk-based screening levels, these TEQs are less than the preliminary remediation goal of 1 µg/kg established for 2,3,7,8-TCDD TEQs in U.S. EPA OSWER 9200.4-26. The maximum TEQ for dioxins in ground water (1.59 pg/L) is approximately 15 times less than the current MCL for 2,3,7,8-TCDD (30 pg/L).

- The risks calculated for vinyl chloride are subject to a number of important uncertainties that tend to overestimate potential risks. Vinyl chloride was detected in two of four surface water samples and risks were calculated based on exposure to the maximum detected concentration. Field notes indicate that the water was covered with ice at the time of sampling. Because vinyl chloride is extremely volatile, it is unlikely that the sampled concentrations would be present in surface water for most of the year. Residential risks from surface water are based on the assumption that hypothetical future residents would be exposed to surface water 350 days a year for 30 years. This assumption overestimates risks because a human receptor would be exposed to the surface water and sediments on a less frequent basis than is assumed for a typical residential exposure to drinking water and soil. Risks for the more reasonable exposure scenarios (i.e., the adolescent trespasser and the adult recreational user) were within U.S. EPA's target risk range.

The carcinogenic risks associated with exposure to other media at the site are minimal for all receptors (i.e., ILCRs are less than or within the U.S. EPA target risk range).

The significant sources of uncertainty are further discussed in Section 5.6.4.

5.6.3.1 Exposure to Lead

Lead was identified as a COPC for surface and surface/subsurface soil at SWMU 5 because maximum detected concentrations (16,900 mg/kg) exceed the 400 mg/kg OSWER soil screening level for residential land use. The maximum lead concentration was detected in surface soil sample 05SB060002. As discussed previously, this sample also contains the highest concentration of antimony in soil at the site. Lead-antimony alloy is commonly used in the manufacture of some lead products, such as storage batteries, and it is likely that the lead (and antimony) concentrations at these locations are attributable to past disposal practices at the site. The average lead concentration in the other surface soil samples collected at the site is 220 mg/kg, which is less than the 400 mg/kg screening level. However, the average concentration of lead in subsurface soil at the site was greater than 1,000 mg/kg. The soil in the vicinity of sample 05SB060002 may represent a hotspot area at the site.

Published toxicity criteria (cancer slope factors, reference doses) are not currently available for lead. U.S. EPA recommends that environmental lead exposures be evaluated using the IEUBK model (U.S. EPA, 1994b) and the Recommendations of the Technical Review Workgroup (TRW) model (U.S. EPA, 1996c) for residential and non-residential exposure scenarios, respectively. The blood-lead concentration of a receptor is considered a key indicator of the potential for adverse health effects. The IEUBK and TRW models calculate the probability of a receptor's blood-lead level exceeding 10 µg/dL. The U.S. EPA goal is to limit the childhood risk of exceeding a 10 µg/dL blood-lead concentration to five percent.

Child Lead Model Results

Current U.S. EPA guidance recommends using the average concentration to evaluate exposure to lead. Therefore, the average lead concentration in surface soil (2,275 mg/kg), the average concentration in surface/subsurface soil (1710 mg/kg), and model default values for other model parameters were used in the IEUBK and TRW model analyses. The results of the IEUBK model evaluation for surface soil indicate that the estimated geometric mean blood-lead level for a child resident is 16.25 µg/dL. This blood-lead level is greater than the established level of concern (10 µg/dL). Approximately 83.75 percent of children assumed to be exposed to surface soil are expected to experience blood-lead levels greater than 10 µg/dL. This estimate is greater than U.S. EPA's goal of limiting exposure to lead so that no more than five percent of the exposed children have an estimated blood-lead level greater than the established level of concern (i.e., 10 µg/dL).

The results of the IEUBK model analysis indicate that blood-lead levels of children exposed to lead in surface soil at SWMU 5 may be greater than 10 µg/dL. If the hotspot area were to be removed, the average surface soil would be 220 mg/kg and lead would not have been selected as a COPC for the site. The results of the IEUBK model are presented in Appendix G.1.

Adult Lead Model Results

The central estimate blood-lead levels for the construction worker exposed to the average concentration of lead (1,710 mg/kg) in surface/subsurface soil ranged from 5.07 µg/dL to 5.57 µg/dL. This range is less than the established level of concern (10 µg/dL). The central estimate of blood-lead concentrations for fetuses carried by construction workers exposed to surface soil also ranged from 4.57 µg/dL to 5.02 µg/dL. These levels are less than the acceptable level of lead in fetal blood (10 µg/dL of blood). The probabilities that the child blood-lead levels would be greater than 10 µg lead/dL of blood ranged from 9.11 to 17.62 percent. This estimate is greater than U.S. EPA's goal of limiting exposure to lead so that

no more than five percent of the exposed children have an estimated blood-lead level greater than the established level of concern (i.e., 10 µg/dL).

The central estimate blood-lead levels predicted for the adult recreational user and maintenance worker exposed to surface soil (2,275 mg/kg) and to fetuses carried by these receptors were also less than the level of concern. Blood-lead levels predicted for the adult recreational user ranged from 3.26 µg/dL to 3.76 µg/dL, and the blood-lead levels for the maintenance worker ranged from 2.42 µg/dL to 2.92 µg/dL. The central estimate of blood-lead concentrations for fetuses carried by recreational users and maintenance workers exposed to surface soil were also less than the level of concern. The probability of a recreational user bearing a child with fetal blood levels exceeding 10 µg/dL ranged from 1.4 to 7.19 percent and the probability of a maintenance worker bearing a child with fetal blood levels exceeding 10 µg/dL ranged from 0.47 to 3.58 percent. The probability range for the maintenance worker was less than the goal of five percent, and the range for the recreational user slightly exceeds U.S. EPA's goal that no more than five percent of the exposed children would have an estimated blood-lead level greater than the established level of concern.

Results of the TRW adult lead model indicate that predicted blood levels for potential receptors and their fetuses were acceptable. However, the probability of construction workers having children with blood-lead levels greater than 10 µg/dL slightly exceeded U.S. EPA's goal of five percent. The results of the TRW modeling are presented in Appendix G.1.

5.6.3.2 CTE Evaluation

As discussed in Section 3.3.2.2, an evaluation of the potential risks associated with the CTE scenario is included to provide a measure of the central or average case exposure. Summaries of the estimated risks for the CTE scenarios are contained in Table 5-22.

Cumulative HIs for the maintenance worker, adult recreational user, and adolescent trespasser under the CTE scenario are less than unity (1), indicating that no toxic effects are anticipated for these receptors under the CTE exposure conditions. Cumulative HIs for future construction workers, adult residents, and child residents exceed unity. The cumulative HIs for the CTE for the construction worker, future adult, and child residents are 1.9, 3.2, and 10, respectively. The HIs exceeding 1 result from exposure to antimony and iron in surface soil and to manganese in ground water.

The cumulative ILCR for the maintenance worker is less than U.S. EPA target risk range, $1x10^{-6}$ to $1x10^{-4}$, the ILCRs for the future construction worker, adult recreational user, and adolescent trespasser are within

the U.S. EPA target risk range, and ILCRs for future residents (adult + child) exceed $1x10^{-4}$. The elevated CTE risks for residents are primarily a result of exposure to dioxins/furans in ground water (primarily by dermal contact).

5.6.3.3 Evaluation of Chemicals Eliminated on the Basis of Background Comparison

This following chemicals were eliminated as COPCs solely on the basis of comparison to background.

Surface chemicals eliminated on the basis of background: Al, As, Mn.

Subsurface soils eliminated on the basis of background: Al.

Ground water: None.

Surface water: None.

Sediment: As, Fe.

Qualitative Risk Evaluation of Metals Eliminated as COPCS Based on Background Comparison.

Aluminum, arsenic, iron, and manganese were detected in soils and/or sediments at concentrations exceeding the conservative screening levels established for COPC selection but were not selected as COPCs because study area concentrations did not exceed background concentrations. The following table provides a qualitative risk evaluation of these metals by comparing the maximum detected concentrations to the EPA Region 9 PRGs for residential and industrial soil exposure.

Parameter	Surface Soil Concentration (mg/kg)	Subsurface Soil Concentration (mg/kg)	Sediment Concentration (mg/kg)	Region 9 Residential (mg/kg)	Region 9 Industrial PRG (mg/kg)	Literature Background (mg/kg)
Aluminum	14,800	15,700		76,000	100,000	10,000 – 300,000
Arsenic	26.8		5.3	0.39	1.6	0.1 - 97
Iron			14,000	23,000	100,000	7,000 – 555,000
Manganese	1,170			1,800	19,000	100 – 4,000

The PRGs presented for aluminum, iron, and manganese are based on the potential for non-cancer health effects (the values are 10 times the COPC screening levels used in this HHRA). The maximum detected concentration of aluminum is approximately one-fifth the relevant residential PRG, and one-sixth

the relevant industrial PRG. However, based on toxicity information provided by EPA Region 1, the Region 9 PRG for aluminum is very conservative and may over predict the potential for non-cancer effects. The maximum detected concentration of manganese is approximately two-thirds the relevant residential PRG, and one-sixteenth of the relevant industrial PRG. The maximum detected concentration of iron does not exceed the PRG. The PRG for iron is a very conservative risk-based concentration based on a recommended daily intake for iron. The PRG presented for arsenic is based on the potential for cancer effects and represent the 1 $x10^{-6}$ (one-in-one-million) cancer risk level (the values are the COPC screening levels used in this HHRA). PRGs representing the 1 $x10^{-5}$ and 1 $x10^{-4}$ cancer risk levels would be 10 and 100 times the values presented for the 1 $x10^{-6}$ cancer risk level. Consequently, the maximum detected concentration of arsenic exceeds the 1 $x10^{-6}$ and 1 $x10^{-5}$ cancer risk levels, but not the1 $x10^{-4}$ risk level. Additionally, as indicated above, the metals concentrations reported in the soils and sediments are within the background range reported in the literature.

No metals in ground water or surface water were eliminated as COPCs on the basis of background because the study area concentrations did not exceed background levels.

5.6.4 Uncertainty Analysis

A summary of the uncertainties specific to the human health risk screening for SWMU 5 is included in this section. The impact of a particular uncertainty on the results of the risk screening is also identified. General uncertainties associated with the risk estimates were discussed in Section 3.3.5.

5.6.4.1 Uncertainty in the Analytical Data

The databases for surface soil, surface water, and sediment at SWMU 5 contain fewer than 10 samples. However, the field sampling program for SWMU 5 was biased toward the areas most likely to demonstrate contamination (e.g., places where ash and debris were known to be buried, where disposal activities were noted, PID readings). The fact that only a small number of samples is used to estimate risks can result in uncertainty both with regard to the COPC selection and in the EPCs used to estimate potential risks. This may result in an overestimation of risks because maximum concentrations are used as EPCs when datasets contain fewer than 10 samples.

Vinyl chloride was identified as a risk driver for surface water. As stated previously, field notes indicate that the water was covered with ice at the time of sampling. Because vinyl chloride is extremely volatile, it is unlikely that the sampled concentrations would be present in surface water most of the year.

Therefore, the risks from exposure to vinyl chloride (and other volatiles detected in surface water) may be overestimated.

5.6.4.2 Uncertainty Associated with COPC Selection

Some constituents identified as COPCs in soil (especially chlorinated volatile organics) were conservatively selected as COPCs because maximum concentrations exceeded U.S. EPA and IDEM SSLs for migration from soil to ground water using a dilution and attenuation factor (DAF) of 1. However, U.S. EPA's Soil Screening Guidance (U.S. EPA, 1996a) states "The EPA has selected a default DAF of 20 to account for contaminant dilution and attenuation during transport through the saturated zone to a compliance point (i.e., receptor well). At most sites, this adjustment will more accurately reflect a contaminant's threat to ground water resources than assuming a DAF of 1 (i.e., no dilution or attenuation)." The guidance further states, "A DAF of 20 is protective for sources up to 0.5 acres in size" and "can be protective of larger sources as well." If a DAF of 20 had been used in the COPC selection process, some compounds, for example, methylene chloride, would not have been selected as COPCs. However, use of a DAF of 1 for screening is not expected to significantly affect the results of the risk assessment because the risks calculated for COPCs selected by a DAF of 1 were minimal.

COPCs for ground water were selected based on the analytical results from unfiltered ground water samples but data from the two filtered samples collected at the site indicate that turbidity in the samples may have affected analytical results. Therefore, it is possible that risk estimates based on the unfiltered ground water samples are overestimated.

Drinking water criteria were used as the basis of screening levels for surface water and residential soil criteria were use for sediment. This assumes that the surface water is used as a drinking source (i.e., potential receptors ingest 2 liters of water per day/350 days per year) and potential receptors are exposed to sediment on a daily basis (i.e., 350 days per year). Drinking water criteria are used because surface water criteria for human health are currently not available. The use of these criteria for screening and risk assessment is conservative because it is unlikely that the water in the creek, drainageways, or marshy areas would ever be used as a source of drinking water. In addition, exposure to sediments in the streams and marshy areas of the site is expected to occur on a less frequent basis than is assumed for a typical residential exposure to soil.

5.6.4.3 Uncertainty Associated with the Use of Background

Aluminum, arsenic, and manganese in surface soil and aluminum in surface/subsurface soil were eliminated from the list of COPCs for SWMU 5 because statistical analyses indicate that concentrations of these chemicals are within representative basewide background levels. Omission of these chemicals from the risk evaluation may underestimate the potential risks for exposure at SWMU 5. However, a high level of confidence is associated with the representative basewide background concentrations. Numerous background samples were collected during the Crane Background Soil Investigation. Additionally, the resultant background data were evaluated for outliers and statistically evaluated using various testing methods, which leads to a high degree of confidence in the established representative concentrations. Consequently, omission of these metals from the soil risk assessment is unlikely to result in an underestimation of site-related chemical risks for SWMU 5.

Since basewide background data are not available for ground water, surface water, and sediment, concentrations in upgradient samples were used for background comparison by comparing the maximum site concentration of a constituent with the concentration in the sample from the upgradient location. This method of screening inorganic compounds may result in retention of inorganic compounds as COPCs that would not have been selected as COPCs based on a more rigorous statistical background evaluation. Therefore, risks for these media may be overestimated.

5.6.4.4 Uncertainty in the Exposure Assessment

General uncertainties associated with the exposure assessment are discussed in Section 3.3.1.5.2. A major source of uncertainty for SWMU 5 is the assumption of future residential use of the site, especially with regard to assumed residential exposure to COPCs in surface water and sediment. As stated previously, development of the site is unlikely because of the shallow depth to ground water and the nature of the site. Therefore, the calculated theoretical residential risks for soil, ground water, surface water, and sediment do not represent current site usage and overestimate risks for receptors under current and anticipated future land use patterns.

Risks from exposure to ground water were based on the assumption that the ground water at the site is used as a source of domestic drinking water. The residential drinking water scenario is evaluated to be conservative because ground water at the site is not used and is not expected to be used as a source of potable water.

Current U.S. EPA guidance (U.S. EPA, 2000) does not provide dermal absorption factors for exposure to volatiles and most metals (except arsenic and cadmium) in soil. Therefore, risks for dermal contact from soil are not evaluated for volatiles and most metals in this risk assessment. Consequently, risks from exposure to soil may be underestimated by omitting dermal exposure to volatiles and metals from the quantitative risk assessment.

5.6.4.5 Uncertainty in the Toxicity Criteria

Aluminum and/or iron were identified as COPCs for ground water, surface water, and sediment at SWMU 5. There is uncertainty associated with the toxicity criteria used to estimate potential risks for these chemicals. NCEA provisional RfDs for aluminum and iron, which are based on allowable daily intakes rather than adverse effect levels, were used to quantify risks from exposure to these constituents. Since the provisional RfDs are not based on adverse health effects, the risks associated with these chemicals are expected to be overstated. Additionally, risks calculated for iron are based on a RfD of 0.6 mg/kg/day. However, based on U.S. EPA Region 3 guidance received in March 2000, this RfD is not recommended for the evaluation of childhood exposures. The nutritional needs of children differ from adults, and a more appropriate RfD for children would be 1.1 mg/kg/day. Consequently, risks calculated for the child resident for exposure to iron may be overestimated by a factor of 1.83 (1.1/0.6).

Arsenic was identified as a COPC in ground water. Although the more restrictive basis for evaluating risk associated with exposure to arsenic is to assume it is a carcinogen, carcinogenic effects are not primary health effects expected to be manifested upon exposure to arsenic. The preponderance of scientific information indicates that humans are capable of metabolizing arsenic to expedite its elimination from the body. Its elimination from the body obviously mitigates the possibility for arsenic to manifest carcinogenic effects. Therefore, evaluating arsenic as a noncarcinogen would be more appropriate. Specifically, the body methylates the arsenic to form monomethyl arsenic and dimethyl arsenic. There is a limited capacity for the body to metabolize methylated arsenic, but this limit is generally reached when the body's intake of arsenic approximately exceeds 500 µg/day. The maximum detected concentration of arsenic in ground water at the site is 1.6 µg/L. Assuming a water ingestion rate of 2 liters per day, exposure to this concentration corresponds to an approximate intake of 3.2 µg/day for exposure to ground water. This intake is well within the body's ability to metabolize arsenic. Although some humans may be more sensitive to arsenic, in that they are poor methylators, the maximum exposure concentration for the site is more than an order of magnitude below the normal limit of metabolic saturation and is most likely below levels that would trigger responses in sensitive individuals. Note that the maximum concentration of arsenic is less than the current MCL for arsenic (50 µg/L) and the recently proposed MCL (10 µg/L).

5.6.5 Summary and Conclusions

This section summarizes the results of the human health risk assessment performed for SWMU 5. A brief summary of the information contained in the human health risk assessment is provided.

SWMU 5 is an inactive site that was used from 1942 to 1972. Undefined amounts of rubbish including wood, paper, construction material, and industrial wastes were burned at the site in the burn pit area. Reportedly, no explosive materials or wastes were burned at the Old Burn Pit. Residual ash and metal debris from the burning activities were buried in the gully north of the burn pit area. This area currently contains miscellaneous metal debris, including decomposed drums and other metal objects that are partially buried or exposed. Currently, the burn pit area of the site has been covered with gravel and is used as a parking area for delivery trailers. The gully north of the former burn pit area has been revegetated.

The baseline human health risk assessment for SWMU 5 was performed to characterize the potential risks to likely human receptors under current and future land use. Potential receptors under current land use are adolescent trespassers. Potential receptors under future land use are construction workers, maintenance workers, recreational users, and hypothetical residents (adults and children). Although future land use is likely to be the same as current land use, the potential future receptors were evaluated in the baseline human health risk assessment, primarily for decision-making purposes. The evaluation of these receptors is based on the assumption that, if various site conditions were to change in the future, potential exposure could occur if the site were developed.

Potential risks associated with inhalation exposures are considered to be minimal. Inhalation of volatile emissions and fugitive dust was evaluated qualitatively via a comparison of site data with U.S. EPA generic SSLs for transfers from soil to air. Inhalation exposure was considered to be relatively insignificant because all detected soil concentrations were less than the SSLs. In addition, the majority of the site is vegetated, thereby reducing the generation of fugitive dust via wind erosion. Inhalation of volatiles from surface water and sediment was considered to result in insignificant exposures compared to ingestion and dermal exposures. The inhalation of volatiles from ground water that could occur during showering, bathing, and other routine household activities was evaluated for SWMU 5 because one VOC (chloroform) was identified as a COPC in ground water.

The list of COPCs for SWMU 5 includes the following:

- Surface soil - 1,1-dichloroethene, benzene, cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, methylene chloride, vinyl chloride, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, Aroclor 1254, pentachlorophenol, dioxins/furans, antimony, barium, cadmium, chromium(total), copper, iron, lead, mercury, silver, and zinc.

- Surface/subsurface soil - 1,1-dichloroethene, benzene, cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, methylene chloride, vinyl chloride, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, 2-methylnaphthalene, naphthalene, dieldrin, Aroclor 1254, Aroclor 1260, pentachlorophenol, dioxins/furans, antimony, arsenic, barium, cadmium, chromium(total), copper, iron, lead, manganese, mercury, nickel, silver, and zinc.

- Ground water - chloroform, bis(2-ethylhexyl) phthalate, dioxins/furans, aluminum, arsenic, iron, and manganese.

- Surface water - 1,1-dichloroethene, cis-1,2-dichloroethene, trichloroethene, vinyl chloride, aluminum, arsenic, iron, and manganese.

- Sediment - dioxins/furans, aluminum, antimony, and manganese.

Quantitative estimates of noncarcinogenic and carcinogenic risks (HIs and ILCRs, respectively) were developed for potential human receptors. Minimal risks (i.e., HIs less than unity and ILCRs within the U.S. EPA target risk range) were calculated for maintenance workers, adult recreational users, and adolescent trespassers. Risks greater than U.S. EPA benchmarks were estimated for construction workers and residents (child and adult) under future land use. The cumulative HIs for future construction workers and for future adult and child residents exceeded unity and the cumulative ILCRs for future residents (adult + child) exceeded 1.0×10^{-4}, the upper limit of the U.S. EPA target risk range.

The elevated HI for the construction worker was due to exposure to antimony in surface/subsurface soil, primarily by ingestion. The construction worker was assumed to be exposed to the maximum concentration of antimony detected in soil (301 mg/kg) because the 95 percent lognormal UCL exceeded the maximum concentration. The maximum concentration occurred in surface soil sample 05SB060002. This sample also contained the highest concentration of lead detected at the site (16,900 mg/kg). Lead-antimony alloy is used in the manufacture of storage batteries, lead shot, and lead electrodes, and elevated concentrations of antimony and lead in this sample may be the result of the disposal of scrap metal and debris that is known to have occurred at the site. The concentrations of antimony and lead were much lower in the other soil samples. Therefore, this sample may represent a hotspot at the site.

The elevated HIs for future residents were the result of exposure to antimony and iron in surface soil and to manganese in ground water, primarily by ingestion. The elevated ILCRs for the future residents were the result of exposure to dioxins/furans in soil and ground water (mainly by dermal contact) and to vinyl chloride in surface water. However, significant uncertainties were associated with the risks calculated for SWMU 5:

- Risks from exposure to manganese in ground water were based on the maximum detected concentration because the maximum concentration exceeded the 95% UCL. Also, as discussed previously, the risk estimates are based on analytical results for unfiltered ground water samples. Analytical results from the two filtered samples collected at the site indicate that the presence of particulate matter in the unfiltered samples may have affected the analytical results.

- There is uncertainty associated with the toxicity criteria used to estimate potential risks for iron. The NCEA provisional RfD for iron, which is based on allowable daily intakes rather than adverse effect levels, was used to quantify risks from exposure to iron. Since the provisional RfDs are not based on adverse health effects, the risks associated with iron are expected to be overestimated.

- Potential receptors were assumed to be exposed to the maximum concentration of antimony detected in soil (301 mg/kg) because the 95 percent lognormal UCL exceeded the maximum concentration. The assumption of exposure to the maximum concentration results in an overestimation of risk. The concentrations of antimony in the other soil samples were much less than the maximum concentration (average concentration of antimony in the other samples is approximately 35 mg/kg), and antimony (and lead) concentrations at location 05SB06 may represent a hotspot condition at the site.

- The risks from dermal exposure to dioxins/furans in ground water account for approximately 95 percent of the risks from dioxins/furans in ground water. Risks from dermal contact are an order of magnitude greater than risks from ingestion (Note that risks from ingestion are within U.S. EPA's target risk range). There is uncertainty in the dermal intakes from ground water which were estimated by a U.S. EPA model (U.S. EPA, 2000).

- The risks calculated for vinyl chloride are subject to a number of important uncertainties that tend to overestimate potential risks. Vinyl chloride was detected in two of four surface water samples, and risks were calculated based on exposure to the maximum detected concentration. Field notes indicate that the water was covered with ice at the time of sampling. Because vinyl chloride is

extremely volatile, it is unlikely that the sampled concentrations would be present in surface water most of the year. Residential risks from surface water are based on the assumption that hypothetical future residents would be exposed to surface water 350 days a year for 30 years. This assumption overestimates risks because a human receptor would be exposed to the surface water and sediments on a less frequent basis than is assumed for a typical residential exposure to soil. Risks for the more reasonable exposure scenarios (i.e., the adolescent trespasser and the adult recreational user) were within U.S. EPA's target risk range.

- The residential ground water scenario assumes that ground water at the site is used as a source of domestic drinking water. However, because of the shallow depth to ground water and the nature of the site, it is unlikely that ground water at the site would be used as a source of potable water in the future.

Lead was identified as a COPC for surface and surface/subsurface soil at SWMU 5 because maximum detected concentrations (16,900 mg/kg) exceed the 400 mg/kg OSWER soil screening level for residential land use. The maximum lead concentration was detected in surface soil sample 05SB060002. As discussed previously, this sample also contains the highest concentration of antimony in soil at the site. Lead-antimony alloy is commonly used in the manufacture of some lead products, such as storage batteries, and it is likely that the lead (and antimony) concentrations at these locations are attributable to past disposal practices at the site. The average lead concentration in the other surface soil samples collected at the site is 220 mg/kg, which is less than the 400 mg/kg screening level. However, the average concentration of lead in subsurface soil at the site was greater than 1,000 mg/kg. The data indicate that the soil in the vicinity of sample 05SB060002 may represent a hotspot area at the site.

Exposure to lead was evaluated by the IEUBK Model for future child residents and for workers and adult recreational users by the TRW adult lead model. Results of the IEUBK model analysis indicate that child blood-lead levels exceeded the level of concern (10 µg/dL) from exposure to lead in surface soil at SWMU 5. If the hotspot area were to be removed, the average surface soil would be 220 mg/kg and lead would not have been selected as a COPC for the site.

Results of the TRW adult lead model indicate that estimated blood-lead levels of the construction worker, recreational user, and maintenance worker are less than 10 µg/dL. However, the probability of construction workers having children with blood-lead levels greater than 10 µg/dL slightly exceeded U.S. EPA's goal of five percent.

In summary, for SWMU 5, no significant potential health risks for human receptors were determined under current land use. Under future land use, elevated noncarcinogenic and/or carcinogenic risks were calculated for construction workers from exposure to antimony in soil and for hypothetical future residents from exposure to antimony, iron, and lead in soil, to dioxins/furans and manganese in ground water, and to vinyl chloride in surface water. Antimony and lead may represent a hotspot condition at the site and there is considerable uncertainty associated with the risks calculated for iron, manganese, and vinyl chloride. A summary of the major contributors to risks at SWMU 5 is provided in Table 5-23.

5.7 ECOLOGICAL RISK ASSESSMENT

5.7.1 Site Description

Section 1.0 of this report presents the site background, site layout, and a general site description. The following text discusses the site description as it pertains to the ecological habitat at the site. The ecological checklist for the site is included in Appendix H.5

SWMU 5, the Old Burn Pit, consists of approximately 25 acres located in the alluvial valley of Culpepper Branch Creek and is surrounded by a natural network of hills. The burn pit has been filled and leveled (Engineering Science, 1991). A gully to the north is forested with mixed hardwoods and shrubs. The walls of the gully are eroded and have steep slopes. This area contains old waste drums and unburned debris. This area has an average to good quality stand of mixed hardwoods including sugar maple (*Acer saccharum*), white oak (*Quercus alba*), and yellow poplar (*Liriodendron tulipifere*) (NRMP, 1991). Nearby is Lake Oberlin, which has largemouth bass (*Micropterus salmoides*), bluegill sunfish (*Leopomis macrochirus*), gizzard shad (*Dorosoma cepedianum*), golden shiners (*Notemigonus crysoleucas*), and gold fish (*Carassius auratus*).

During a site visit by TtNUS in October 2001, the drainageway north of the site was observed to be 2 to 3 feet wide and less than 1 foot deep. The water flow was slow, and there were some stagnant pools. The sediment was silty with some sand. No fish were observed in the creek, and the small size of the creek would limit the fish population to a few small fish, if fish are present at all.

The Culpepper Branch Creek waterbody segment designated state water uses are aquatic life support and primary contact. The Furst Creek waterbody segment designated state water use is aquatic life support; the Furst Creek waterbody segment does not support primary contact. Neither of these waterbody segments were assessed as part of the 2004 Indiana Integrated Water Quality Monitoring and Assessment Report to determine if they support fish consumption (IDEM, 2004).

Bald eagles (as discussed in Section 1.3.7) and ospreys are not expected to occur at SWMU 5 due to the absence of preferred foraging habitat (large open waters). Similarly, the Virginia rail and king rail are found in marshes and mudflats, the Henslow's sparrow is found in damp fields, and the yellow crowned night heron is primarily a bird of swamps. These habitats are present at SWMU 5 so the presence of these species can not be ruled out. The loggerhead shrike prefers open fields with scattered trees, but is occasionally found in open woodlands. Thus, use of the site by the loggerhead shrike would be occasional at most. The prime timber rattlesnake habitat is forested land on higher dry ridges with a south or southwestern exposure. SWMU 5 is not located on a high dry ridge, so it is unlikely that the timber rattlesnake is present at the SWMU.

Furst Creek discharges off-site to the West Fork of the White River. The Nongame and Endangered Wildlife Program of the Indiana DNR Division of Fish and Wildlife has reported the occurrence of some species of special concern in the West Fork White River (IDFW, Annual Report, August 2003). Historic information indicates that the eastern sand darter (*Ammocrypta pellucida*), a species of special concern in Indiana, is present in the West Fork White River. A statewide survey for this species was initiated in 2001 and is currently underway. Additionally, surveys for freshwater mussels are also underway for most of Indiana's major drainage basins. A statewide survey for these species was also initiated in 2001 and a previously unknown reproducing population of *Obovaria subrotunda* (round hickorynut), a state species of special concern, was located in the West Fork White River drainage (IDFW, August 2003). Note that other threatened, endangered, or special concern species also may be present in the water bodies just off-site of Crane, as well.

5.7.2 Potential Ecological Receptors and Exposure Pathways

Based on the above description of the site and potential contaminant migration pathways, ecological receptors could be directly exposed to chemicals in the surface water and surface soil (i.e., plant and soil invertebrates) and indirectly via the food chain (i.e., through the ingestion of plants and invertebrates). Figure 5-14 presents the conceptual site model for SWMU 5. Additionally, ecological receptors (i.e., aquatic invertebrates) could be exposed to chemicals in the surface water and sediment in the stream. The following assessment endpoints (and surrogate wildlife species where applicable) are selected for this site:

- Soil invertebrates
- Terrestrial vegetation
- Benthic invertebrates

- Fish
- Soil invertebrate-eating mammal (short-tailed shrew)
- Herbivorous mammal (meadow vole)
- Invertebrate-eating bird (American robin)
- Herbivorous bird (bobwhite quail)
- Piscivorous mammal (raccoon)
- Piscivorous bird (belted kingfisher)

Although piscivorous mammals and birds are included as assessment endpoints, the actual exposure to site chemicals is expected to be low because the creek north of the site is unlikely to sustain large fish populations. The measurement endpoints for each of these assessment endpoints are presented in Section 3.4.

5.7.3 Sampling Investigation and Results

A total of eight surface soil locations, five sediment locations, and five surface water locations were sampled at the site and are evaluated as part of the SERA. Figures 5-6 through 5-12 show the positive results for samples collected at these locations.

Section 5.4 of this report discusses the analytical results and nature and extent of contamination for the site. In summary, VOCs, SVOCs, pesticides, herbicides, dioxins, and/or inorganic chemicals are detected in the soil, sediment, and surface water. For the surface soil samples, a statistical comparison between the site data set and the background data set was conducted to determine if any of the inorganic chemicals in the site samples are detected below background levels (see Section 5.4). Also, surface water and sediment station 05SW/SD01 was an upgradient location. Therefore, the chemical concentrations in this sample are assumed to represent concentrations in the surface water and sediment that are not related to activities at SWMU 5. As such, the inorganic chemical concentrations in the remaining surface water and sediment samples from SWMU 5 are compared to this upgradient sample for the selection of COPCs. If inorganic chemical concentrations are higher at the upgradient sample than the maximum concentration of downgradient samples, the chemical is eliminated as a COPC.

5.7.4 Ecological Screening

This section contains the ecological risk screening evaluation that is conducted for the chemicals detected in the surface soil, sediment, and surface water samples. The general methodologies used for

the exposure assessment and risk characterization are presented in Section 3.4 of this report. The EDQLs used for the screening are presented in Tables 3-14 and 3-15.

5.7.4.1 Surface Soil

Table 5-24 is the screening table for plants, invertebrates, and terrestrial wildlife exposed to chemicals detected in the surface soil samples. In addition to summary statistics (e.g., frequency of detection), the table also includes the results of the comparison to the representative soil background and anthropogenic values for inorganics, which are used to select COPCs. Twenty-four dioxins (including total dioxin groups), eight VOCs, 18 SVOCs, one pesticide, one PCB, two herbicides, and 20 inorganic chemicals were detected in the surface soil samples.

All 24 dioxins except 1,2,3,7,8,9-HXCDF and total PECDF exceeded Region 5 screening levels. Additionally, cis-1,2-dichloroethene, bis(2-ethylhexyl) phthalate, naphthalene, antimony, barium, cadmium, chromium, copper, iron, lead, mercury, silver, tin, and zinc were initially selected as COPCs because the maximum concentrations exceeded the surface soil Region 5 screening levels and the site concentrations were statistically greater than the background concentrations (for inorganics only). The highest EEQs are from several of the dioxin compounds and inorganic chemicals, including cadmium and lead.

5.7.4.2 Sediment

Table 5-25 is the screening table for aquatic receptors and piscivorous wildlife exposed to chemicals detected in the sediment. In addition to summary statistics (e.g., frequency of detection), the table also includes the results of the comparison to the upgradient sample, 04SD010006, which is considered a representative sediment background and anthropogenic sample. Nineteen dioxins (including total dioxin groups), three VOCs, 13 SVOCs, one PCB, two herbicides, and 18 inorganic chemicals were detected in the sediment samples.

Five inorganic chemicals including aluminum, antimony, barium, manganese, and vanadium were initially selected as COPCs because no sediment Region 5 screening levels are available for these chemicals and the maximum downgradient concentration exceeded that of 05SD010006. Seventeen dioxins, 2-methylnaphthalene, dibenzo(a,h)anthracene, cis-1,2-dichloroethene, trichloroethene, Aroclor 1260, cadmium, copper, lead, and zinc were initially selected as COPCs because the maximum concentrations exceeded the sediment COPC screening level; many dioxins had EEQs greater than 100.

5.7.4.3 Surface Water

Table 5-26 is the surface water screening table for aquatic receptors and piscivorous wildlife. In addition to summary statistics (e.g., frequency of detection), the table also includes a comparison to the upgradient sample, 05SW0101, which is considered a representative surface water background and anthropogenic sample. One dioxin, five VOCs, one SVOC, 11 inorganic chemicals (unfiltered surface water), and 10 filtered inorganic chemicals were detected in the surface water samples.

Cis-1,2-dichloroethene, aluminum, iron, and manganese are initially selected as COPCs because no surface water COPC screening levels are available for these chemicals and their maximum detected concentrations were greater than the downgradient concentration at 05SW0101 (for inorganics only). Total PECDD, trichloroethene and vinyl chloride are initially selected as COPCs because the maximum concentrations exceeded the surface water Region 5 screening level with EEQs of 33.8, 1.60, and 9.24.

5.7.5 Scientific/Management Decision Point

The SERA includes the estimation of exposure levels and screening for ecological risks. The SERA is concluded by a Scientific/Management Decision Point (SMDP) at which point one of the following decisions is made (DON, 1999):

(1) Adequate information exists to conclude that ecological threats at a site are negligible; no further evaluations of ecological risks are necessary.

(2) Adequate information exists and there is a potential for adverse ecological effects. In this case, the decision can be to either conduct an interim cleanup (if cost-effective to do so) or continue to Step 3.

Included in the decisions listed above is an evaluation of the adequacy of the available information on which the decisions are based. Questions are answered during this evaluation include the following:

- Were adequate numbers of samples collected in the appropriate locations?
- Were the samples analyzed for the appropriate parameters and was the data of sufficient quality for use in a risk assessment?

This section of the ERA describes whether or not the collected data are adequate for making ecological risk decisions for SWMU 5. Section 5.4 of this report contains discussion of the nature and extent of

contamination at SWMU 5, and Figures 1-8 and 1-9 show the site topography and site photographs, respectively.

The Old Burn Pit (SWMU 5) is an inactive site that was used from 1942 to 1972. The old burn pit site is located in the northwestern corner of the NSWC Crane. The site occupies approximately 25 acres and is bounded on the west by Highway 331, on the south by the gravel lot south of the burn pit, and on the east by the power line running along a ridge north of Lake Oberline. Undefined amounts of rubbish including wood, paper, construction material, and industrial wastes were burned at the site in the burn pit area. Reportedly, no explosive materials or wastes were burned at the Old Burn Pit. Residual ash and metal debris from the burning activities were buried in the gully north of the burn pit area. This area currently contains miscellaneous metal debris, including decomposed drums and other metal objects, which are partially buried or exposed. Currently, the burn pit area of the site has been covered with gravel and is used as a parking area for delivery trailers. The gully north of the former burn pit area has been revegetated.

5.7.5.1 Surface Soil

A total of eight surface soil samples were collected at SWMU 5. All eight surface soil samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, Appendix IX dioxins/furans, TAL metals (plus tin), and cyanide. Additionally, one surface soil sample was analyzed for CEC (05SB040002), pH (05SB060002), and TOC (05SB040002). Table 5-2 presents the summary of positive surface soil analytical results and Table 5-24 is the ecological risk screening table for surface soils. Seventeen individual dioxins, seven total dioxins, eight VOCs, 18 SVOCs, one pesticide, one PCB, two herbicides, and 20 inorganics were detected in surface soils samples. Of these, 16 individual dioxins and six total dioxins, one VOC, two SVOCs, and 11 inorganics were initially selected as COPCs because their maximum detected concentrations exceeded EDQLs. Iron was initially selected as a COPC because an EDQL was not available for comparison. COPCs considered bioaccumulative (U.S. EPA, 2000) were initially selected for food-chain modeling and are presented in Table 5-27.

Dioxins were encountered at a high frequency at the site. However, maximum concentrations were detected primarily in sample 05SB06. Maximum EEQs for the dioxins initially selected as COPCs ranged from 1.4 to 25,377. Sample location 05SB06 also has high detections of other constituents and is located in an area where it is known dumping of burned materials occurred. One VOC, cis-1,2-dichloroethene, was detected in two of the eight surface soils samples collected at SWMU 5. Its maximum concentration was also detected in sample 05SB06 with an EEQ of 3.57. Overall, VOCs were detected less frequently

than other constituents at SWMU 5 and at low concentrations. Bis(2-ethylhexyl)phthalate was detected in two of eight samples collected with a maximum EEQ of 3.7 in sample 05SB05. The only other detection of bis(2-ethylhexyl)phthalate was located in sample 05SB06. These two samples are located in an area where dumping has occurred. For this reason, and because it was not detected in samples collected in other areas of SWMU 5, bis(2-ethylhexyl)phthalate contamination is believed to be sufficiently bounded. Naphthalene was detected in five of eight samples collected at SWMU 5 with a maximum EEQ of 1.01 in sample 05SB06. Naphthalene concentrations exceeded the EDQL only in this one sample. Detections of naphthalene were found in samples collected from the former burn pit area and in samples 05SB05 and 05SB06, areas where dumping of the burned materials occurred but not in outside samples, including 05SB04, 05SB07, and 05SB08. PAHs are typical by-products of incomplete combustion and it is reasonable to find these constituents at the locations where they were detected. Consequently, these organic chemicals are likely to be site-related constituents and are further evaluated in Step 3a of the BERA.

Antimony, barium, cadmium, chromium, copper, lead, mercury, silver, tin, and zinc were initially selected as COPCs because their maximum concentrations exceeded background concentrations and the EDQLs. Maximum EEQs for these inorganics ranged from 1.9 (silver) to 314,536 (lead) (see Table 5-24). An EEQ for iron is not available as an EDQL does not exist. Similar to other detected constituents, the majority of these chemicals have maximum concentrations in sample 05SB06. Because the surface soil samples are well distributed in the burn pit area, and because potential ecological risks exist, these metals in surface soils at SWMU 5 are further evaluated in Step 3a of the BERA.

5.7.5.2 Sediment/Surface Water

Sediment

A total of four site-related sediment samples were collected at SWMU 5. All four sediment samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, Appendix IX dioxin/furans, TAL metals (plus tin), cyanide, and TOC. Sample 05SD010006 (designated as the upgradient sediment sample) was analyzed for the same parameters. Table 5-10 presents the summary of the positive sediment results and Table 5-25 is the ecological risk screening table for sediment. Seventeen individual dioxins, two total dioxins, three VOCs, 13 SVOCs, one PCB, two herbicides, and 18 inorganics were detected in sediment samples. Of these, 15 individual dioxins, two total dioxins, two VOCs, two SVOCs, one PCB, and nine inorganics were initially selected as COPCs because their maximum detected concentrations exceeded EDQLs. Only five of these inorganics, including aluminum, antimony, barium, manganese, and vanadium, were initially selected as

COPCs because an EDQL was not available for these chemicals. COPCs considered bioaccumulative (U.S. EPA, 2000) were retained for food-chain modeling and are presented in Table 5-27.

The dioxins were detected at a high frequency in site samples with maximum detections primarily at sample location 05SD02. However, dioxins were detected in almost all samples at concentrations exceeding corresponding EDQLs. EEQs for the dioxins ranged from 1.12 to 17,287. Dioxins were detected in other media as well. As noted in Section 5.4.5, dioxin/furan compounds are often found in environmental media as a result of natural (e.g., forest fires) and anthropogenic activities (i.e., as by-products of various combustion and chemical processes). However, it was determined that the concentrations detected in these sediment samples are likely to be attributable to burning at SWMU 5. Cis-1,2-dichloroethene and trichloroethene were each detected in one of four sediment samples. Detections for both were observed in sample 05SD020006 with EEQs of 4.8 and 3.9, respectively. As indicated in Section 5.4.5, the surface water sample from this location contained a high level of suspended solids and is located downgradient of a surface soil sample that contained cis-1,2-dichloroethene and trichloroethene at concentrations in excess of 2,000 µg/kg. Because dioxins and chlorinated VOCs are likely related to past site activities and are present in high concentrations (i.e., EEQ exceedances of 1.0), they will be further evaluated in Step 3a of the BERA.

Of the SVOCs detected in sediment samples, 2-methylnaphthalene and dibenzo(a,h)anthracene were initially selected as COPCs. 2-Methylnaphthalene and dibenzo(a,h)anthracene were both detected in one of the four samples collected with EEQs of 1.19 and 2.6, respectively. These PAHs, as well as most PAHs that were detected, had maximum concentrations at sample location 05SD05. As shown in Figure 5-12, the upgradient sample location 05SD01 contained concentrations of PAHs that were higher than site samples. The PAHs detected in the upgradient location are one order of magnitude larger than those detected in the four sediment samples collected from within or downgradient of SWMU 5. The source of PAHs at this upgradient location is not known but may be the result of roadway runoff as PAHs are a component of vehicular exhaust and asphalt. Additionally, PAHs may have been transported (in the form or ashes or dust) and deposited via wind. Aroclor-1260 was the only PCB detected in SWMU 5 sediment samples. PCBs were also detected in surface soil locations 05SB05 and 05SB06 at similar concentrations. The presence of Aroclors in sediment is likely the result of past site disposal activities.

Nine metals were initially selected as COPCs in SWMU 5 sediment samples. Metals were detected frequently at the site with maximum concentrations primarily at sample location 05SD05. As shown in Figure 5-12, the concentrations of metals detected in the sediment across the SWMU are similar (i.e., within one order of magnitude, including upgradient concentrations), indicating no clear pattern of contamination. Also, most of these metals were detected in all other media samples at SWMU 5.

Surface Water

A total of four site related surface water samples were collected at SWMU 5. All four surface water samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, Appendix IX dioxin/furans, total and dissolved TAL metals (plus tin), cyanide, hardness, and total suspended solids. Additionally, sample 05SW0101 was selected to represent the SWMU 5 upgradient surface water sample and it was analyzed for the same parameters. Table 5-8 presents a summary of the positive surface water analytical results and Table 5-26 is the ecological risk screening for surface water. One dioxin, five VOCs, one SVOC, 11 unfiltered inorganics, and 10 filtered inorganics. Of these, three VOCs, three unfiltered inorganics, and two filtered inorganics were initially selected as COPCs. Trichloroethene and vinyl chloride were initially selected as COPCs because their maximum detected concentrations exceeded EDQLs. Cis-1,2-dichloroethene, iron, and manganese were initially selected as COPCs because EDQLs were not available. No COPCs are considered bioaccumulative (U.S. EPA, 2000) and so there are no surface water COPCs for food chain modeling.

VOCs are not typically found in surface water samples due to their volatility. At the time the sample was collected the surface water was iced over. VOCs would have been prevented from volatilization by the ice. As mentioned in Section 5.4.4, VOCs would probably be diluted or would evaporate; however, sample 05SW0201 did have a high level of suspended solids (52 mg/L), indicating that perhaps these levels are a result of VOC contamination in sediment. However, it is possible that a seep containing VOCs is discharging into the surface water and for this reason, VOCs will be further evaluated in Step 3a of the BERA.

Maximum detected concentrations of the inorganics were found in a variety of the samples collected indicating no clear pattern of metals contamination. However, because no EDQLs were available for comparison, concentrations of aluminum, iron, and manganese will be further evaluated against available alternate toxicity information.

5.7.5.3 Summary

In summary, a SERA was performed for SWMU 5. Based on the results of the collected data, adequate information exists to determine that potential risks are possible to receptors from exposure to the selected COPCs. Also, the samples were placed in areas where the contamination, if present, should be detected.

Therefore, the SERA is advancing to the Step 3a of the BERA – the refinement of the site-related COPCs.

5.7.6 Step 3a Refinement

Subsequent to the initial screening, other factors are considered to further refine COPCs. These factors include food chain modeling, habitat quality, area use factors, toxicological evaluation of COPCs, frequency of detection, background concentrations, and comparisons of COPCs to alternate benchmarks/toxicity (U.S. EPA, 1997; and 2001; Navy, 1999). Section 3.4.4 presents the methodologies used to further evaluate risks to ecological receptors in Step 3a.

Food chain modeling is conducted to investigate potential risks to representative receptors from ingested doses of COPCs that are known to bioaccumulate or biomagnify. The methods used to model the doses that representative receptors could receive, as well as the selection of TRVs and the calculation sheets for the food chain model, are described and presented in Section 3.4.4.2 and Appendix H. The assessment endpoints associated with food chain modeling are the protection of ecological receptors from adverse effects of COPCs on growth, survival, and reproduction. The associated measurement endpoints are doses of COPCs associated with adverse effects on growth, survival, and reproduction of these receptor groups.

Concentrations of COPCs are compared to alternate (usually less conservative) benchmarks in Step 3a of this assessment. These alternate benchmarks are presented in Tables 5-28 (surface soil), 5-29 (sediment) and 5-30 (surface water) along with the Step 3a evaluation.

5.7.6.1 Risks to Terrestrial Plants, Terrestrial and Sediment Invertebrates

Potential risks to terrestrial plants, terrestrial and aquatic invertebrates, and fish from exposure to COPCs were evaluated using the methodologies described in Section 3.4.4. The following subsections discuss whether the chemicals initially selected as COPCs should be retained for further evaluation of risks to soil invertebrates and terrestrial vegetation (Section 5.7.6.1.1) and benthic invertebrates (Section 5.7.6.1.2).

5.7.6.1.1 Terrestrial Plants and Invertebrates – Surface Soil Risk

Risks to terrestrial plants and invertebrates resulting from exposure to the COPCs in surface soil are evaluated using the methodologies described in Section 3.4.4. Table 5-28 presents a summary of some of the common alternate benchmarks available for surface soil COPCs, along with a summary of the Step

3a evaluation. The toxicological basis of the alternate benchmarks is presented below. As presented in Table 5-24, several chemicals were detected at concentrations exceeding screening levels (or screening levels were not available) but were eliminated as COPCs because they were not detected at concentrations greater than background concentrations. For soil, these chemicals included aluminum, arsenic, cobalt, manganese, nickel, and vanadium. Therefore, risks to these chemicals were not evaluated in the ERA, however, any risks would be within background risks and not related to site activities.

As discussed below, the majority of elevated concentrations of metals were found in the northern area of the SWMU. Various metal debris piles are located throughout the area (and the steep drop-off into the main gully); the waste piles include rusted drums, metal shavings and other pieces of metal. Most of the maximum detected concentrations of metals at the SWMU were found in sample 05SB060002, which was described in the field log sheets (Appendix B) as having metal shavings. Because some of the metal shavings were likely inadvertently analyzed along with soil sample, it is not known what percentage of the metals in the sample was actually in the soil versus the percentage attributable to the metals shavings. The importance of this is that metal shavings are likely not very bioavailable.

Because metal debris is scattered throughout the northern portion of the SWMU, the contamination in the soil cannot be bounded by soil samples. Metals concentrations in a soil sample are reflective of a particular sample location (i.e. near metal debris) or the presence of small pieces of metals in the sample. Therefore, two samples relatively close in proximity could have large differences in metals concentrations, if one sample contained metal fragments and the other did not.

As depicted in the site photographs (Figure 1-9), the site in the area of the metal debris is heavily vegetated so the metals do not appear to be significantly impacting the plant community in this area. However, the available information alone can not be used to determine whether there are subtle effects to the plants. The following paragraphs present the Step 3a evaluation for evaluating risks to plants and invertebrates.

Dioxins

Many dioxins were initially selected as COPCs because the maximum detected surface soil concentrations exceeded Region 5 screening levels. However, the EDQLs are based on risks to wildlife (i.e., the masked shrew) and not risks to invertebrates and plants; therefore alternate toxicological data was used to further evaluate risks to plants and soil invertebrates.

One study reported in the literature demonstrated that two species of earthworms showed no adverse effects when exposed for 85 days to soil containing levels of 5 mg/kg of 2,3,7,8-TCDD, but both species died at 10 mg/kg (Eisler, 1986). The reason dioxins are not harmful to invertebrates at dioxin levels considered "high", is that many, if not all, invertebrates lack the aryl hydrocarbon (Ah) receptor, or a comparably sensitive receptor for dioxins. For example, in USEPA (1993), it is noted that the Ah receptor has not been detected in plants or nine species of invertebrates, representing eight classes of four phyla. The document further notes that aquatic invertebrates are much less sensitive to TCDD than fish, this is perhaps due to the absence of the Ah receptor, or a comparably sensitive receptor for dioxins USEPA (1993). The Ah receptor is important because the dioxins need to bind to the receptor in order to cause toxicity. Van den Berg, (1998) states that "At this time, development of TEFs for invertebrates is not recommended because there is limited evidence for ligand activation of Ah receptor or for TCDD-like toxicity in invertebrates." For this reason, the potential for risks to invertebrates from dioxins in the soil are unlikely. Also, because the Ah receptor has not been detected in plants, it is not likely plants at SWMU 5 will be impacted by the detected levels of dioxins in the soil. Therefore, risks to plants and invertebrates from dioxins in the soil are acceptable so dioxins are not retained as COPCs for risks to these receptors. However, because dioxins are bioaccumulative chemicals, risks to wildlife from dioxins are evaluated in Section 5.7.6.2 of this ERA.

Cis-1,2-dichloroethene

Cis-1,2-dichloroethene was initially selected as a COPC because the maximum detected surface soil concentration of 2.8 mg/kg in sample 05SB060002 exceeded the Region 5 screening level (0.78 mg/kg). The EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to invertebrates and plants; however, no alternate benchmarks are available so other Step 3a factors are used to further evaluate risks to plants and soil invertebrates.

Sample 05SB060002 was located near the middle of the site; however the location is not well bounded. Cis-1,2-dichloroethene was detected in two of the eight samples collected and the only other detection of this parameter (sample 05SB080102 - 0.008 mg/kg), was less than the EDQL. VOCs are typically not detected in surface soil because they are volatile, but cis-1,2-dichloroethene was likely detected because the soil samples were collected in the winter, when volatilization is low. However, because there are very few receptors in the soil in winter, and because VOCs are not expected to be detected in the surface soil during the warmer months when receptors would be present and/or active, it is unlikely that cis-1,2-dichloroethene in the soil is adversely impacting plants or invertebrates. Therefore, risks to plants and soil invertebrates from cis-1,2-dichloroethene are acceptable so cis-1,2-dichloroethene is not retained as a COPC for risks to these receptors.

Bis(2-ethylhexyl) phthalate

Bis(2-ethylhexyl) phthalate was initially selected as a COPC because the maximum detected surface soil concentration of 3.4 mg/kg at location 05SB05 exceeded the Region 5 screening level (0.93 mg/kg). However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to invertebrates and plants; therefore, alternate benchmarks/toxicity information were used to further evaluate risks to plants and soil invertebrates:

- ORNL Plant – 100 mg/kg (Efroymson et al., 1997b)

The bis(2-ethylhexyl) phthalate ORNL benchmark for plants is based on an effect concentration (EC)50 value of 134 mg/kg based on effects on the growth of lettuce from seedling to 14 days in loam soils. Even though the ORNL benchmark is based on an EC50 value, the maximum detected concentration is much lower than the ORNL plant benchmark so impacts to plants are not expected. Therefore, risks to plants from bis (2-ethylhexyl) phthalate are acceptable; bis(2-ethylhexyl) phthalate is not retained as a COPC for risks to plants.

No benchmarks are available for bis(2-ethylhexyl) phthalate to evaluate risks to earthworms; therefore, the ORNL earthworm benchmark for dimethylphthalate (200 mg/kg) was used because the toxicity of these two phthalates is anticipated to be generally similar in magnitude. The ORNL earthworm benchmark for dimethylphthalate was developed based on survival of adults of four earthworm species. After 14 days, a three-fold difference in sensitivity of the earthworms was observed. An lethal concentration (LC)50 value of 1,064 mg/kg was the lowest toxic concentration of the three reported. The ORNL earthworm value of 200 mg/kg for dimethylphthalate was obtained by dividing the LC50 (1,064 mg/kg) by a safety factor 5 (Efroymson et al., 1997). Although there are uncertainties in comparing the maximum di-n-butylphthalate concentration to toxicity information available for dimethylphthalate, the maximum di-n-butylphthalate concentration is much less than the ORNL earthworm benchmark for dimethylphthalate and impacts to invertebrates are not likely. The maximum detected concentration is less than the ORNL earthworm benchmark di-n-butylphthalate so risks to earthworms from bis (2-ethylhexyl) phthalate are acceptable; bis (2-ethylhexyl) phthalate is not retained as a COPC for risks to earthworms.

Naphthalene

Naphthalene was initially selected as a COPC because the maximum detected surface soil concentration in sample 05SB060002 (0.1 mg/kg) was slightly above the Region 5 screening level (0.1 mg/kg), with an EEQ of 1.006. Surface soil concentrations for all other samples were less than the screening level. The EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates; therefore, the maximum concentration was compared to the following alternate benchmark to evaluate risks to plants and invertebrates.

- Canadian SQG – 0.6 mg/kg (EC, 1999e)

The Canadian SQG for naphthalene of 0.6 mg/kg is based on an Effects Concentration 25 (EC25) for lettuce (3 mg/kg) divided by an uncertainty factor of 5 to approximate a no effects concentration. This method was used because only three studies were identified to evaluate risks from naphthalene; two were for plants and one was for invertebrates. The EC25 of 3 mg/kg was the lowest value of the three studies. The maximum concentration is less than the SQG; therefore, risks to plants and invertebrates from naphthalene are acceptable. Naphthalene is not retained as a COPC for risks to plants and invertebrates.

Antimony

Antimony was initially selected as a COPC because the maximum detected soil concentration at location 05SB06 (301 mg/kg) exceeded the Region 5 screening level of 0.1423 mg/kg and was greater than background concentrations. However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates. Therefore, the maximum antimony concentration was compared to the following alternate benchmarks to evaluate risks to plants and invertebrates:

- Eco-SSL for soil invertebrates - 78 mg/kg (U.S. EPA, 2003c)
- ORNL Plant – 5 mg/kg (Efroymson et al., 1997b)

The Eco-SSL for soil invertebrates is the geometric mean of the EC20 values reported for each of three test species (i.e., Enchytraeid, Springtail, and Earthworm) exposed under similar conditions. The maximum detected concentration of antimony at SWMU 5 is greater than the Eco-SSL for soil invertebrates; however, antimony concentrations reported for other surface soil locations sampled did not exceed the Eco-SSL. As discussed above, metal shavings were observed in the surface soil sample collected at 05SB06 which likely contributed to the elevated detection of antimony in the sample,

especially because the detected concentration in this sample was much greater than the next greatest detected concentration (76.1 mg/kg). Because the bioavailability of antimony in the soil at 05SB06 is not known, and because the detected concentration at this location exceeded the Eco-SSL for invertebrates, risks to invertebrates are possible.

An Eco-SSL for plants is not available; however there is an ORNL plant value. The ORNL plant value of 5 mg/kg is based on a report of unspecified toxic effects on plants grown in a surface soil with the addition of 5 mg/kg antimony. Antimony concentrations were greater than the ORNL plant value in six of the eight samples collected indicating risks to plants are possible, although based on the heavy vegetation at the site, antimony does not appear to be significantly impacting the plant community in this area.

In summary, risks to plants and invertebrates from antimony in the surface soil are possible because detected concentrations were greater that benchmarks for plants and invertebrates. Therefore, risks to plants and invertebrates are unacceptable; antimony is retained as a COPC for further evaluation for these receptors.

Barium

Barium was initially selected as a COPC because the maximum detected soil concentration at location 05SB06 (2,020 mg/kg) exceeded the COPC screening level of 1.04 mg/kg and was greater than background concentrations. However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to terrestrial invertebrates and plants. Therefore, the maximum barium concentration was compared to the following alternate benchmarks to further evaluate risks to plants and invertebrates:

U.S. EPA Eco-SSL for soil invertebrates – 330 mg/kg (U.S. EPA, 2003b)
ORNL Plant – 500 mg/kg (Efroymson at al., 1997b)

The U.S. EPA Eco-SSL of 330 mg/kg for soil invertebrates was developed after a review of over 152 technical studies. Of these, three studies were accepted for inclusion in the development of the Eco-SSL based on a ranking that followed U.S. EPA Study Acceptance Criteria. The Eco-SSL is the geometric mean of the EC20 values (based on reproduction) reported for each of three test species under three separate test conditions of pH (U.S. EPA, 2003b). Barium concentrations exceeded the Eco-SSL for soil invertebrates in three samples, and the barium concentration at location 05SB05 (328 mg/kg) was just slightly less than the Eco-SSL. As discussed above, metal shavings were observed in the surface soil sample collected at 05SB06 which likely contributed to the elevated detection of barium in the sample, especially because the detected concentration in this sample was much greater than the next greatest

detected concentration (938 mg/kg). Because the bioavailability of barium in the soil at 05SB06 is not known, and because the detected concentration at this location, and several other locations exceeded the Eco SSL for invertebrates, risks to invertebrates are possible.

An Eco-SSL for plants was not generated because only one study was found that met the necessary evaluation criteria (U.S. EPA, 2003b). The study was the same study referenced in Efroymson et al., (1997b), but the Eco SSL document reported a maximum acceptable toxicant concentration (MATC) of 1,414 mg/kg for growth of bush beans. The ORNL plant benchmark is based on a study that found a 38% reduction in shoot growth of barley 14 days after the addition of 500 mg/kg barium, which was the lowest concentration tested (Efroymson et al., 1997b). In another study cited in Efroymson et al., (1997b), shoot growth of bush beans was reduced 30% after 14 days by the addition of 2,000 ppm barium, but was not reduced at the next lowest level tested, 1,000 ppm. Therefore, the 500 mg/kg benchmark for plants may be conservative for evaluating risks to other plants, even though it caused a 38% reduction in shoot growth of barley. Barium concentrations were greater than the ORNL plant benchmark in two samples collected at SWMU 5 (05SB060002 and 05SB070002) indicating risks to plants are possible, although based on the heavy vegetation at the site, barium does not appear to be significantly impacting the plant community in this area.

In summary, risks to plants and invertebrates from barium in the surface soil are possible because detected concentrations were greater than benchmarks for plants and invertebrates. Therefore, risks to plants and invertebrates are unacceptable; barium is retained as a COPC for further evaluation for these receptors.

Cadmium

Cadmium was initially selected as a COPC because the maximum detected soil concentration in sample 05SB060002 (31.1 mg/kg) exceeded the Region 5 screening level of 0.00222 mg/kg and was greater than background concentrations. However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates. Consequently the maximum cadmium concentration was compared to the U.S. EPA Eco-SSLs to further evaluate risks to plants and soil invertebrates:

- U.S. EPA Eco-SSL for soil invertebrates – 140 mg/kg (U.S. EPA, 2003a)
- U.S. EPA Eco-SSL for plants – 32 mg/kg (U.S. EPA, 2003a)

The U.S. EPA Eco-SSL for soil invertebrates of 140 mg/kg was developed after a review of over 239 technical studies. Of these, 10 studies were accepted for inclusion in the development of the Eco-SSL.

The Eco-SSL is the geometric mean of the MATC or EC10 values (based on growth, population, or reproduction) reported for each of three test species evaluated under six separate test conditions of pH (U.S. EPA, 2003a). The U.S. EPA Eco-SSL for plants (32 mg/kg) was developed after a review of over 716 technical studies. Of these, 14 studies were accepted for inclusion in the development of the Eco-SSL. The Eco-SSL is the geometric mean of the MATC (based on growth) reported for 14 test species under six separate test conditions of pH and percent organic matter (U.S. EPA, 2003a). The maximum cadmium detection is less than the Eco-SSLs for plants and soil invertebrates. Therefore, risks to plants and invertebrates from cadmium are acceptable and cadmium is not retained as a COPC for risks to these receptors. However, because cadmium is a bioaccumulative chemical, risks to wildlife from cadmium are evaluated in Section 5.7.6.2 of this ERA.

Chromium

Chromium was initially selected as a COPC because the maximum detected soil concentration (112 mg/kg) in sample 05SB060002 exceeded the Region 5 screening level of 0.4 mg/kg and was greater than background concentrations. However, even though the EDQL is based on risks to invertebrates, the following alternate benchmark was used to further evaluate risks to plants and soil invertebrates:

- Canadian SQG – 64 mg/kg (EC, 1999f)

As presented in the supporting document for the Canadian SQG for chromium (EC, 1999f), the Canadian guideline for total chromium (64 mg/kg) is the geometric mean of the threshold effects concentration (TEC) of 78 mg/kg for risks to plants and invertebrates and the nutrient and energy cycling check value (NECC) of 52 mg/kg. The TEC is the 6th of 22 data points associated with the no observable effects and observable effects data for plants and invertebrates and corresponds to the average radish germination EC25. As can be seen in the supporting document, no effects concentrations for earthworms (235 mg/kg to 900 mg/kg) were greater than the no effects concentrations for plants (10 mg/kg to 230 mg/kg) indicating invertebrates are less sensitive to total chromium than plants. The maximum detected concentration is less than the NOECs reported for invertebrates indicating invertebrates are likely not being adversely impacted from surface soil chromium concentrations. For this reason, risks to invertebrates are acceptable and chromium is not retained as a COPC for risks to invertebrates.

The maximum concentration of chromium at SWMU 5 is greater than the SQG, which is based on effects to plants; no other samples had detected concentrations of chromium that were greater than the SQG. Because chromium was detected at a concentration in one sample that exceeded the SQG, risks to

plants are possible. However, based on the heavy vegetation at the site, chromium does not appear to be significantly impacting the plant community in this area.

In summary, risks to plants from chromium in the surface soil are possible because detected concentrations were greater than benchmarks for plants; the detected concentrations are less than NOECs for invertebrates. Therefore, risks to plants are unacceptable; chromium is retained as a COPC for further evaluation for plants. Because chromium is a bioaccumulative chemical, risks to wildlife from chromium are evaluated in Section 5.7.6.2 of this ERA.

Copper

Copper was initially selected as a COPC because the maximum detected soil concentration in sample 05SB060002 (1,520 mg/kg) exceeded the Region 5 screening level of 2.96 mg/kg and was greater than the background concentrations. However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates. Therefore, the maximum copper concentration was compared to the following alternate benchmark to evaluate risks to plants and invertebrates.

- Canadian SQG – 63 mg/kg (CCME, 1997c)
- ORNL Plant – 100 mg/kg (Efroymson et al., 1997b)
- ORNL Earthworm – 60 mg/kg (Efroymson et al., 1997a)

The Canadian SQG for copper (63 mg/kg) is the 25th percentile of effects and no effects data distribution for plants and invertebrates, which is the 17th of 69 data points and corresponds to an effect on radish seedling emergence. The ORNL benchmark for copper for plants (100 mg/kg) was based on toxicity data from three studies. Two of the studies demonstrated reductions in root and shoot weights of little bluestem grown in sandy soil to which 100 ppm copper (as copper sulfate) was added (Miles and Parker, 1979). The third study showed no effect on leaf and stem weights of bush beans grown in soil to which 100 ppm copper (as copper sulfate) was added, but leaf weight was reduced 26% when 200 ppm copper was added (Wallace et al., 1977). The ORNL benchmark for copper for invertebrates (60 mg/kg) was based on toxicity data from 10 to 20 studies. The endpoints for most of the studies cited in Efroymson et al., (1997a) are survival or impacts on reproduction (i.e., cocoon production, hatchling success). Because there were more than 10 studies, the benchmark was based on a 10th percentile LOEC value. However, a review of the data in Appendix A.1 of Efroymson et al., (1997a) shows that most of the studies cited in that document have NOECs that are greater than 60 mg/kg.

Copper concentrations were greater than the SQG and the ORNL benchmark for earthworms in five of the eight samples collected at SWMU 5. Copper concentrations were greater than the ORNL benchmark for plants in four samples. The sampled areas are located across the SWMU; the greatest concentrations are located in the samples collected from the northern part of the SWMU where the metal debris was observed. Therefore, there may be risks to plants and invertebrates from copper in the surface soil, although based on the heavily vegetation at the site, copper does not appear to be significantly impacting the plant community at the SWMU.

In summary, risks to plants and invertebrates from copper in the surface soil are possible because detected concentrations were greater that benchmarks for plants and invertebrates. Therefore, risks to plants and invertebrates are unacceptable; copper is retained as a COPC for further evaluation for these receptors. Because copper is a bioaccumulative chemical, risks to wildlife from copper are evaluated in Section 5.7.6.2 of this ERA.

Iron

Iron was initially selected as a COPC because no Region 5 screening level is available and the maximum iron concentration of 105,000 mg/kg in sample 05SB060002 was greater than the background concentrations. According to the ECO-SSL for iron (U.S. EPA, 2003d), iron is essential for plant growth, and is generally considered to be a micronutrient. Because plants regulate its uptake, iron is not expected to be toxic to plants in well aerated soils with pH levels between 5 and 8 S.U. (U.S. EPA, 2003d). The one surface soil sample measured for pH had a value of 5.1 S.U. Only one surface soil sample was measured for pH, so the pH data for the subsurface soil samples were reviewed. The pH in the subsurface soil samples, which were collected from 5 to 10 feet bgs, ranged from 7.2 to 7.6 S.U. Although there are uncertainties in applying pH in the subsurface soil to the surface soil, it is likely that the average surface soil pH would be between 5 and 8 S.U based on the available data. Therefore, iron is not expected to be toxic to plants at the site. No toxicity data was located to evaluate risks to invertebrates from iron, however, because iron is generally considered a non-toxic metal, it is highly unlikely that soil invertebrates are being impacted by iron at the SWMU. For these reasons, any potential risks to plants and invertebrates from iron are acceptable and iron is not retained as a COPC for risks to these receptors.

Lead

Lead was initially selected as a COPC because the maximum detected soil concentration in 05SB060002 (16,900 mg/kg) exceeded the Region 5 screening level of 0.05373 mg/kg and was above the site-specific

background concentration. However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates, so the maximum concentration of lead was compared to the following alternate benchmarks to evaluate risks to these receptors.

- Eco-SSL for plants – 115 mg/kg (U.S. EPA, 2003e)
- Eco-SSL for soil invertebrates – 1,700 mg/kg (U.S. EPA, 2003e)

The Eco-SSL for plants is the geometric mean of the MATC values for four test species under three different test conditions. Soil pH values of the tests ranged from 4 to 6.3. The ecological endpoint for the derivation of the Eco-SSL for plants was growth. The maximum lead concentration is greater than the Eco-SSL for plants. The Eco-SSL for soil invertebrates is the geometric mean of the MATC values for one test species (*Folsomia candida*) under three different test conditions (pH of 4.5 to 6.0) and is based on a reproductive endpoint. Lead concentrations were greater than the Eco-SSL for plants in five of the eight samples collected indicating risks to plants are possible, although based on the heavily vegetation at the site, lead does not appear to be significantly impacting the plant community in this area.

The maximum concentration of lead at SWMU 5 is greater than the Eco-SSL for soil invertebrates; no other samples had detected concentrations of lead that were greater than the Eco-SSL. As discussed above, metal shavings were observed in the surface soil sample collected at 05SB06 which likely contributed to the elevated detection of lead in the sample, especially because the detected concentration in this sample was much greater than the next greatest detected concentration (450 mg/kg). Because the bioavailability of lead in the soil at 05SB06 is not known, and because the detected concentration at this location exceeded the Eco-SSL for invertebrates, risks to invertebrates are possible.

The maximum lead concentration in soil at SWMU 5 is orders of magnitude greater than other detected concentrations of lead in site samples and is greater than the Eco-SSLs. As previously mentioned, the location of the maximum concentration is also the location for the maximum detection of many other metals at SMWU 5 and for this reason lead is retained as a COPC for risks to plants and soil invertebrates. Because lead is a bioaccumulative chemical, risks to wildlife from lead are evaluated in Section 5.7.6.2 of this ERA.

Mercury

Mercury was initially selected as a COPC because the maximum detected soil concentration in sample 05SB010002 (0.43 mg/kg) exceeded the Region 5 screening level (0.073 mg/kg) and was greater than the background concentrations. However, even though the most recent soil ESL of 0.1 mg/kg is based

on risks to earthworms, the following alternate benchmark was used to further evaluate risks to plants and soil invertebrates:

- Canadian SQG – 12 mg/kg (EC, 1999g)

As presented in the supporting document for the Canadian SQG for mercury (EC, 1999g), the Canadian guideline of 12 mg/kg for mercury is based on the 25th percentile of effects and no effects data distribution for plants and invertebrates. The 25th percentile is the 6th of 22 data points and corresponds to an EC50 for turnip seedling emergence (50 mg/kg). The EC50 value of 50 mg/kg was then divided by an uncertainty factor of 4 considering the importance of definitive effects data. In Appendix VIII of the supporting document, NOECs for earthworm survival were reported at 96 mg/kg and 100 mg/kg in soils of pH 4.0 to 4.2 and 7.4, respectively.

The maximum concentration is less than the Canadian SQG; therefore, risks to plants and invertebrates are acceptable Additionally, the maximum mercury detection was reported for a sample that did not have elevated concentrations of other metals or organic chemicals indicating mercury is not likely related to site activities. Mercury is not retained as a COPC for risks to plants and invertebrates; however, because mercury is a bioaccumulative chemical, risks to wildlife from mercury were evaluated in section 5.7.6.2.

Silver

Silver was initially selected as a COPC because the maximum detected soil concentration in sample 05SB060002 (7.5 mg/kg) exceeded the Region 5 screening level of 4.04 mg/kg and was greater than background concentrations. However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates so the following alternate benchmarks were used to further evaluate risks to plants and soil invertebrates:

- ORNL Plant – 2 mg/kg (Efroymson et al., 1997b)
- ORNL Microorganisms – 50 mg/kg (Efroymson et al., 1997a)

The ORNL plant benchmark for silver (2 mg/kg) is based on a report of unspecified toxic effects on plants grown in a surface soil with 2 mg/kg silver (Efroymson et al, 1997b). Silver concentrations exceeded the ORNL plant benchmark at locations 05SB06 and 05SB03 indicating risks to plants are possible, although based on the heavy vegetation at the site, silver does not appear to be significantly impacting the plant community in this area.

No alternate benchmarks are available for risks to soil invertebrates; however, there is an ORNL value for risks to microorganisms of 50 mg/kg (Efroymson et al., 1997a). There is uncertainty in the sensitivity of an earthworm to silver versus the sensitivity of microorganisms to silver; however, ORNL values reported for other metals for earthworms and microorganisms are relatively similar (i.e., less than two times) (Efroymson et al., 1997a). The maximum detected concentration of silver is less than the ORNL microorganism benchmark so risks to soil invertebrates at SWMU 5 are not likely. Silver is not retained as a COPC for risks to soil invertebrates.

In summary, risks to plants from silver in the surface soil are possible because detected concentrations were greater than benchmarks for plants, but risks to soil invertebrates are not likely. Therefore, risks to plants are unacceptable; silver is retained as a COPC for further evaluation for plants. Because silver is a bioaccumulative chemical, risks to wildlife from silver were evaluated in section 5.7.6.2.

Tin

Tin was initially selected as a COPC because the maximum detected soil concentration in sample 05SB080002 (849 mg/kg) exceeded the Region 5 screening level of 7.62 mg/kg and was greater than the background concentrations. However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates so the following alternate benchmarks were used to further evaluate risks to plants and soil invertebrates:

- ORNL Plant – 50 mg/kg (Efroymson et al., 1997b)
- ORNL Microorganisms – 2,000 mg/kg (Efroymson et al., 1997a)

The ORNL benchmark for plants is the only alternate benchmark available for risks to plants. The 50 mg/kg value is based on two studies conducted in soil. Both studies measured growth as the endpoint. In the first study, shoot weight of bush beans were reduced by 22% when grown for 17 days in 500 mg/kg tin while 50 mg/kg had no effect. The second study reported unspecified toxic effects on plants grown in 50 mg/kg tin in soil. Tin was detected in seven of the eight samples collected and exceeded the ORNL plant benchmark in three of the samples; therefore, risks to plants are possible and tin is retained as a COPC for risks to plants. Based on the heavy vegetation at the site, however, tin does not appear to be significantly impacting the plant community in this area

No alternate benchmarks are available for risks to soil invertebrates; however, there is an ORNL value for risks to microorganisms of 2,000 mg/kg (Efroymson et al., 1997a). The maximum detected tin concentration at SWMU 5 is less than the ORNL tin value for microorganisms. Therefore, it is unlikely

earthworms at SWMU 5 are being adversely impacted because the maximum tin detection is below the ORNL value for microorganisms; therefore, risks to soil invertebrates from tin are acceptable and tin is not retained as a COPC for risks to soil invertebrates.

In summary, risks to plants from tin in the surface soil are possible because detected concentrations were greater than benchmarks for plants, but risks to soil invertebrates are not likely. Therefore, risks to plants are unacceptable; tin is retained as a COPC for further evaluation for plants.

Zinc

Zinc was initially selected as a COPC because the maximum detected soil concentration in sample 05SB060002 (5,110 mg/kg) exceeded the Region 5 screening level of 6.62 mg/kg and was greater than background concentrations. However, even though the EDQL is based on risks to invertebrates, the following alternate benchmark was used to further evaluate risks to plants and soil invertebrates:

- Canadian SQG – 200 mg/kg (EC, 1999d)

The Canadian SQG (200 mg/kg) for zinc is the lowest LOEC of the plants and invertebrate data set and is based on an effect on seedling emergence for radish (EC, 1999d). The weight-of-evidence method was not used to develop the SQG because greater than 50 percent of the "effects" data were dominated by median effective or median lethal concentrations (EC, 1999d). As presented in Appendix VI of the Canadian SQG document (EC, 1999d), all of the earthworm effects and no-effects data (with the exception of one test in one study) were equal to or greater than 200 mg/kg, indicating that earthworms appear to be less sensitive to zinc than plants. Zinc concentrations were greater than the SQG in five of the eight samples collected at SWMU 5. Therefore, risks to plants and invertebrates from zinc in the soil are possible and zinc is retained as a COPC for risks to these receptors. Because zinc is a bioaccumulative chemical, risks to wildlife from zinc are evaluated in Section 5.7.6.2 of this ERA.

5.7.6.1.2 Sediment

Table 5-29 presents a summary of the common alternate benchmarks used in refining the list of COPCs in sediment, along with a summary of the Step 3a evaluation. As discussed in the following narrative, several inorganic chemicals were not detected in site samples at concentrations greater than the upgradient concentrations (background comparisons were not used as a COPC selection criterion for organics). For sediment, these included arsenic, iron, and nickel. Any risks from these chemicals would be within background risks and not related to site activities.

Sediment samples were collected during the winter and because the surface water was frozen, the field crew had to break through the ice to collect some of the sediment samples. A site visit for SWMU 5 was conducted on June 9, 2004 with representatives from the Navy, USEPA Region 5, IDEM, and TtNUS. During that site visit, it was noted that the creek by 05SD02 was very narrow (approximately one foot wide) and only a few inches deep. There were orange deposits on the sediment, likely from the rusting metal debris located adjacent to the stream. The stream sediment consisted of a fine silt, and appeared to be poor habitat for benthic invertebrates. No fish were observed in the stream and it is unlikely that significant numbers of fish would inhabit the stream based on its small size. Figure 1-9 includes photographs of the stream taken during the field sampling event.

The aquatic habitat at location 05SD05 is very minimal. Although the photograph of this location in Figure 1-9 shows the presence of water, the area was completely dry during the June 9, 2004 sampling event, and appeared to be a washout area. The runoff from this washout area drains to a concrete culvert along the road as is visible in Figure 5-10. It is likely that this area is only wet during periods of rain, snowmelt, or other wet times of the year. Therefore, there is no potential for fish to live in this area and little potential for benthic invertebrates.

The following paragraphs present the Step 3a evaluation for evaluating risks to sediment invertebrates.

Dioxins

Many dioxins were initially selected as COPCs because the maximum detected sediment concentrations exceeded Region 5 screening levels. In the Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife (U.S. EPA, 1993), a sediment concentration of 60 ng/kg TCDD is provided as a concentration that would cause a low risk to fish.

As observed on Table 5-25, only three individual dioxins (OCDD, OCDF, and 1,2,3,4,6,7,8-HPCDD) and two dioxin groups (Total HPCDD and Total HPCDF) had concentrations greater than 60 ng/kg. Because these dioxins are less toxic to fish than 2,3,7,8-TCDD, the concentrations were multiplied by TEFs from Van den Berg et al. (1998) to give toxicity in terms of a TCDD toxicity equivalent (TEQ) value. The fish TEFs for OCDD, OCDF, and 1,2,3,4,6,7,8-HPCDD are 0.0001, which converts the detected concentrations of these individual dioxins to TCDD TEQ values of 0.61, 0.022, and 0.02 ng/kg, respectively. The fish TEFs for HPCDD and HPCDF are 0.001 and 0.01, which converts the detected concentrations of these individual dioxins to TCDD TEQ values of 0.42 and 1.1 ng/kg, respectively. The

summation of these converted values (i.e.; the sum TEQ value) is much less than 60 ng/kg. Also, as discussed in the Step 3a evaluation for dioxins in soil, invertebrates appear to lack the Ah receptor which is why dioxins do not cause toxicity to invertebrates at low concentrations. Therefore, risks to aquatic receptors from dioxins in the sediment are acceptable and dioxins are not retained as COPCs for risks to sediment dwelling invertebrates. However, because dioxins are bioaccumulative chemicals, risks to piscivorous wildlife from dioxins are evaluated in Section 5.7.6.2 of this ERA.

Cis-1,2-dichloroethene and Trichloroethene

Cis-1,2-dichloroethene and trichloroethene were initially selected as COPCs because their maximum detected sediment concentrations of 1 mg/kg and 0.7 mg/kg, respectively, in sample 05SD020006 exceeded the Region 5 screening levels. These VOCs were both detected in one of four samples collected. The updated EDQLs (now called ESLs) were used to further evaluate risks to sediment invertebrates from exposure to VOCs in the sediment, as follows:

Cis-1,2-dichloroethene ESL – 0.654 mg/kg (U.S. EPA, 2003)
Trichloroethene ESL – 0.112 mg/kg (U.S. EPA, 2003)

The detected concentrations are greater than the new ESLs; however, the location of the maximum concentration (05SD02) is very poor aquatic habitat, as discussed above. Because VOCs are volatile, their presence in environmental samples was somewhat unexpected. VOCs were likely detected because the samples were collected in winter when volatilization is lower. The concentrations of the VOCs are expected to be lower in the warmer months (because of volatilization) when the sediment dwelling invertebrates are more viable. Also, the VOCs were not detected in the downgradient sediment sample location (05SD03) which indicates that they are either volatilizing and/or diluting after a short distance (see Figure 5-11). Although the detected concentrations slightly exceeded the, ESLs, risks to benthic invertebrates from these VOCs are not expected because the VOCs are not likely to present during the warmer months when aquatic organisms may be present in the stream. Therefore, potential risks to aquatic receptors from VOCs in the sediment are acceptable and cis-1,2-dichloroethene and trichloroethene are not retained as COPCs.

PAHs

PAHs were initially selected as COPCs because they were detected at concentrations greater than the EDQLs. Although 2-methylnaphthalene and dibenzo(a,h)anthracene were the only PAHs detected at maximum concentrations exceeding the Region 5 screening levels, total PAHs were evaluated instead of

the individually detected PAHs because the toxicity of PAHs may be additive and there are several sediment benchmarks for total PAHs. The maximum total PAH concentration was found at sample location 05SD05 and calculated at 0.104 mg/kg. Because an EDQL for evaluating total PAHs is not available, total PAH concentrations are compared to the following alternate benchmark:

- Consensus-based Threshold Effect Concentration (TEC) – 1.61 mg/kg (MacDonald et al., 2000)

The consensus-based TEC is the geometric mean of the threshold effect level (TEL; Smith et al., 1996), effect range low value (ER-L; Long and Morgan 1991), lowest effect level (LEL; OMOE, 1993) minimal effect threshold (MET; EC and MENVIQ 1992) and sediment quality advisory levels (SQALs; U.S. EPA 1997) for each chemical. These effects levels were calculated using slightly different methods, but they all represent concentrations below which impacts to sediment invertebrates are unlikely or not expected. For that reason, the consensus-based TEC is intended to identify contaminant concentrations below which harmful effects on sediment-dwelling organisms are not expected. The maximum total PAHs concentration is less than the consensus-based TEC indicating risks to sediment dwelling organisms are not expected.

Therefore, risks from PAHs (including 2-methylnaphthalene and dibenzo(a,h)anthracene) to aquatic receptors at SWMU 5 are acceptable; these chemicals were not retained as COPCs for risks to sediment invertebrates. However, because PAHs are bioaccumulative chemicals, risks to piscivorous wildlife from these PAHs are evaluated in Section 5.7.6.2 of this ERA.

Aroclor-1260

Aroclor-1260 was initially selected as a COPC because the maximum detected sediment concentration in sample 05SD020006 (0.17 mg/kg) exceeded the Region 5 screening level of 0.034 mg/kg. The most recent EDQL (now called ESLs) (U.S. EPA, 2003) is based on the consensus-based TEC. The TEC, along with the consensus-based Probable Effect Concentration (PEC) were used to further evaluate risks to sediment invertebrates from exposure to PCBs in the sediment, as follows:

- Consensus-based TEC – 0.0598 mg/kg (MacDonald et al., 2000)
- Consensus-based PEC – 0.676 mg/kg (MacDonald et al., 2000)

The sediment ESL is the consensus-based TEC as described above for PAHs. The PEC was derived similarly to the TEC but is the geometric mean of the probable effect levels (PELs; Smith et al., 1996), effect range median values (ER-Ms; Long and Morgan, 1991), severe effect levels (SELs; Persaud et al.,

1993) and Toxic Effect Thresholds (TETs; Ec and MENVIQ, 1992). The PEC is the level above which harmful effects on sediment dwelling organisms are expected to frequently occur (MacDonald, et al., 2000). The maximum concentration is less than the PEC.

The only detected Aroclor-1260 concentration in a SWMU 5 sediment sample is greater than the TEC but much less than the PEC. Because the concentration of the one Aroclor-1260 detection is between the TEC and the PEC, impacts to benthic invertebrates are possible. However, because of the poor habitat at 05SD02, potential risks in the vicinity of this location are not great enough to warrant carrying Aroclor-1260 in the sediment through a BERA. Consequently, risks to benthic invertebrates from Aroclor-1260 are acceptable so Aroclor-1260 is not retained as a COPC for risks to sediment dwelling invertebrates. Because Aroclor-1260 is a bioaccumulative chemical, risks to piscivorous wildlife from Aroclor-1248 are evaluated in Section 5.7.6.2 of this ERA.

Aluminum

Aluminum was initially selected as a COPC because a Region 5 screening level is not available and the maximum concentration (7,660 mg/kg) is greater than the upgradient sediment concentration. The alternate benchmark selected for aluminum is the TEL of 25,500 mg/kg (Buchman, 1999). The TEL represents the concentration below which adverse effects on survival or growth of the amphipod Hyalella azteca are expected to occur only rarely in 28 day tests (MacDonald et al., 2000). The maximum aluminum (7,600 mg/kg) in sample 05SD050006 was less than the TEL. Therefore, risks to sediment dwelling invertebrates from aluminum are acceptable and aluminum is not retained as a COPC for risks to sediment dwelling invertebrates.

Antimony

Antimony was initially selected as a COPC because a Region 5 screening level is not available and the maximum concentration (5.8 mg/kg) is greater than the upgradient sediment concentration. The alternate benchmark selected for antimony is the ER-L of 2 mg/kg (Long and Morgan, 1991).The ER-L values were developed by first sorting the chemical concentrations in sediment samples that were associated with adverse effects by ascending concentrations. The ER-L is the lower 10th percentile of the data and indicates the low end of the range of concentrations in which effects were observed or predicted. The ER-M is the 50th percentile of the data and indicates the point above which adverse effects to sediment invertebrate are probable. The ER-M for antimony is 25 mg/kg.

Antimony was detected in two of the four site samples at concentrations slightly greater than the ER-L, but the concentrations were much less than the ER-M. Therefore, effects to sediment invertebrates are possible, but not probable. Note that there is some uncertainty in using the ER-L to evaluate risks to sediment dwelling invertebrates at SWMU 5 because saltwater studies were used to develop the ER-L.

The maximum detected concentration was in the sediment sample collected at 05SD05, which is the drainage swale with very little aquatic habitat. Therefore, risks to sediment invertebrates in this area are unlikely because the invertebrates are not likely to be present. The other detected concentration greater than the ER-L, was a concentration of 2.2 mg/kg in the sediment sample collected at 05SD02. This concentration just slightly exceeded the ER-L so effects to sediment invertebrates are unlikely.

In summary, two sediment samples had detected concentrations of antimony slightly greater than the ER-L. Effects to sediment dwelling invertebrates are unlikely because of the lack of suitable habitat at one location and marginal exceedance of the ER-L at the other location. For that reason, risks to benthic invertebrates from antimony are acceptable so antimony is not retained as a COPC for risks to sediment dwelling invertebrates.

Barium

Barium was initially selected as a COPC because a Region 5 screening level is not available and the maximum concentration (148 mg/kg) is greater than the upgradient sediment concentration. The only available alternate benchmark for barium is the Apparent Effects Threshold (AET) of 48 mg/kg (Buchman, 1999). Based on the Navy's agreement with U.S. EPA, if a chemical only has a higher effects level such as an AET, the chemical will not be eliminated as a COPC even if the maximum detection is below the higher effects level, unless other Step 3a factors can be used to justify the chemical's elimination as a COPC. Barium was detected in all four sediment samples at SWMU 5 at concentrations ranging from 76.6 mg/kg to 148 mg/kg) which are greater than the AET and the upgradient sediment concentration (55 mg/kg). To put the concentrations in perspective, the barium concentrations in all of the sediment samples are within the soil background data set for NSWC Crane (24.8 mg/kg - 155 mg/kg). This indicates that although the barium concentrations are elevated compared to the upgradient sediment sample, they are not significantly elevated in the sediment at the site. Additionally, the aquatic habitat at SWMU 5 is poor; potential risks to aquatic organisms from barium in the sediment are not great enough to warrant retaining it as a COPC for further evaluation in the BERA.

Cadmium

Cadmium was initially selected as a COPC because the maximum detected sediment concentration (2.5 mg/kg) exceeded the Region 5 screening level of 0.596 mg/kg and was greater than the upgradient sediment concentration. The most recent EDQL (now called ESLs) (U.S. EPA, 2003) is based on the TEC. The TEC, along with the PEC were used to further evaluate risks to sediment invertebrates from exposure to cadmium in the sediment, as follows:

- Consensus-based TEC – 0.99 mg/kg (MacDonald et al., 2000)
- Consensus-based PEC – 4.98 mg/kg (MacDonald et al. 2000)

The maximum cadmium concentration is greater than the TEC, but less than the PEC. Based on the toxicological basis of the TEC and PEC as presented above for Aroclor-1260, impacts to benthic invertebrates from cadmium concentrations in the sediment are possible. However, cadmium was only detected in one of the four sediment samples, at location 05SD05, where the aquatic habitat is poor to non-existent. Location 05SD05 is a drainage swale that is typically dry and is not likely to support benthic organisms. Therefore, effects to sediment invertebrates from cadmium are unlikely so risks are acceptable; cadmium is not retained as a COPC. Because cadmium is a bioaccumulative chemical, risks to piscivorous wildlife from cadmium are evaluated in Section 5.7.6.2 of this ERA.

Copper

Copper was initially selected as a COPC because the maximum detected sediment concentration (37.1 mg/kg) exceeded the Region 5 screening level of 16 mg/kg and was greater than the upgradient sediment concentration. The most recent EDQL (now called ESLs) (U.S. EPA, 2003) is based on the TEC. The TEC, along with the PEC were used to further evaluate risks to sediment invertebrates from exposure to copper in the sediment, as follows:

- Consensus-based TEC – 31.6 mg/kg (MacDonald et al., 2000)
- Consensus-based PEC – 149 mg/kg (MacDonald et al., 2000)

The maximum copper concentration is slightly greater than the consensus-based TEC in the sediment sample collected at 05SD05, but the concentration is much lower than the consensus based PEC. All other detected copper concentrations were less than the TEC. Based on the toxicological basis of the TEC and PEC as presented above for Aroclor-1260, impacts to sediment invertebrates from concentrations in the sediment are possible. However, location 05SD05 is a drainage swale that is

typically dry and is not likely to support benthic organisms. Therefore, effects to sediment invertebrates from copper are unlikely so risks are acceptable; copper is not retained as a COPC. However, because copper is a bioaccumulative chemical, risks to piscivorous wildlife from copper are evaluated in Section 5.7.6.2 of this ERA.

Lead

Lead was initially selected as a COPC because the maximum detected sediment concentration in sample 05SD050006 (130 mg/kg) exceeded the Region 5 screening level of 31 mg/kg and was greater than upgradient sediment concentrations. The most recent EDQL (now called ESLs) (U.S. EPA, 2003) is based on the TEC. The TEC, along with the PEC were used to further evaluate risks to sediment invertebrates from exposure to lead in the sediment, as follows:

- Consensus-based TEC – 35.8 mg/kg (MacDonald et al., 2000)
- Consensus-based PEC – 128 mg/kg (MacDonald et al., 2000)

The maximum lead concentration is greater than the TEC and slightly greater than the PEC. All other detected lead concentrations were less than the TEC. Based on the toxicological basis of the TEC and PEC as presented above for Aroclor-1260, impacts to sediment invertebrates from concentrations in the sediment are probable. However, location 05SD05 is a drainage swale that is typically dry and is not likely to support benthic organisms. Therefore, effects to sediment invertebrates from lead are unlikely so risks are acceptable; lead is not retained as a COPC. However, because lead is a bioaccumulative chemical, risks to piscivorous wildlife from lead are evaluated in Section 5.7.6.2 of this ERA.

Manganese

Manganese was initially selected as a COPC because a Region 5 screening level is not available and the maximum concentration (812 mg/kg) is greater than the upgradient sediment concentration so the following alternate benchmarks were used to further evaluate risks to sediment invertebrates:

- Canadian Sediment Guidelines LEL – 460 mg/kg (OMOE, 1993)
- Canadian Sediment Guidelines SEL – 1,1 00 mg/kg (OMOE, 1993)

The LEL indicates the level of sediment contamination which has no effect on and can be tolerated by the majority of sediment-dwelling organisms. The Canadian sediment guidelines were developed by first calculating the 90th percentile of the concentrations evaluated in toxicity studies where a species was

present, and then plotting the 90th percentile concentrations for all of the species considered to develop the guideline. The 5th percentile of the plot was selected as the LEL for metals and the 95th percentile from the plot was selected as the SEL for metals.

Manganese was detected at a maximum concentration of 812 mg/kg in sample 05SD030006 and the manganese concentrations in two of the four site samples exceed the LEL; none of the detected concentrations of manganese were greater than the SEL. Based on the definition of the LEL and SEL, potential impacts to benthic invertebrates at those locations are possible. However, manganese concentrations in the surface soil samples are within background concentrations and are not site-related. Because the source of manganese in the sediment would be surface soil runoff, it is likely that the manganese in the sediment is also not related to site activities. Therefore, although some risks may be possible to sediment dwelling invertebrates (even though the habitat is poor), these risks are not great enough to warrant carrying manganese through a BERA and manganese is not retained as a COPC.

Vanadium

Vanadium was initially selected as a COPC because a Region 5 screening level is not available and the maximum concentration (16.7 mg/kg) is greater than the upgradient sediment concentration. The only available alternate benchmark for vanadium is the AET of 57 mg/kg (Buchman, 1999). As mentioned above for barium, the Navy has agreed with the U.S. EPA to not eliminate a COPC if the chemical only has a higher effects level, unless other Step 3a factors can be used to justify the chemical's elimination as a COPC. For vanadium, the chemical concentrations in the sediment ranged from 10.2 mg/kg to 16.7 mg/kg, which were less than and only slightly greater than the concentration in the upgradient sample of 15.1 mg/kg and less than the AET. Therefore, although risks to benthic invertebrates can not be ruled out because of the lack of lower-effects toxicity data, any potential site-related risks from vanadium are not great enough to warrant carrying vanadium through the BERA process. Vanadium is not retained as a COPC for risks to sediment dwelling invertebrates.

Zinc

Zinc was initially selected as a COPC because the maximum detected sediment concentration (243 mg/kg) in sample 05SD050006 exceeded the Region 5 screening level. All other concentrations from this site were at or below 110 mg/kg. The most recent EDQL (now called ESLs) (U.S. EPA, 2003) is based on the TEC. The TEC, along with the PEC were used to further evaluate risks to sediment invertebrates from exposure to zinc in the sediment, as follows:

- Consensus-based TEC – 121 mg/kg (MacDonald et al., 2000)
- Consensus-based PEC – 459 mg/kg (MacDonald et al. 2000)

The maximum concentration of zinc (at location 05SD05) in the sediment samples is greater than the TEC, but the concentration is less than the PEC; none of the other samples had zinc concentrations that exceeded the TEC. Location 05SD05 is a drainage swale that is typically dry and is not likely to support benthic organisms. Therefore, effects to sediment invertebrates from zinc are unlikely so risks are acceptable; zinc is not retained as a COPC. However, because zinc is a bioaccumulative chemical, risks to piscivorous wildlife from zinc are evaluated in Section 5.7.6.2 of this ERA.

5.7.6.1.3 Surface Water

Table 5-30 presents a summary of the common alternate benchmarks used in refining the list of COPCs in surface water, along with a summary of the Step 3a evaluation. The upgradient surface water concentrations are presented in Table 5-26. Water-quality standards (WQS) for surface water have been developed for Indiana (IDEM, 1998). In addition, U.S. EPA has established water-quality criteria (WQC) for a few contaminants (U.S. EPA, 2002). The Indiana WQS were not used in the evaluation because the WQS are based on the dated U.S. EPA WQC. Therefore, it is more appropriate to use the updated U.S. EPA WQC.

Surface water samples were collected during the winter and because the surface water was frozen, the field crew broke through the ice to collect some of the samples. A site visit for SWMU 5 was conducted on June 9, 2004 with representatives from the Navy, USEPA Region 5, IDEM, and TtNUS. During that site visit, it was noted that the creek by 05SD02 was very narrow (approximately one foot wide) and only a few inches deep. There were orange seeps discharging to the surface water, likely from the rusting metal debris located adjacent to the stream. No fish were observed in the stream and it is unlikely that significant numbers of fish would inhabit the stream based on its small size. It is more likely that the aquatic invertebrates would be present in the surface water, although their numbers would also be limited by the poor aquatic habitat. Figure 1-9 includes photographs of the stream taken during the field sampling event.

The aquatic habitat at location 05SD05 is very minimal. Although the photograph of this location in Figure 1-9 shows the presence of water, the area was completely dry during the June 9, 2004 sampling event, and appeared to be a washout area. The runoff from this washout area drains to a concrete culvert along the road as is visible in Figure 5-10. It is likely that this area is only wet during periods of rain, snowmelt,

or other wet times of the year. Therefore, there is no potential for fish to live in this area and little potential for aquatic organisms.

The following paragraphs present the Step 3a evaluation for evaluating risks to aquatic organisms.

Total PECDD

Total PECDD was initially selected as a COPC because the maximum detected surface water concentration at sample location 05SW04 (0.0000094 µg/L) exceeded the Region 5 screening level of 0.000000278 µg/L. PECDD has a TEF of 1.0 indicating that its toxicity is similar to 2,3,7,8-TCDD. In the Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife (U.S. EPA, 1993), water concentrations associated with low risk to fish are provided for waters with different particulate organic carbon (POC) concentrations. These concentrations are 0.0000006 µg/L for waters with a POC of 0.2 mg/L, and 0.0000031 µg/L for waters with a POC of 1 mg/L. The maximum detected concentration of PECDD is greater than both of those values. However, as discussed above, invertebrates are more likely than fish to be present in these streams. As discussed in Section 5.7.6.1.1, aquatic invertebrates are much less sensitive to TCDD than fish, which is perhaps due to the absence of the aryl hydrocarbon (Ah) receptor, or a comparably sensitive receptor for dioxins USEPA (1993). Therefore, it is unlikely that the PECDD detection in the one surface water sample will adversely impact aquatic organisms in the stream at SWMU 5. Consequently, risks to aquatic organisms from PECDD are acceptable so PECDD is not retained as a COPC for further evaluation of risks to aquatic organisms. Because dioxins are bioaccumulative chemicals, risks to piscivorous wildlife from PECDD are evaluated in Section 5.7.6.2 of this ERA.

Cis-1,2-dichloroethene

Cis-1,2-dichloroethene was initially selected as a COPC because no Region 5 surface water screening level is available. The maximum detected surface water concentration was 290 µg/L at sample location 05SW0201 and is less than the current ESL for trans-1,2-dichloroethene of 970 µg/L. Therefore, cis-1,2-dichloroethene is not expected to effect aquatic organisms so risks are acceptable; cis-1,2-dichloroethene is not retained as a COPC.

Trichloroethene

Trichloroethene was initially selected as a COPC because the maximum detected surface water concentration (120 µg/L) in sample 05SW0201 exceeded the Region 5 screening level of 75 µg/L. The maximum concentration also exceeds the new ESL of 47 µg/L which is based on the ORNL Tier II

method. Trichloroethene was detected in one other sample at a concentration (48 µg/L) slightly exceeding the ESL. The presence of trichloroethene in the surface water samples was somewhat unexpected because trichloroethene is volatile, but it was likely detected because the samples were collected in winter when volatilization is lower. The concentration of trichloroethene is expected to be lower in the warmer months (because of volatilization) when the aquatic organisms are more viable. Although the detected concentrations slightly exceeded the ESLs, risks to benthic invertebrates from these VOCs are not expected because the VOCs are not likely to present during the warmer months when aquatic organisms may be present in the stream. Also note that the ESL is likely a very conservative number because the lowest chronic value for all aquatic organisms is 7,257 µg/L for daphnids, and the population effects concentration (EC)20 for trichloroethene is 232 µg/L (Suter and Tsao, 1996). The Tier II value is low because of the numerous uncertainty factors that are applied to the effects concentrations. Therefore, trichloroethene is not expected to effect aquatic organisms so risks are acceptable; trichloroethene is not retained as a COPC.

Vinyl chloride

Vinyl chloride was initially selected as a COPC because the maximum detected surface water concentration (85 µg/L) exceeded the Region 5 screening level of 9.2 µg/L. However, the maximum concentration is less than the current ESL for vinyl chloride of 930 µg/L. Therefore, risks to aquatic receptors from vinyl chloride in the surface water are acceptable and vinyl chloride is not retained as a COPC for further evaluation.

Aluminum

Aluminum was initially selected as a COPC because an EDQL is not available and the maximum concentration (204 µg/L) was greater than the site-specific upgradient surface water concentration. Aluminum was detected in unfiltered surface water samples only (204 µg/L in sample 05SW0301) but was not detected in the filtered surface water samples. Because the filtered samples represent the bioavailable portion of the metals (U.S. EPA, 1992), the filtered surface water results are most indicative of the level of direct risk to aquatic receptors. Therefore, risks to aquatic receptors from aluminum are considered acceptable and aluminum is not retained as a COPC for risks to aquatic organisms.

Iron

Iron was initially selected as a COPC because an EDQL is not available and the maximum concentration was greater than the site-specific upgradient surface water concentration. The maximum detected iron

concentration was 1,520 µg/L in unfiltered samples and 594 µg/L in filtered samples at 05SW04. Other filtered sample concentrations were 577 µg/L (in sample 05SW03) and less.

The U.S. EPA WQC (U.S. EPA, 2002) for iron is 1000 µg/L; therefore, risks to aquatic invertebrates are acceptable because iron concentrations in filtered samples (which represents the bioavailable portion of iron in the water column) are less than the WQC. Iron is not retained as a COPC for risks to aquatic organisms.

Manganese

Manganese was initially selected as a COPC because an EDQL is not available and the maximum concentration was greater than the site-specific upgradient concentration. Because an EDQL and AWQC is not available for manganese, concentrations in the surface water are compared to the following benchmark:

- ORNL SCV – 120 µg/L (Suter and Tsao, 1996)

The ORNL chronic benchmark was developed using the Tier II method described in the U.S. EPA's Proposed Water Quality Guidance for the Great Lakes System in U.S. EPA (1993b) (Suter and Tsao, 1996). Tier II values were developed so that aquatic benchmarks could be established with fewer data than are required for the U.S. EPA water quality criteria. Tier II values are concentrations expected to be higher than AWQC in no more than 20 percent of cases (Suter and Tsao, 1996). Also, in the U.S. EPA 1986 Quality Criteria for Water (the Gold Book), it states that ions of manganese are found rarely at concentrations above 1 mg/L and, because the tolerance values reported range from 1.5 mg/L to over 1000 mg/L, manganese is not considered to be a problem in fresh waters (U.S. EPA, 1986). For manganese, the maximum detected concentration was 315 µg/L (unfiltered) and 304 µg/L (filtered). Because the ORNL benchmark for manganese is very conservative (Suter and Tsao, 1996), risks to aquatic life from manganese are expected to be low especially based on the information in U.S. EPA (1986). For these reasons, risks to aquatic organisms from manganese in the surface water are acceptable and manganese is not retained as a COPC for these receptors.

5.7.6.2 Risks to Terrestrial Wildlife

The discussions in Sections 5.7.6.1 and 5.7.6.2 were not designed to evaluate risks to wildlife through ingestion of food items, drinking water, and incidental ingestion of soil. Instead, a food-chain model was used to evaluate potential risks posed by COPCs to upper-level terrestrial wildlife receptors. Section

3.4.4.2 describes the food-chain model methodology. Chemicals evaluated in the terrestrial food-chain model were limited to those identified by the U.S. EPA as bioaccumulative (U.S. EPA, 2000). Separate discussions are provided below for evaluations of potential risk to insectivorous/herbivorous and piscivorous receptors. The maximum concentration detected in the surface soil, surface water, and sediment samples is used for the conservative food chain model. The 95% UCL was not used in the FCM because less than 10 samples were collected in each of the media. The average concentration detected in the surface soil, surface water, and sediment samples is used for the average food chain model. Appendix H.4 presents the spreadsheets used to calculate the doses and EEQs. Table 5-35 presents a summary of the Step 3a evaluation for terrestrial wildlife.

5.7.6.2.1 Risks to Insectivorous/Herbivorous Receptors

Table 5-31 presents the terrestrial wildlife model EEQs based on conservative input parameters for terrestrial surrogate species (meadow vole, short-tailed shrew, American robin, and bobwhite quail). In general, NOAEL EEQs for dioxins are less than 1.0 for the meadow vole and bobwhite quail. However, many NOAEL-based EEQs for dioxins were greater than 1.0 for the short-tailed shrew and American Robin. For most inorganics, NOAEL based EEQs were greater than 1.0 for the short-tailed shrew, American robin, and bobwhite quail. Few EEQs were greater than 1.0 in the meadow vole model.

Table 5-32 presents the terrestrial wildlife model EEQs based on average exposure input parameters for those chemicals with NOAEL based EEQs greater than 1.0 under the maximum input, conservative scenario. The results of the robin model yielded more EEQs that were greater than 1.0, than the models for the other receptors. NOAEL EEQs for three individual dioxins and four total dioxins were greater than 1.0 in the robin model but the LOAEL EEQs were greater than 1.0 for only two total dioxins. NOAEL EEQs for two total dioxins were greater than 1.0 in the shrew model but no LOAEL EEQs were greater than 1.0. The NOAEL and LOAEL for birds used in the food chain model are based on a study in which egg production and hatchability was significantly reduced among birds receiving 0.00014 mg/kg/d dose of 2,3,7,8-TCDD. No significant effects were observed among the other two lower dose levels tested. Because no significant differences were observed at the two lower dose levels and the study considered exposure throughout a critical lifestage (reproduction), the 0.000014 mg/kg/d dose was considered to be a chronic NOAEL and the 0.00014 mg/kg/d dose was considered to be a chronic LOAEL. The NOAEL and LOAEL for mammals that were used in the food chain model is based on a study in which fertility and neonatal survival was significantly reduced among rats receiving 0.0001 and 0.00001 µg/kg/d dose of 2,3,7,8-TCDD but no significant differences were observed at the 0.000001 mg/kg/d dose level. Because the study considered exposure throughout 3 generations including critical lifestages (reproduction), 0.000001 mg/kg/d dose was considered to be a chronic NOAEL and 0.00001 mg/kg/d dose was

considered to be a chronic LOAEL. Therefore, it is possible there may be some reproductive effects to mammals and birds exposed to dioxins in the soils at SWMU 5 through the food chain.

NOAEL EEQs for six inorganics were greater than 1.0 in the robin model and the LOAEL EEQs were greater than 1.0 for four inorganics. The NOAEL EEQ for one inorganic was greater than 1.0 in the shrew model but no LOAEL EEQs were greater than 1.0. Finally, NOAEL EEQs for two inorganics were greater than 1.0 in the quail model and the LOAEL EEQs were greater than 1.0 for one inorganic. As presented in the TRV table in Appendix H.3, the NOAELs and LOAELs that were used in the food chain models were based primarily on reproductive studies. Therefore, it is possible that there are some reproductive effects to mammals and birds exposed to metals in the soils at SMWU 5 through the food chain.

Average COPC concentrations are typically more realistic exposure point concentrations (EPCs) for mammals and birds than maximum concentrations because mammals and birds are exposed to COPC concentrations throughout the SWMU, rather than a single location. As mentioned previously, the maximum concentration of several metals were reported for sample 05SB060002, which was likely because metal shavings in the sample were undoubtedly analyzed along with the soil. Therefore, there is a lot of uncertainty regarding actual risks to wildlife because the bioavailability of the metals, especially the metals related to the metal shavings, is expected to be low so risks are likely overestimated. Also, the bioavailability of the dioxins in the soil is not known, but it is likely to be low since a portion of the dioxins are likely bound to the organic matter in the soil.

In summary, because the EEQs based on the LOAEL exceed 1.0 for dioxins and metals, it is possible that there are some reproductive effects to mammals and birds exposed to dioxins and metals in the soils at SWMU 5 through the food chain. However, there is a lot of uncertainty in this conclusion because the bioavailability of the chemicals in the soil is not known. Table 5-35 summarizes the Step 3a evaluation for wildlife.

5.7.6.2.2 Risks to Piscivorous Species

Table 5-33 presents the terrestrial wildlife model EEQs based on conservative input parameters for piscivorous surrogate species (raccoon and belted kingfisher). Four individual dioxins, dibenzo(a,h)anthracene, Aroclor-1260, and all four inorganics retained as COPCs (see Table 5-30) had NOAEL based EEQs greater than 1.0 in the raccoon food chain model; however, only Aroclor-1260 and the inorganics had LOAEL based EEQs greater than 1.0 in the raccoon model. Only Aroclor-1260 and lead had NOAEL based EEQs greater than 1.0 in the kingfisher model at 6.3 and 3.6, respectively; LOAEL based EEQs for these chemicals were less than 1.0.

Table 5-34 presents the terrestrial wildlife model EEQs based on average exposure input parameters (including NOAELs and LOAELs) for those chemicals with NOAEL based EEQs greater than 1.0 under the maximum input, conservative scenario. 2,3,7,8-TCDD, Aroclor-1260, and all four inorganics retained as COPCs had NOAEL based EEQs greater than 1.0 in the raccoon model. Aroclor-1260 and lead had NOAEL based EEQs greater than 1.0 in the kingfisher mode. Although, the LOAEL EEQs calculated for several chemicals were greater than 1.0, actual risks to piscivorous wildlife are unlikely for the following reasons:

- The water bodies associated with SWMU 5 are only expected to account for a small portion of the raccoon's diet, if any, because the home range of the raccoon (>250 acres) is much larger than the SWMU, and the water body is small. Also, fish have not been observed in the small drainage pathways at SWMU 5 and are unlikely to be present in quantities that would support a significant portion of the diet for piscivorous wildlife.

- EEQs for chemicals in the raccoon food chain model are high primarily because of the weight of the raccoon and the conservative body weight scaling used to calculate the TRVs for the raccoon. Because the raccoon has a greater body weight than the test species used in developing the TRVs, the NOAELs and LOAELs are calculated to be lower than TRVs developed with the test species, increasing the calculated risk. This approach is conservative but may be overpredicting actual risk.

- All the metals have high EEQs, in part, because there are no sediment to fish BAF values for inorganics. Therefore, a BAF of 1.0 is used in the model, which assumes that the fish tissue concentrations are equal to the sediment concentrations. This likely overestimates the exposure dose to the raccoon, which then increases the calculated EEQs.

- The only PCB detection was at sample location 05SD05, which was collected in a drainage ditch that is dry most of the time. Therefore, raccoons or birds will not be consuming aquatic organisms from this area so impacts to piscivorous wildlife from PCBs in the sediment are not expected.

For the reasons listed above, risks to piscivorous mammals are acceptable and Aroclor-1260 and metals are not retained as COPC in sediment for risks to piscivorous birds and mammals. Table 5-35 summarizes this Step 3a evaluation for wildlife.

5.7.7 Ecological Risk Uncertainty Analysis

Section 3.4.6 in the general methodology section presents the uncertainties that apply to all the SWMUs. The uncertainty analysis presented in this section presents the uncertainties associated with the SWMU 5.

5.7.7.1 Measurement and Assessment Endpoints

As presented in Section 5.7.2, several assessment endpoints were selected for this risk assessment, including the selection of piscivorous wildlife as an assessment endpoint. The waterbody adjacent to SWMU 5 is very small and highly unlikely to contain a significant fish population. In fact, fish were not observed in the small drainage channels during a site visit in June 2004. Therefore, risks to these receptors are overestimated.

Risks to reptiles and amphibians are not quantitatively evaluated because exposure factors are not established for most species, and toxicity data are very limited. Using aquatic organisms as a surrogate species, risks to amphibians exposed to the surface water and sediment are expected to be low based on the Step 3a evaluations. Additionally, amphibians are not likely present at SWMU 5 in significant populations because these species are dependent on aquatic habitats for at least some stages in their life cycles. Potential risks to reptiles cannot be evaluated in this SERA because of a lack of toxicity and exposure data (see below for a discussion of potential risks to the timber rattlesnake).

Food-chain modeling was not conducted for large carnivorous mammals and birds for several reasons including, the uncertainty of estimating contaminant uptake into the diet source (small mammal tissue) and area use factors (presented in Appendix H.2). Sixteen individual dioxins, six total dioxins, one VOC, two PAHs, and 11 inorganics were retained as COPCs in surface soil samples. Of these chemicals, only the dioxins and seven inorganics are considered important bioaccumulative chemicals (U.S. EPA, 2000). Dioxins and metals were detected at SWMU 5 and these chemicals are bioaccumulative. However, the low EEQs in the food chain models conducted for SWMU 5 indicate that these compounds are not causing great risks to small insectivorous/herbivorous mammals. For example, the greatest risks from dioxins occurred for the robin with the average input LOAEL EEQs for total TCDD and total TCDF of 1.2 and 3.5, respectively. Therefore, although some chemicals detected at SWMU 5 may accumulate in the tissue of small mammals, risks to large carnivorous birds and mammals are expected to be lower than the risks to the small herbivorous or insectivorous mammals and birds. This is because the accumulation factors from soil to wildlife, soil to plants, and soil to invertebrate are similar (U.S. EPA, November 1999) but carnivorous birds and mammals are only expected to obtain a small fraction of their food from SWMU

5. The boundaries of SWMU 5 are approximately 25 acres and home ranges of the red fox and red-tailed hawk are 193 acres and 370 acres, respectively (U.S. EPA, 1993). The food chain EEQs assume that the small herbivorous or insectivorous mammals and birds at SWMU 5 obtain all of their food from the site. Finally, metals typically do not biomagnify in terrestrial systems (Newman, 1998).

As discussed in Section 1.3.7, several endangered and threatened species or species of special concern are present at NSWC Crane, and potentially may inhabit SWMU 5. Risks to these species were not specifically calculated so the uncertainties of not calculating risks to these species are presented here. As discussed above, risks to large carnivorous mammals and birds are expected to be negligible so risks to the bobcat, bald eagle, Northern harrier, and osprey are expected to be negligible, as are risks to carnivorous reptiles such as the timber rattlesnake. Loggerhead shrikes and the sedge wren consume mostly aboveground insects such as caterpillars, beetles, spiders, and flies, as opposed to the worms that are consumed by the American robin in the food-chain model. Because worms are in direct contact with exposure to the soil, it is expected that they would have greater levels of contaminants at SWMU 5 than aboveground insects; therefore, risks to the robin from consuming worms are expected to be greater than risks to the loggerhead shrike and sedge wren from consuming aboveground insects. Risks to the worm eating American robin from chemicals in the surface soil and surface water were unacceptable; therefore, risks to the loggerhead shrike and sedge wren are possible if present at SWMU 5. The American bittern is a marshland loving bird that feeds on fish, frogs, eels, insects, and water snakes. Although there is some aquatic habitat, it is not suitable for the bittern. Additionally, risks to the belted kingfisher were acceptable; therefore, risks to the American bittern, if present at SMWU 5, would also be acceptable.

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 1.3.7, one threatened reptilian species is listed as potentially present at NSWC Crane. Based on the preferred habitat of the timber rattlesnake and the ecology of SWMU 5, this species may potentially inhabit areas of SWMU 5. Risks to these species were not specifically calculated so uncertainties exist as to how this species would be affected if an exposure to site chemical concentrations occurred.

5.7.7.2 Exposure Characterization

Although some of the metals are elevated in a few samples, the greatest metal concentrations occur in the sample collected from 05SB006. Several of the metals in this sample are an order of magnitude greater than the next highest metal detection at the SWMU, which is causing the exposure point concentration to be biased high. In fact, the high average metals concentrations at this SWMU are caused by the elevated detection at 05SB006. As presented in Section 5.7.5.1, the field log sheet from

this sample location indicated that metal shavings were present in the surface soil sample. Most of the metal in this sample is not likely to be bioavailable, so actual risks are expected to be much lower than predicted from the screening levels and the models.

5.7.7.3 Ecological Effects Data

Toxicological data for a few of the chemicals are limited or do not exist. This occurred for a few inorganics in the surface soil, but it did not affect the outcome of the risk assessment because the chemicals without toxicity data were detected below base-specific background levels. This also occurred for some inorganics in the sediment, but it did not affect the outcome of the risk assessment because the chemicals without toxicity data were evaluated using other Step 3a factors.

Several alternative benchmark values were used to gain a better understanding of the relationship between the maximum concentration values of the selected COPCs to the overall ecological assessment of the site. There is some uncertainty involved when using these alternative benchmarks (Table 5-28). However, attempts have been made to lessen the uncertainties by providing the toxicological basis of the alternate benchmarks when they were used.

5.8 CONCLUSIONS

Tables 5-28, 5-29, 5-30, and 5-35 present summaries of the Step 3a evaluation including the overall conclusion of whether chemicals initially selected as COPCs are retained as COPCs after the refined evaluation.

Terrestrial Plants and Invertebrates

After the initial screening, 16 individual dioxins and six total dioxins, one VOC, two SVOCs, and 11 inorganics were selected as COPCs. The potential risks to terrestrial vegetation and soil invertebrates associated with all the COPCs in the surface soil were further evaluated to determine whether site-related risks from the chemicals were acceptable or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

It was determined that the concentrations of dioxins in the surface soil at the SWMU were unlikely to affect plants or invertebrates at the site. That was based on effects levels that were found for invertebrates, and the fact that the Ah receptor has not been detected in plants or invertebrates. The Ah receptor is important because the dioxins need to bind to the receptor in order to cause toxicity. No benchmark was available to determine the toxicity to plants and invertebrates from

cis-1,2-dichloroethene, but it is unlikely that cis-1,2-dichloroethene will be detected in the surface soil during the warmer months when receptors would be present and/or growing. Therefore, it is unlikely that cis-1,2-dichloroethene in the soil is adversely impacting plants or invertebrates. Finally, bis(2-ethylhexyl)phthalate and naphthalene were detected at concentrations less than benchmarks for plants and invertebrates so these chemicals are not likely to impact plants and invertebrates at SWMU 5. For these reasons, risks from organic chemicals in the surface soil are acceptable so no organic chemicals detected in the surface soil at SWMU 5 are retained as COPCs for risks to plants or invertebrates.

The majority of the metals detected in the soil samples were found at concentrations that exceeded benchmarks based on effects to plants and invertebrates. However, it was determined that cadmium and mercury levels in the soil were not great enough to impact plants or invertebrates and chromium, silver, and tin concentrations were not great enough to impact invertebrates. Also, based on the soil pH, it was concluded that iron in the soil was not expected to be toxic to plants and because iron is not typically considered to toxic, impacts to invertebrates are not expected. Therefore, these metals were not retained as COPCs for risks to plants and/or invertebrates.

The majority of the metals that were retained as COPCs for risks to plants and invertebrates had their greatest detected concentrations in the northern area of the SWMU, and specifically in sample 05SB060002. According to the sample log sheets (see Appendix B), sample 05SB060002 contained metal shavings which likely contributed to the very high metals concentrations in this sample because some of the shavings were undoubtedly analyzed along with the soil. Although the extremely high metals concentrations were only found in one sample, various metal debris piles are located throughout the area (and the steep drop-off into the main gully) including rusted drums, metal shavings and other pieces of metal. Therefore, the metals contamination in the soil cannot be bounded by soil samples. The reason is that the levels of metals in the soil sample are reflective of where a sample is collected (i.e. near metal debris) or if some small pieces of metal are in the sample. Therefore, two samples relatively close in proximity could have large differences in metals concentrations, if one sample contained metal fragments and the other did not.

Because some of the metal shavings were likely inadvertently analyzed along with soil sample, it is not known what percentage of the metals in the sample was actually in the soil versus the percentage that was from the metals shavings. The importance of this is that the amount of metal related to the shavings are likely not very bioavailable, while the amount in the soil may be somewhat more bioavailable. Therefore, it is difficult to determine if plants and invertebrates are being significantly impacted from the metals in the soil. As seen in the site photographs on Figure 1-9, the site in the area of the metal debris

is heavily vegetated so the metals do not appear to be significantly impacting the plant community in this area. However, whether there are subtle effects to the plants cannot be determined based on the available information. Also, although the health of the invertebrates was not observed, it is unlikely that invertebrates are being impacted because invertebrates are necessary to sustain a health plant community.

In summary, because of the high detected concentrations of several inorganic chemicals, and because of the uncertainty regarding whether there are actual risks to plants and invertebrates from these chemicals, risks from organic chemicals in the surface soil are unacceptable. Therefore, several metals were retained as COPCs for risks to plants or invertebrates. Also, because dioxins and several of the inorganic chemicals are bioaccumulative, risks to wildlife from these chemicals in the surface soil are evaluated in Section 5.7.6.2 of this ERA.

Sediment Invertebrates

After the initial screening, 15 individual dioxins, two total dioxins, two VOCs, two SVOCs, one PCB, and nine inorganics were selected as COPCs. Potential risks to sediment invertebrates associated with all the COPCs in the sediment were further evaluated to determine whether site-related risks from the chemicals were acceptable and/or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

It was determined that the concentrations of dioxins in the sediment at the SWMU were unlikely to impact sediment invertebrates at the site. That was because the detected concentrations of dioxins at the site were less than effects levels for fish, and because invertebrates are much less sensitive to dioxins than are fish, impacts to invertebrates are not likely. Although the detected concentrations of the two VOCs are greater than the new ESLs, the location of the maximum concentration (05SD02) is very poor aquatic habitat. The concentrations of the VOCs are expected to be lower in the warmer months (because of volatilization) when the sediment dwelling invertebrates are more viable. Also, the VOCs were not detected in the downgradient sediment sample location (05SD03) which indicates that they are either volatilizing and/or diluting after a short distance (see Figure 5-11). Therefore, risks to benthic invertebrates from VOCs in the sediment are not expected. The maximum total PAHs concentration is less than the TEC indicating risks to sediment dwelling organisms are not expected. Finally, the only detected Aroclor-1260 concentration in a SWMU 5 sediment sample is greater than the TEC but much less than the PEC so impacts to benthic invertebrates are possible. However, because of the poor habitat at 05SD02 (the location of the PCB detection), potential risks in the vicinity of location 05SD02 are not great enough to warrant carrying Aroclor-1260 in the sediment through a BERA. For the reasons

presented above, no organic chemicals were retained as COPCs for risks to sediment dwelling invertebrates.

Of the inorganic chemicals, the maximum detected concentrations of aluminum was less than the lower effects level indicating risks to sediment dwelling organisms are not expected. Several of the inorganics were detected at concentrations that were greater than lower effects levels but less than the higher effects level indicating the potential impacts to sediment invertebrates were possible. Lead was the only chemical with a detected concentration that was slightly greater than a higher effects level. Sediment samples collected at 05SD02 and 05SD05 generally had the greatest concentrations of most metals. The creek by 05SD02 is very small (approximately one foot wide) and only a few inches deep (see photographs in Figure 1-9). There are orange deposits on the sediment, likely from the rusting metal debris located adjacent to the stream and the stream sediment consisted of a fine silt, which is poor habitat for benthic invertebrates. No fish were observed in the stream and it is unlikely that significant numbers of fish would inhabit the stream based on its small size. The aquatic habitat at location 05SD05 is very minimal. Although the photograph of this location in Figure 1-9 shows the presence of water, the area was completely dry during the June 9, 2004 sampling event, and appeared to be a washout area. The runoff from this washout area drains to a concrete culvert along the road as is visible in Figure 5-10. It is likely that this area is only wet during periods of rain, snowmelt, or other wet times of the year. Therefore, there is no potential for fish to live in this area and little potential for benthic invertebrates. Because of the poor aquatic habitat at SWMU 5, the presence of chemicals in the sediment at concentrations between the higher effects levels and lower effects levels does not warrant their retention as COPCs for risks to sediment dwelling invertebrates.

In summary, no chemicals were retained as COPCs for risks to sediment invertebrates. However, because several of the organic and inorganic chemicals are bioaccumulative, risks to piscivorous wildlife from these chemicals in the sediment are evaluated in Section 5.7.6.3 of this ERA.

Aquatic Organisms

After the initial screening, dioxins, three VOCs and three inorganics were initially selected as COPCs. Potential risks to aquatic receptors associated with all the COPCs in the surface water were further evaluated to determine whether site-related risks from the chemicals were acceptable or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

The maximum detected concentration of PECDD is greater than water concentrations associated with low risk to fish are provided for waters with different particulate organic carbon (POC) concentrations.

However, invertebrates are more likely than fish to be present in these streams and aquatic invertebrates are much less sensitive to TCDD than fish. Therefore, it is unlikely that the one detection of PECDD in the surface water sample will adversely impact aquatic organisms in the stream at SWMU 5. Cis-1,2-dichloroethene and vinyl chloride were detected at concentrations that were less than the new region 5 ESLs. Therefore, risks to aquatic organisms from those chemicals are not likely. Trichloroethene was detected at concentrations in two samples that exceeded the Region 5 ESL. The presence of trichloroethene in surface water was somewhat unexpected because trichloroethene is volatile, but it was likely detected because the samples were collected in winter when volatilization is lower. The concentration of trichloroethene is expected to be lower in the warmer months (because of volatilization) when the aquatic organisms are more viable. Therefore, risks to aquatic organisms from trichloroethene are not expected. For the reasons presented above, risks from organic chemicals in the surface water are acceptable so no organic chemicals were retained as COPCs for risks to aquatic organisms.

Of the four inorganic chemicals retained as COPCs in surface water, aluminum was not detected in the filtered samples so risks to aquatic receptors from aluminum are not likely. Also, the concentrations of iron were less than U.S. EPA WQC so risks to aquatic receptors from these metals are not likely. Finally, the manganese levels in surface water are below levels expected to cause toxicity to aquatic receptors. Therefore, risks to aquatic receptors from inorganics in the surface water at SWMU 5 are acceptable so the inorganics were eliminated as COPCs for risks to aquatic receptors.

In summary, no chemicals were retained as COPCs for risks to aquatic organisms.

Summary of Food Chain Modeling

After the initial screening, several organic and inorganic chemicals were initially selected as COPCs for potential risks to mammals and birds. In Step 3a, dioxins and seven inorganics in soil/surface water were included in the food chain model for insectivorous and herbivorous mammals and birds. Also, dioxins, one PAH, one PCB, and four inorganics in sediment/surface water were included in the food chain model for piscivorous mammals and birds. The potential risks to mammals and birds associated with all the COPCs in the surface soil, sediment, and/or surface water were further evaluated to determine whether site-related risks from the chemicals were acceptable or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

Risks to Insectivorous/Herbivorous Receptors

In the less conservative food chain model, the results of the robin model yielded more EEQs that were greater than 1.0, than the models for the other receptors. NOAEL and LOAEL EEQs for several dioxins were greater than 1.0 in the robin model and NOAEL EEQs for two dioxins were greater than 1.0 in the shrew model but no LOAEL EEQs were greater than 1.0. Because the NOAELs and LOAELs for dioxins were developed from reproductive studies, it is possible that there are some reproductive effects to mammals and birds feeding at SWMU 5 from dioxins in the soil.

NOAEL and LOAEL EEQs for inorganics were greater than 1.0 in the robin and quail models. The NOAEL EEQ for one inorganic was greater than 1.0 in the shrew model but no LOAEL EEQs were greater than 1.0. Because the NOAELs and LOAELs for most of the inorganics were developed from reproductive studies it is possible that there are some reproductive effects to mammals and birds feeding at SWMU 5 from inorganics in the soil.

Sample 05SB060002 had some of the greatest detected concentrations of metals at the site, which was likely because metal shavings in the sample were undoubtedly analyzed along with the soil. Therefore, there is a lot of uncertainty regarding actual risks to wildlife because the bioavailability of the metals, especially the metals related to the metal shavings, is expected to be low so risks are likely overestimated. Also, the bioavailability of the dioxins in the soil is not known, but it is likely to be low since a portion of the dioxins are likely bound to the organic matter in the soil.

In summary, because the EEQs based on the LOAEL exceed 1.0 for dioxins and metals, it is possible that there are some reproductive effects to mammals and birds feeding at SWMU 5 from dioxins and inorganics in the soil. However, there is a lot of uncertainty in this conclusion because the bioavailability of the chemicals in the soil is not known.

Risks to Piscivorous Receptors

In the less conservative food chain model, 2,3,7,8-TCDD, Aroclor-1260, and all four inorganics retained as COPCs had NOAEL based EEQs greater than 1.0 in the raccoon model. Aroclor-1260 and lead had NOAEL based EEQs greater than 1.0 in the kingfisher mode. Also, several of the chemicals had LOAEL based EEQs greater than 1.0 in the raccoon model. Although, the LOAEL EEQs calculated for several chemicals were greater than 1.0, actual risks to piscivorous wildlife are unlikely for the following reasons:

- Because of the small size of the water bodies at SWMU 5, and the lack of fish in these water bodies, and home range of piscivorous wildlife, food obtained from these streams, if any, will only account for a very small portion of the diet for piscivorous wildlife.

- The NOAELs and LOAELs used in the raccoon food chain model are lower than TRVs developed with the test species, because of the body scaling equation used to calculate the TRVs. This approach is conservative but may be overpredicting actual risk.

- Because there are no sediment to fish BAFs for inorganics, a BAF of 1.0 is used in the model, which assumes that the fish tissue concentrations is equal to the sediment concentrations. This likely overestimates the exposure dose to the raccoon, which then increases the calculated EEQs.

- The only PCB detection was at sample location 05SD05, which was collected in a drainage ditch that is dry most of the time. Therefore, raccoons or birds will not be consuming aquatic organisms from this area so impacts to piscivorous wildlife from PCBs in the sediment are not expected.

For the reasons listed above, risks to piscivorous mammals are acceptable and Aroclor-1260 and metals are not retained as COPC in sediment for risks to piscivorous birds and mammals.

TABLE 5-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Location	Sample Depth	Sample Number	Analyses								
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs (PAHs via SIM)	App. IX Pest./PCBs	App. IX Herbicides	Dioxins/ Furans	TAL Metals + Sn	Cyanide	Miscellaneous Parameters(1)
05SB07	0 - 2 feet	05SB070002	NA	NA	X	X	X	X	X	X	NA
	1 - 2 feet	05SB070102	X	X	NA	NA	NA	NA	NA	NA	NA
	6 - 8 feet	05SB070608	X	X	X	X	X	X	X	X	NA
05SB08	0 - 2 feet	05SB080002	NA	NA	X	X	X	X	X	X	NA
	1 - 2 feet	05SB080102	X	X	NA	NA	NA	NA	NA	NA	NA
SEDIMENT											
05SW/SD01	0 – 6 inches	05SD010006 (upgradient)	X	X	X	X	X	X	X	X	TOC
05SW/SD02	0 – 6 inches	05SD020006	X	X	X	X	X	X	X	X	TOC
05SW/SD03	0 – 6 inches	05SD030006	X	X	X	X	X	X	X	X	TOC
05SW/SD04	0 – 6 inches	05SD040006	X	X	X	X	X	X	X	X	TOC
05SW/SD05	0 – 6 inches	05SD050006	X	X	X	X	X	X	X	X	TOC
GROUND WATER											
05-01		05GW0101 (upgradient)	X	X	X	X	X	X	X	X	NA
05-02		05GW0201	X	X	X	X	X	X	X	X	NA
05-03		05GW0301	X	X	X	X	X	X	X	X	NA
		05GW0301-F	NA	NA	NA	NA	NA	NA	X	NA	NA
05-04		05GW0401	X	X	X	X	X	X	X	X	NA
05-06		05GW0601	X	X	X	X	X	X	X	X	NA
05-07		05GW0701	X	X	X	X	X	X	X	X	NA
05-08		05GW0801	X	X	X	X	X	X	X	X	NA
05-09		05GW0901	X	X	X	X	X	X	X	X	NA

TABLE 5-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Location	Sample Depth	Sample Number	Analyses								
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs (PAHs via SIM)	App. IX Pest./PCBs	App. IX Herbicides	Dioxins/ Furans	TAL Metals + Sn	Cyanide	Miscellaneous Parameters(1)
05-13		05GW1301	X	X	X	X	X	X	X	X	NA
		05GW1301-F	NA	NA	NA	NA	NA	NA	X	NA	NA
05-15		05GW1501	X	X	X	X	X	X	X	X	NA
05-16		05GW1601	X	X	X	X	X	X	X	X	NA
05-19		05GW1901	X	X	X	X	X	X	X	X	NA
05T01		05GWT0101	X	X	X	X	X	X	X	X	NA
05T02		05GWT0201	X	X	X	X	X	X	X	X	NA
05T03		05GWT0301	X	X	X	X	X	X	X	X	NA
SURFACE WATER											
05SW/SD01		05SW0101 (upgradient)	X	X	X	X	X	X	X	X	X
		05SW0101-F	NA	NA	NA	NA	NA	NA	X	NA	NA
05SW/SD02		05SW0201	X	X	X	X	X	X	X	X	X
		05SW0201-F	NA	NA	NA	NA	NA	NA	X	NA	NA
05SW/SD03		05SW0301	X	X	X	X	X	X	X	X	X
		05SW0301-F	NA	NA	NA	NA	NA	NA	X	NA	NA
05SW/SD04		05SW0401	X	X	X	X	X	X	X	X	X
		05SW0401-F	NA	NA	NA	NA	NA	NA	X	NA	NA
05SW/SD05		05SW0501	X	X	X	X	X	X	X	X	X
		05SW0501-F	NA	NA	NA	NA	NA	NA	X	NA	NA

TABLE 5-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

App. IX = Appendix IX.
NA = Not analyzed.
PAHs = Polycyclic aromatic hydrocarbons.
Pest/PCBs = Pesticides and polychlorinated biphenyls.
TAL = Target analyte list.
SIM = Selective ion monitoring.
Sn = Tin.
SVOCs = Semivolatile organic compounds.
VOCs = Volatile organic compounds.

Note: Sample numbers ending with "F" were field filtered prior to metals analyses.

1 Miscellaneous parameters:
- surface and subsurface soil were analyzed for cation exchange capacity, pH, and total organic carbon.
- ground water samples were not analyzed for miscellaneous parameters.
- surface water samples were analyzed for hardness and total suspended soils.
- sediment samples were analyzed for total organic carbon.

TABLE 5-2

SUMMARY OF POSITIVE SURFACE SOIL ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Sample Identification	05SB010002	05SB010102	05SB020002	05SB020102	05SB030002	05SB030102	05SB040002	05SB040102	05SB050002	05SB050102	05SB060002	05SB060102	05SB070002	05SB070102	05SB080002	05SB080102
Depth Range (feet bgs)	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2
Soil Group:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Dioxins (µg/kg)																
1,2,3,4,6,7,8,9-OCDD	824 J		415 J		1220 J		1000 J		1220 J		683 J		1550 J		5050 J	
1,2,3,4,6,7,8,9-OCDF	9.5 J		17.7 J		85.9 J		0.4 UJ		172 J		313 J		99.5 J		8.5 J	
1,2,3,4,6,7,8-HPCDD	25.1 BJ		49.3 BJ		103 J		7.2		128 J		359 J		123 J		64	
1,2,3,4,6,7,8-HPCDF	12.1 BJ		30.4 J		49 J		0.54 BU		168 J		541 J		98.8 J		12.7 J	
1,2,3,4,7,8,9-HPCDF	0.88 J		1.8 U		4.4 J		0.3 U		14.7		57.5		7.1		1.1 J	
1,2,3,4,7,8-HXCDD	1 J		1.1 U		2.1 U		0.2 U		6.3		21.7		3.9 J		1.2 J	
1,2,3,4,7,8-HXCDF	5.7 BJ		3.7 BJ		18.5 J		0.55 BU		78.8 J		361 J		47.1 J		6.6 J	
1,2,3,6,7,8-HXCDD	2.3 J		4.3 J		5.6 J		0.3 U		14.9 J		53 J		13 J		1.9 J	
1,2,3,6,7,8-HXCDF	2.6 BJ		1.3 BJ		7.4		0.28 J		29.2		128		17.1		2.8 J	
1,2,3,7,8,9-HXCDD	2.5 J		3.7 J		6.6 J		0.36 J		20.2 J		69.1 J		12.3 J		3 J	
1,2,3,7,8,9-HXCDF	0.35 U		0.8 U		0.3 U		0.2 U		4.1 J		9.8 J		3.2 U		0.41 J	
1,2,3,7,8-PECDD	1.4 J		0.7 U		2 J		0.3 U		5.9		22.1		4.8 J		0.9 U	
1,2,3,7,8-PECDF	2.3 J		1.3 J		5.8		0.2 U		30.4 U		105		16.5 U		1.9 U	
2,3,4,6,7,8-HXCDF	3.2 J		2.4 J		9.1		0.2 U		34.5		146		21.3		3.2 J	
2,3,4,7,8-PECDF	4.3 J		2.2 J		9.4		0.2 UJ		38.4		143		19.2 J		3.3 J	
2,3,7,8-TCDD	0.45 U		0.4 U		0.7 J		0.3 U		1.7		6.1		1.3		0.49 J	
2,3,7,8-TCDF	10.3 J		6.3		27.1		0.2 U		17.4		325		43.6		2.8	
TOTAL HPCDD	46.4 J		102 J		203 J		15.1		270 J		803 J		235 J		138	
TOTAL HPCDF	21.9 J		49.8 J		106 U		0.54 U		293 J		792 J		176 J		22.2 J	
TOTAL HXCDD	25.4 J		35.2 J		68.6 U		0.65 U		223 J		890 J		144 J		24.5 U	
TOTAL HXCDF	31.1 U		25.4 J		97.4 U		1.5 U		372 U		1390 U		229 U		28.6 U	
TOTAL PECDF	53.1 U		31.2 U		139 U		1.3 J		574 U		1970 U		315 U		38.8 U	
TOTAL TCDD	16.1 U		5.6 U		38.2 U		0.3 U		133		404		66.1 U		11.6 U	
TOTAL TCDF	68.8 U		44.3 U		182 U		0.2 U		648 U		2100 U		310 U		52.4	
TCDD TEQ	6.5		4.3		16.9		0.68		51.3		226		34.6		6.1	
Volatiles (µg/kg)																
1,1-DICHLOROETHENE		3 U		3 U		3 UJ		3 U		3 U		13 J		4 U		3 U
BENZENE		3 U		3 U		3 U		3 U		3 U		5 J		4 U		3 U
CIS-1,2-DICHLOROETHENE		3 U		3 U		3 U		3 U		3 U		2800 J		4 U		8
METHYLENE CHLORIDE		3 U		4 J		4 J		3 U		3 U		4 U		4 U		4 J
TETRACHLOROETHENE		3 U		3 U		3 U		3 U		3 U		7 J		4 U		3
TRANS-1,2-DICHLOROETHENE		3 U		3 U		3 U		3 U		3 U		29 J		4 U		3 U
TRICHLOROETHENE		3 U		3 U		4		3 U		7		5100 J		360 J		1200 J
VINYL CHLORIDE		3 U		3 U		3 U		3 U		3 U		5 J		4 U		3 U
Semi-Volatiles (µg/kg)																
2-METHYLNAPHTHALENE	12		24		15		8.00 U		37 J		65		33 U		8.00 U	
ACENAPHTHENE	120		8 U		9 U		8.00 U		110 J		30		33 U		8.00 U	
ACENAPHTHYLENE	8 U		8 U		16		8.00 U		32 U		8 U		33 U		8.00 U	
ANTHRACENE	220		9		17		8.00 U		340 J		140		44		8.00 U	
BENZO(A)ANTHRACENE	520		31		140		8.00 U		950 J		400		190 J		8.00 U	
BENZO(A)PYRENE	510		31		170		8.00 U		820 J		380		280 J		8.00 U	
BENZO(B)FLUORANTHENE	440		39		250		8.00 U		790 J		470		210 J		8.00	
BENZO(G,H,I)PERYLENE	150 J		17		76		8.00 UJ		350 J		190		300 J		8.00 UJ	
BENZO(K)FLUORANTHENE	460		28		170		8.00 U		670 J		300		200 J		8.00 U	
BIS(2-ETHYLHEXYL)PHTHALATE	400 U		410 U		430 U		400 U		3400		930		410 U		400 U	
CHRYSENE	450		35		180		8.00 U		910 J		390 J		200 J		8.00 U	
DIBENZO(A,H)ANTHRACENE	89 J		8		23		8.00 UJ		180 J		82		120 J		8.00 UJ	
FLUORANTHENE	960		51		130		8.00 U		2200 J		780		320 J		11.0	
FLUORENE	65		8 U		9 U		8.00 U		110 J		20		33 U		8.00 U	
INDENO(1,2,3-CD)PYRENE	170 J		15		79		8.00 UJ		360 J		170		130 J		8.00 UJ	
NAPHTHALENE	23		48		34		8.00 U		42 J		100		33 U		8.00 U	

TABLE 5-2

SUMMARY OF POSITIVE SURFACE SOIL ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA
PAGE 2 OF 2

Sample Identification	05SB010002	05SB010102	05SB020002	05SB020102	05SB030002	05SB030102	05SB040002	05SB040102	05SB050002	05SB050102	05SB060002	05SB060102	05SB070002	05SB070102	05SB080002	05SB080102
Depth Range (feet bgs)	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2
Soil Group:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
PHENANTHRENE	730		60		48		8.00 U		1700		430		200		8.00 U	
PYRENE	820		52		150		8.00 U		2400		730		410 J		9.00	
Pesticides (µg/kg)																
4,4'-DDE	4.0 U		4.0 U		4.3 U		3.9 U		10 R		6.2 R		4.1 U		6.7	
AROCLOR-1254	40 U		40 U		43 U		39 U		220		150		100 J		240	
Herbicides (µg/kg)																
2,4,5-T	3.2 UJ		3.3 UJ		3.5 UJ		3.2 U		3.2 UJ		10 J		3.3 UJ		16 J	
2,4-D	3.2 UJ		3.3 UJ		3.5 UJ		3.2 U		3.2 UJ		3.3 UJ		3.3 UJ		3.2 U	
PENTACHLOROPHENOL	0.81 U		2.7 J		2.4 J		0.80 U		12		4.5		5.8 J		4.5 R	
Inorganics (mg/kg)																
ALUMINUM	9010 J		6830 J		9440 J		14800 J		3580 J		10500 J		9860 J		11200 J	
ANTIMONY	5.8 J		33.2 J		13.3 J		0.90 U		76.1 J		301 J		9.6 J		3.2 J	
ARSENIC	5.5 J		6.6 J		6.1 J		6.2		5.1 J		26.8 J		6.9 J		5.9	
BARIUM	113		346		200		99.3 J		328		2020		938		74.7 J	
CADMIUM	1.6 J		3.3 J		3.7 J		0.83 U		5.6 J		31.1 J		3.9 J		0.84 U	
CALCIUM	30800 J		4780 J		15700 J		413 UJ		241000 J		27700 J		3110 J		685 J	
CHROMIUM	16.4 J		19.3 J		18.8 J		10.4		40.0 J		112 J		43.4 J		11.7	
COBALT	5.8		6.1		6.4		12.0		5.8		35.8		12.3		5.9	
COPPER	41.6 J		174 J		84.5 J		11.7		109 J		1520 J		198 J		15.9	
IRON	20400 J		21100 J		16700 J		17300 J		17400 J		105000 J		32800 J		15600 J	
LEAD	82.7 J		450 J		204 J		15.2 J		342 J		16900 J		196 J		16.4 J	
MAGNESIUM	1380 J		1050 J		2220 J		660 J		4900 J		3640 J		1060 J		1020 J	
MANGANESE	306 J		381 J		361 J		1170		344 J		907 J		358 J		264	
MERCURY	0.43		0.11		0.39		0.09 J		0.06		0.10		0.14		0.04 J	
NICKEL	12.8		14.7		12.2		12.0		20.5		62.6		26.0		14.4	
POTASSIUM	432 U		565 J		651 J		413 UJ		462 U		1050 J		576 J		464 J	
SILVER	0.86 U		0.87 U		2.8 J		0.83 UJ		0.92 U		7.5 J		1.8 J		0.84 UJ	
TIN	26.4 J		44.6 J		13.2 J		4.5 U		83.6 J		337 J		14.3 J		849	
VANADIUM	19.6		15.7		18.6		22.9		9.9		21.5		21.3		20.6	
ZINC	152 J		499 J		363 J		26.6		506 J		5110 J		950 J		51.8	
Miscellaneous Parameters																
CATION EXCHANGE CAPACITY (MEQ/100 g)							13.0 J									
pH (S.U.)							5.1 J									
TOTAL ORGANIC CARBON (mg/kg)							1700									

Blank cells indicate the sample was not analyzed for this parameter.

MEQ = milliequivalents

bgs - Below ground surface.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected in this sample as well as the associated laboratory method blank, but has been qualified non-detected result as a laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

Soil Group 3 - Alluvial, Mississippian, and Pennsylvanian surface soil as per the "Basewide Soil Background Investigation Report," NSWC Crane, Indiana (TtNUS, January 2001).

TABLE 5-3

SURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?[2]
Dioxins (ng/kg)									
3268-87-9	1,2,3,4,6,7,8,9-OCDD	8/8	415	J	5050	J	---	05SB080002	---
39001-02-0	1,2,3,4,6,7,8,9-OCDF	7/8	8.5	J	313	J	0.4	05SB060002	---
35822-46-9	1,2,3,4,6,7,8-HPCDD	8/8	7.2		359	J	---	05SB060002	---
67562-39-4	1,2,3,4,6,7,8-HPCDF	7/8	12.1		541	J	0.54	05SB060002	---
55673-89-7	1,2,3,4,7,8,9-HPCDF	6/8	0.88	J	57.5		0.3 - 1.8	05SB060002	---
39227-28-6	1,2,3,4,7,8-HXCDD	5/8	1	J	21.7		0.2 - 2.1	05SB060002	---
70648-26-9	1,2,3,4,7,8-HXCDF	7/8	3.7		361	J	0.55	05SB060002	---
57653-85-7	1,2,3,6,7,8-HXCDD	7/8	1.9	J	53	J	0.3	05SB060002	---
57117-44-9	1,2,3,6,7,8-HXCDF	8/8	0.28	J	128		---	05SB060002	---
19408-74-3	1,2,3,7,8,9-HXCDD	8/8	0.36	J	69.1	J	---	05SB060002	---
72918-21-9	1,2,3,7,8,9-HXCDF	3/8	0.41	J	9.8	J	0.2 - 3.2	05SB060002	---
40321-76-4	1,2,3,7,8-PECDD	5/8	1.4	J	22.1		0.3 - 0.9	05SB060002	---
57117-41-6	1,2,3,7,8-PECDF	4/8	1.3	J	105		0.2 - 30.4	05SB060002	---
60851-34-5	2,3,4,6,7,8-HXCDF	7/8	2.4	J	146		0.2	05SB060002	---
57117-31-4	2,3,4,7,8-PECDF	7/8	2.2	J	143		0.2	05SB060002	---
1746-01-6	2,3,7,8-TCDD	5/8	0.49	J	6.1		0.3 - 0.45	05SB060002	---
51207-31-9	2,3,7,8-TCDF	7/8	2.8		325		0.2	05SB060002	---
37871-00-4	TOTAL HPCDD	8/8	15.1		803	J	---	05SB060002	---
38998-75-3	TOTAL HPCDF	6/8	21.9	J	792	J	0.54 - 106	05SB060002	---
34465-46-8	TOTAL HXCDD	5/8	25.4	J	890	J	0.65 - 68.6	05SB060002	---
55684-94-1	TOTAL HXCDF	1/8	25.4	J	25.4	J	1.5 - 1390	05SB020002	---
30402-15-4	TOTAL PECDF	1/8	1.3	J	1.3	J	31.2 - 1970	05SB040002	---
41903-57-5	TOTAL TCDD	2/8	133		404		0.3 - 66.1	05SB060002	---
55722-27-5	TOTAL TCDF	1/8	52.4		52.4		0.2 - 2100	05SB080002	---
	TCDD TEQ	8/8	0.68		226		---	05SB060002	---
Volatile Organics (µg/kg)									
75-35-4	1,1-DICHLOROETHENE	1/8	13	J	13	J	3 - 4	05SB060102	---
71-43-2	BENZENE	1/8	5	J	5	J	3 - 4	05SB060102	---
156-59-2	CIS-1,2-DICHLOROETHENE	2/8	8		2800	J	3 - 4	05SB060102	---
75-09-2	METHYLENE CHLORIDE	3/8	4	J	4	J	3 - 4	05SB080102, 05SB030102, 05SB020102	---
127-18-4	TETRACHLOROETHENE	2/8	3		7	J	3 - 4	05SB060102	---
156-60-5	TRANS-1,2-DICHLOROETHENE	1/8	29	J	29	J	3 - 4	05SB060102	---
79-01-6	TRICHLOROETHENE	5/8	4		5100	J	3	05SB060102	---
75-01-4	VINYL CHLORIDE	1/8	5	J	5	J	3 - 4	05SB060102	---

TABLE 5-3

SURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?[2]
Semi-Volatile Organics (µg/kg)									
91-57-6	2-METHYLNAPHTHALENE	5/8	12		65		8 - 33	05SB060002	---
83-32-9	ACENAPHTHENE	3/8	30		120		8 - 33	05SB010002	---
208-96-8	ACENAPHTHYLENE	1/8	16		16		8 - 33	05SB030002	---
120-12-7	ANTHRACENE	6/8	9		340	J	8	05SB050002	---
56-55-3	BENZO(A)ANTHRACENE	6/8	31		950	J	8	05SB050002	---
50-32-8	BENZO(A)PYRENE	6/8	31		820	J	8	05SB050002	---
205-99-2	BENZO(B)FLUORANTHENE	7/8	8		790	J	8	05SB050002	---
191-24-2	BENZO(G,H,I)PERYLENE	6/8	17		350	J	8	05SB050002	---
207-08-9	BENZO(K)FLUORANTHENE	6/8	28		670	J	8	05SB050002	---
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	2/8	930		3400		400 - 430	05SB050002	---
218-01-9	CHRYSENE	6/8	35		910	J	8	05SB050002	---
53-70-3	DIBENZO(A,H)ANTHRACENE	6/8	8		180	J	8	05SB050002	---
206-44-0	FLUORANTHENE	7/8	11		2200	J	8	05SB050002	---
86-73-7	FLUORENE	3/8	20		110	J	8 - 33	05SB050002	---
193-39-5	INDENO(1,2,3-CD)PYRENE	6/8	15		360	J	8	05SB050002	---
91-20-3	NAPHTHALENE	5/8	23		100		8 - 33	05SB060002	---
85-01-8	PHENANTHRENE	6/8	48		1700		8	05SB050002	---
129-00-0	PYRENE	7/8	9		2400		8	05SB050002	---
Pesticides/PCB's (µg/kg)									
72-55-9	4,4'-DDE	1/6	6.7		6.7		3.9 - 4.3	05SB080002	---
11097-69-1	AROCLOR-1254	4/8	100	J	240		39 - 43	05SB080002	---
Herbicides (µg/kg)									
93-76-5	2,4,5-T	2/8	10	J	16	J	3.2 - 3.5	05SB080002	---
87-86-5	PENTACHLOROPHENOL	5/7	2.4	J	12		0.8 - 0.81	05SB050002	---
Inorganics (mg/kg)									
7429-90-5	ALUMINUM	8/8	3580	J	14800	J	---	05SB040002	NO
7440-36-0	**ANTIMONY**	**7/8**	**3.2**	**J**	**301**	**J**	**0.9**	**05SB060002**	**YES**
7440-38-2	ARSENIC	8/8	5.1	J	26.8	J	---	05SB060002	NO
7440-39-3	**BARIUM**	**8/8**	**74.7**	**J**	**2020**		**—**	**05SB060002**	**YES**
7440-43-9	**CADMIUM**	**6/8**	**1.6**	**J**	**31.1**	**J**	**0.83 - 0.84**	**05SB060002**	**YES**
7440-70-2	**CALCIUM**	**7/8**	**685**	**J**	**241000**	**J**	**413**	**05SB050002**	**YES**
7440-47-3	**CHROMIUM**	**8/8**	**10.4**		**112**	**J**	**—**	**05SB060002**	**YES**
7440-48-4	COBALT	8/8	5.8		35.8		---	05SB060002	NO
7440-50-8	**COPPER**	**8/8**	**11.7**		**1520**	**J**	**—**	**05SB060002**	**YES**
7439-89-6	**IRON**	**8/8**	**15600**	**J**	**105000**	**J**	**—**	**05SB060002**	**YES**

TABLE 5-3

SURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?[2]
7439-92-1	**LEAD**	**8/8**	**15.2**	**J**	**16900**	**J**	**---**	**05SB060002**	**YES**
7439-95-4	MAGNESIUM	8/8	660	J	4900	J	---	05SB050002	NO
7439-96-5	MANGANESE	8/8	264		1170		---	05SB040002	NO
7439-97-6	**MERCURY**	**8/8**	**0.04**	**J**	**0.43**		**---**	**05SB010002**	**YES**
7440-02-0	NICKEL	8/8	12		62.6		---	05SB060002	NO
7440-09-7	POTASSIUM	5/8	464	J	1050	J	413 - 462	05SB060002	NO
7440-22-4	**SILVER**	**3/8**	**1.8**	**J**	**7.5**	**J**	**0.83 - 0.92**	**05SB060002**	**YES**
7440-31-5	**TIN**	**7/8**	**13.2**	**J**	**849**		**4.5**	**05SB080002**	**YES**
7440-62-2	VANADIUM	8/8	9.9		22.9		---	05SB040002	NO
7440-66-6	**ZINC**	**8/8**	**26.6**		**5110**	**J**	**---**	**05SB060002**	**YES**
Miscellaneous Parameter (MEQ/100 g)									
TTNUS014	CATION EXCHANGE CAPACITY	1/1	13	J	13	J	---	05SB040002	---
Miscellaneous Parameter (S.U.)									
TTNUS002	pH	1/1	5.1	J	5.1	J	---	05SB040002	---
Miscellaneous Parameter (mg/kg)									
TTNUS003	TOTAL ORGANIC CARBON	1/1	1700		1700		---	05SB040002	---

1 - Associated Samples:

05SB010002	05SB050002
05SB010102	05SB050102
05SB020002	05SB060002
05SB020102	05SB060102
05SB030002	05SB070002
05SB030102	05SB070102
05SB040002	05SB080002
05SB040102	05SB080102

2 - Backgound Samples:

BG1SBA0101	BG3SBA0301
BG1SBA0401	BG3SBA0501
BG1SBP0401	BG3SBM0201
BG1SBP0601-MAX	BG3SBM0401
BG1SBP0701	BG3SBM0601
BG1SBP0801	BG3SBM0701
BG1SBP0901	BG3SBM0801
BG3SBA0101-MAX	

--- Not Applicable

Bolding indicates that parameter is in excess c

CAS - Chemical abstract services.

ng - nanogram.

mg - milogram.

kg - kilogram.

µg - microgram.

MEQ/100 g - Milliequivalent per 100 grams.

Note:

Surface soil samples were collected from the 0 to 2-foot depth interval. Samples collected fro all analyses other than VOCs were taken from the full interval. Samples collected for VOC analyses were taken from the 1 to 2-foot interval because the 0 to 1-foot interval would be depelted n VOCs.

TABLE 5-4

SUMMARY OF POSITIVE SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Sample Identification	05SB010810	05SB020406	05SB030507	05SB040204	05SB050608	05SB060608	05SB070608
Depth Range (feet bgs)	8 - 10	4 - 6	5 - 7	2 - 4	6 - 8	6 - 8	6 - 8
Soil Group:	9	8	8	8	8	8	8
Dioxins (ng/kg)							
1,2,3,4,6,7,8,9-OCDD	58.1 J	666 J	1330 J	1520 J	278 J	1250 J	1760 J
1,2,3,4,6,7,8,9-OCDF	2.2 J	25.6 J	328 J	0.26 J	10 J	59 J	477 J
1,2,3,4,6,7,8-HPCDD	5.7 BU	67.7 J	736 J	9.8 J	9 U	188 J	498 J
1,2,3,4,6,7,8-HPCDF	2.4 BU	48 J	1590 J	0.76 U	66.6 J	109 J	807 J
1,2,3,4,7,8,9-HPCDF	0.49 J	1.6 U	23.1 J	0.1 U	6 U	7.7 UJ	68.6
1,2,3,4,7,8-HXCDD	0.26 J	1.2 U	84.9 J	0.13 U	3.3 UJ	5 UJ	29.8
1,2,3,4,7,8-HXCDF	1.1 BU	9.4 J	1010 J	0.66 BU	15.2 J	50.2 J	524 J
1,2,3,6,7,8-HXCDD	0.62 U	4.8 J	192 J	0.14 U	4.6 J	22.3 J	72.8 J
1,2,3,6,7,8-HXCDF	0.58 BJ	3.8 BJ	447 J	0.3 J	2.4 U	19.3 J	180
1,2,3,7,8,9-HXCDD	0.65 U	4.5 J	42.5 J	0.7 J	3.1 U	22 U	93.4 J
1,2,3,7,8,9-HXCDF	0.1 U	0.7 U	6.6 J	0.14 U	3.1 U	3.8 U	7.5 J
1,2,3,7,8-PECDD	0.1 U	1.4 J	97.7 J	0.11 U	2.4 U	7.9	36
1,2,3,7,8-PECDF	0.49 J	2.5 U	378 J	0.32 J	1.7 U	28.3 U	130
2,3,4,6,7,8-HXCDF	0.61 U	4.4 J	78.6 J	0.14 U	2.6 U	26 J	191
2,3,4,7,8-PECDF	0.77 J	5.2	118 J	0.22 J	1.7 U	30	189
2,3,7,8-TCDD	0.2 U	0.3 U	33.5 J	0.06 U	1.3 U	2.4	8.8
2,3,7,8-TCDF	1.6	15.3	453 J	0.36 J	3.1 U	20.3	107
TOTAL HPCDD	10.2 U	136 J	1690 J	26.1 J	17.4 U	427 J	1080 J
TOTAL HPCDF	4.4 U	78.8 J	1850 J	0.94 U	112 J	124 J	1200 J
TOTAL HXCDD	5 J	53.5 U	3040 J	3.5 U	30.8 U	27.3 U	1100 J
TOTAL HXCDF	4.4 U	55 U	3940 J	2.3 U	72 J	243 J	2010 U
TOTAL PECDD	1.2 U	25.8 U	2280 J	0.58 U	8.5 U	89.4 U	840 U
TOTAL PECDF	7 U	71.5 U	5740 J	2.7 U	67.3	396 U	2910 U
TOTAL TCDF	10 U	109 U	36840 J	3.4 U	67.9 U	215 U	3040 U
TCDD TEQ	0.98	10.1	464	0.81	9.2	46.8	280
Volatiles (µg/kg)							
1,1-DICHLOROETHANE	3 U	3 U	140	3 U	4 U	3 U	3 U
ACETONE	16 U	14 U	54	15 U	48	16 U	15 U
BENZENE	3 U	3 U	17	3 U	4 U	3	3 U
CHLOROETHANE	3 U	3 U	48	3 U	4 U	3 U	3 U
CIS-1,2-DICHLOROETHENE	130	3 U	61	3 U	5	51	3 U
ETHYLBENZENE	3 U	3 U	19	3 U	4 U	3 U	3 U
METHYLENE CHLORIDE	3 U	3 U	42	4 J	4 U	3 U	3 U
TOLUENE	3 U	3 U	27	3 U	4 U	3 U	3 U

TABLE 5-4

SUMMARY OF POSITIVE SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Sample Identification	05SB010810	05SB020406	05SB030507	05SB040204	05SB050608	05SB060608	05SB070608
Depth Range (feet bgs)	8 - 10	4 - 6	5 - 7	2 - 4	6 - 8	6 - 8	6 - 8
Soil Group:	9	8	8	8	8	8	8
TRANS-1,2-DICHLOROETHENE	3 U	3 U	7	3 U	4 U	3 U	3 U
TRICHLOROETHENE	3 U	3 U	9	3 U	4 U	13	9
VINYL CHLORIDE	7	3 U	76	3 U	24	160	3 U
XYLENES, TOTAL	3 U	3 U	61	3 U	10	3 U	3 U
Semi-Volatiles (µg/kg)							
2-METHYLNAPHTHALENE	7 U	120	2500 J	8.00 U	660 J	150	25
4-METHYLPHENOL	360 U	460	5900 U	400 UJ	420 U	770 J	410 U
ACENAPHTHENE	7 U	45	5900 U	8.00 U	34 U	40	10
ACENAPHTHYLENE	7 U	9	5900 U	8.00 U	52 J	16	18
ANTHRACENE	7 U	66	5900 U	8.00 U	34 U	50	89
BENZO(A)ANTHRACENE	7 U	78	5900 U	8.00 U	100 J	50 J	730
BENZO(A)PYRENE	7 U	53 J	5900 U	8.00 U	93 J	47 J	650
BENZO(B)FLUORANTHENE	10	67 J	5900 U	8.00 U	140 J	76 J	960
BENZO(G,H,I)PERYLENE	7 U	20 J	5900 U	8.00 UJ	68 J	37 J	260 J
BENZO(K)FLUORANTHENE	7 U	50 J	5900 U	8.00 U	34 UJ	16 UJ	530
BIS(2-ETHYLHEXYL)PHTHALATE	360 U	940	1600 J	400 UJ	1100	1900	410 U
CHRYSENE	7 U	75	1500 J	8.00 U	150 J	70 J	840
DIBENZO(A,H)ANTHRACENE	7 U	11 UJ	5900 U	8.00 UJ	34 UJ	16 UJ	130 J
FLUORANTHENE	10	130	5900 U	8.00 U	120 J	61 J	830
FLUORENE	7 U	50	5900 U	8.00 U	84 J	35	8 U
INDENO(1,2,3-CD)PYRENE	7 U	18 J	5900 U	8.00 UJ	39 J	20 J	240 J
NAPHTHALENE	7 U	180	1200 J	8.00 U	250 J	330	41
PHENANTHRENE	12	210	2800 J	8.00 U	310 J	190	170
PYRENE	9	190	3100 J	8.00 U	350 J	180 J	870
Pesticides/PCBs (µg/kg)							
4,4'-DDD	3.5 U	8.0	58 U	3.9 UJ	4.2 U	14 R	4.0 U
AROCLOR-1254	35 U	39 U	580 U	39 U	42 U	670	150
AROCLOR-1260	35 U	39 U	580 U	39 U	640	40 U	40 U
DIELDRIN	3.5 U	3.9 U	58 U	3.9 U	7.4	4.0 U	4.0 U
METHOXYCHLOR	18 U	20 U	300 U	20 UJ	22 U	28 J	49 J

TABLE 5-4

SUMMARY OF POSITIVE SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Sample Identification	05SB010810	05SB020406	05SB030507	05SB040204	05SB050608	05SB060608	05SB070608
Depth Range (feet bgs)	8 - 10	4 - 6	5 - 7	2 - 4	6 - 8	6 - 8	6 - 8
Soil Group:	9	8	8	8	8	8	8
Herbcides (µg/kg)							
PENTACHLOROPHENOL	1.5 J	3.0	12 U	0.80 U	2.4 J	3.3	4.8 J
Inorganics (mg/kg)							
ALUMINUM	3910 J	8240 J	14600 J	15700 J	8740 J	9240 J	6660 J
ANTIMONY	0.90 J	96.1 J	126 J	0.84 U	6.5 J	208 J	11.5 J
ARSENIC	2.9 J	9.0 J	10.5 J	4.0	6.9 J	12.2 J	5.6 J
BARIUM	30.3	593	1430	99.4 J	234	1230	193
CADMIUM	0.80 U	9.8 J	27.9 J	0.90 U	1.8 J	13.4 J	4.8 J
CALCIUM	399 U	11400 J	17600 J	449 UJ	3190 J	15500 J	2760 J
CHROMIUM	5.7 J	30.0 J	54.2 J	8.8	20.8 J	110 J	29.6 J
COBALT	6.7	7.0	22.6	5.5	7.6	11.8	7.7
COPPER	8.1 J	258 J	2580 J	10.7	77.4 J	6370 J	387 J
IRON	11400 J	31600 J	72900 J	12700 J	29900 J	43900 J	35200 J
LEAD	9.0 J	1330 J	549 J	8.2 J	2550 J	2860 J	151 J
MAGNESIUM	496 J	2340 J	1740 J	702 J	1180 J	2590 J	1110 J
MANGANESE	157 J	472 J	1070 J	258	383 J	626 J	286 J
MERCURY	0.04 U	0.11	0.04 U	0.04 J	93.2	0.06	0.17
NICKEL	8.8	20.0	50.5	12.0	15.7	33.4	18.8
POTASSIUM	399 U	1060 J	1070 J	449 UJ	561 J	1520 J	621 J
SILVER	0.80 U	1.7 J	16.1 J	0.90 UJ	0.92 U	2.7 J	3.8 J
SODIUM	399 U	500	1300 J	449 U	462 U	933 J	447 U
TIN	4.1 UJ	212 J	233 J	4.2 U	16.0 J	324 J	14.0 J
VANADIUM	9.6	21.1	22.7	17.6	18.2	21.3	16.3
ZINC	33.7 J	1140 J	2050 J	25.9	374 J	3010 J	491 J
Miscellaneous Parameters							
CATION EXCHANGE CAPACITY (MEQ/100 g)	3.20		8.10		11.0		
pH (S.U.)	7.20 J		7.60 J		7.50 J		
TOTAL ORGANIC CARBON (mg/kg)	1500		72000		23000		

TABLE 5-4

SUMMARY OF POSITIVE SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Sample Identification	05SB010810	05SB020406	05SB030507	05SB040204	05SB050608	05SB060608	05SB070608
Depth Range (feet bgs)	8 - 10	4 - 6	5 - 7	2 - 4	6 - 8	6 - 8	6 - 8
Soil Group:	9	8	8	8	8	8	8

Blank cells indicate the sample was not analyzed for this parameter.

bgs - Below ground surface.

MEQ - milliequivalents

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e.; holding times missed by a factor of two times the specified time limit, severe calibration noncompliances; and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical results reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected n this sample as well as the associated laboratory method blank but has been qualified non-detected resultant of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

Soil Group 8 - Pennsylvanian subsurface day and silt as per "Basewide Background Soil Investigation Report," NSWC Crane, Indiana (TtNUS, January 2001).

Soil Group 9 - Pennsylvanian subsurface sand as per "Basewide Background Soil Investigation Report," NSWC Crane, Indiana (TtNUS, January 2001).

TABLE 5-5

SUBSURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?[2]
Dioxins (ng/kg)									
3268-87-9	1,2,3,4,6,7,8,9-OCDD	7/7	58.1	J	1760	J	---	05SB070608	---
39001-02-0	1,2,3,4,6,7,8,9-OCDF	7/7	0.26	J	477	J	---	05SB070608	---
35822-46-9	1,2,3,4,6,7,8-HPCDD	5/7	9.8	J	736	J	5.7 - 9	05SB030507	---
67562-39-4	1,2,3,4,6,7,8-HPCDF	5/7	48	J	1590	J	0.76 - 2.4	05SB030507	---
55673-89-7	1,2,3,4,7,8,9-HPCDF	3/7	0.49	J	68.6		0.1 - 7.7	05SB070608	---
39227-28-6	1,2,3,4,7,8-HXCDD	3/7	0.26	J	84.9	J	0.13 - 5	05SB030507	---
70648-26-9	1,2,3,4,7,8-HXCDF	5/7	9.4	J	1010	J	0.66 - 1.1	05SB030507	---
57653-85-7	1,2,3,6,7,8-HXCDD	5/7	4.6	J	192	J	0.14 - 0.62	05SB030507	---
57117-44-9	1,2,3,6,7,8-HXCDF	6/7	0.3	J	447	J	2.4	05SB030507	---
19408-74-3	1,2,3,7,8,9-HXCDD	4/7	0.7	J	93.4	J	0.65 - 22	05SB070608	---
72918-21-9	1,2,3,7,8,9-HXCDF	2/7	6.6	J	7.5	J	0.1 - 3.8	05SB070608	---
40321-76-4	1,2,3,7,8-PECDD	4/7	1.4	J	97.7	J	0.1 - 2.4	05SB030507	---
57117-41-6	1,2,3,7,8-PECDF	4/7	0.32	J	378	J	1.7 - 28.3	05SB030507	---
60851-34-5	2,3,4,6,7,8-HXCDF	4/7	4.4	J	191		0.14 - 2.6	05SB070608	---
57117-31-4	2,3,4,7,8-PECDF	6/7	0.22	J	189		1.7	05SB070608	---
1746-01-6	2,3,7,8-TCDD	3/7	2.4		33.5	J	0.06 - 1.3	05SB030507	---
51207-31-9	2,3,7,8-TCDF	6/7	0.36	J	453	J	3.1	05SB030507	---
37871-00-4	TOTAL HPCDD	5/7	26.1	J	1690	J	10.2 - 17.4	05SB030507	---
38998-75-3	TOTAL HPCDF	5/7	78.8	J	1850	J	0.94 - 4.4	05SB030507	---
34465-46-8	TOTAL HXCDD	3/7	5	J	3040	J	3.5 - 53.5	05SB030507	---
55684-94-1	TOTAL HXCDF	3/7	72	J	3940	J	2.3 - 2010	05SB030507	---
36088-22-9	TOTAL PECDD	1/7	2280	J	2280	J	0.58 - 840	05SB030507	---
30402-15-4	TOTAL PECDF	2/7	67.3		5740	J	2.7 - 2910	05SB030507	---
55722-27-5	TOTAL TCDF	1/7	36840	J	36840	J	3.4 - 3040	05SB030507	---
	TCDD TEQ								
Volatile Organics (µg/kg)									
75-34-3	1,1-DICHLOROETHANE	1/7	140		140		3 - 4	05SB030507	---
67-64-1	ACETONE	2/7	48		54		14 - 16	05SB030507	---
71-43-2	BENZENE	2/7	3		17		3 - 4	05SB030507	---
75-00-3	CHLOROETHANE	1/7	48		48		3 - 4	05SB030507	---
156-59-2	CIS-1,2-DICHLOROETHENE	4/7	5		130		3	05SB010810	---
100-41-4	ETHYLBENZENE	1/7	19		19		3 - 4	05SB030507	---
75-09-2	METHYLENE CHLORIDE	2/7	4	J	42		3 - 4	05SB030507	---
108-88-3	TOLUENE	1/7	27		27		3 - 4	05SB030507	---
156-60-5	TRANS-1,2-DICHLOROETHENE	1/7	7		7		3 - 4	05SB030507	---
79-01-6	TRICHLOROETHENE	3/7	9		13		3 - 4	05SB060608	---
75-01-4	VINYL CHLORIDE	4/7	7		160		3	05SB060608	---
1330-20-7	XYLENES, TOTAL	2/7	10		61		3	05SB030507	---

TABLE 5-5

SUBSURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?[2]
Semi-Volatile Organics (µg/kg)									
91-57-6	2-METHYLNAPHTHALENE	5/7	25		2500	J	7 - 8	05SB030507	---
106-44-5	4-METHYLPHENOL	2/7	460		770	J	360 - 5900	05SB060608	---
83-32-9	ACENAPHTHENE	3/7	10		45		7 - 5900	05SB020406	---
208-96-8	ACENAPHTHYLENE	4/7	9		52	J	7 - 5900	05SB050608	---
120-12-7	ANTHRACENE	3/7	50		89		7 - 5900	05SB070608	---
56-55-3	BENZO(A)ANTHRACENE	4/7	50	J	730		7 - 5900	05SB070608	---
50-32-8	BENZO(A)PYRENE	4/7	47	J	650		7 - 5900	05SB070608	---
205-99-2	BENZO(B)FLUORANTHENE	5/7	10		960		8 - 5900	05SB070608	---
191-24-2	BENZO(G,H,I)PERYLENE	4/7	20	J	260	J	7 - 5900	05SB070608	---
207-08-9	BENZO(K)FLUORANTHENE	2/7	50	J	530		7 - 5900	05SB070608	---
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	4/7	940		1900		360 - 410	05SB060608	---
218-01-9	CHRYSENE	5/7	70	J	1500	J	7 - 8	05SB030507	---
53-70-3	DIBENZO(A,H)ANTHRACENE	1/7	130	J	130	J	7 - 5900	05SB070608	---
206-44-0	FLUORANTHENE	5/7	10		830		8 - 5900	05SB070608	---
86-73-7	FLUORENE	3/7	35		84	J	7 - 5900	05SB050608	---
193-39-5	INDENO(1,2,3-CD)PYRENE	4/7	18	J	240	J	7 - 5900	05SB070608	---
91-20-3	NAPHTHALENE	5/7	41		1200	J	7 - 8	05SB030507	---
85-01-8	PHENANTHRENE	6/7	12		2800	J	8	05SB030507	---
129-00-0	PYRENE	6/7	9		3100	J	8	05SB030507	---
Pesticides/PCB's (µg/kg)									
72-54-8	4,4'-DDD	1/6	8		8		3.5 - 58	05SB020406	---
11097-69-1	AROCLOR-1254	2/7	150		670		35 - 580	05SB060608	---
11096-82-5	AROCLOR-1260	1/7	640		640		35 - 580	05SB050608	---
60-57-1	DIELDRIN	1/7	7.4		7.4		3.5 - 58	05SB050608	---
72-43-5	METHOXYCHLOR	2/7	28	J	49	J	18 - 300	05SB070608	---
Herbicides (µg/kg)									
87-86-5	PENTACHLOROPHENOL	5/7	1.5	J	4.8	J	0.8 - 12	05SB070608	---
Inorganics (mg/kg)									
7429-90-5	ALUMINUM	7/7	3910	J	15700	J	---	05SB040204	NO
7440-36-0	**ANTIMONY**	**6/7**	**0.9**	**J**	**208**	**J**	**0.84**	**05SB060608**	**YES**
7440-38-2	**ARSENIC**	**7/7**	**2.9**	**J**	**12.2**	**J**	**---**	**05SB060608**	**YES**
7440-39-3	**BARIUM**	**7/7**	**30.3**		**1430**		**---**	**05SB030507**	**YES**
7440-43-9	**CADMIUM**	**5/7**	**1.8**	**J**	**27.9**	**J**	**0.8 - 0.9**	**05SB030507**	**YES**
7440-70-2	**CALCIUM**	**5/7**	**2760**	**J**	**17600**	**J**	**399 - 449**	**05SB030507**	**YES**
7440-47-3	**CHROMIUM**	**7/7**	**5.7**	**J**	**110**	**J**	**---**	**05SB060608**	**YES**
7440-48-4	COBALT	7/7	5.5		22.6		---	05SB030507	NO
7440-50-8	**COPPER**	**7/7**	**8.1**	**J**	**6370**	**J**	**---**	**05SB060608**	**YES**
7439-89-6	**IRON**	**7/7**	**11400**	**J**	**72900**	**J**	**---**	**05SB030507**	**YES**

TABLE 5-5

SUBSURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?[2]
7439-92-1	**LEAD**	**7/7**	**8.2**	**J**	**2860**	**J**	**---**	**05SB060608**	**YES**
7439-95-4	MAGNESIUM	7/7	496	J	2590	J	---	05SB060608	NO
7439-96-5	**MANGANESE**	**7/7**	**157**	**J**	**1070**	**J**	**---**	**05SB030507**	**YES**
7439-97-6	**MERCURY**	**5/7**	**0.04**	**J**	**93.2**		**0.04**	**05SB050608**	**YES**
7440-02-0	**NICKEL**	**7/7**	**8.8**		**50.5**		**---**	**05SB030507**	**YES**
7440-09-7	POTASSIUM	5/7	561	J	1520	J	399 - 449	05SB060608	NO
7440-22-4	**SILVER**	**4/7**	**1.7**	**J**	**16.1**	**J**	**0.8 - 0.92**	**05SB030507**	**YES**
7440-23-5	**SODIUM**	**3/7**	**500**		**1300**	**J**	**399 - 462**	**05SB030507**	**YES**
7440-31-5	**TIN**	**5/7**	**14**	**J**	**324**	**J**	**4.1 - 4.2**	**05SB060608**	**YES**
7440-62-2	VANADIUM	7/7	9.6		22.7		---	05SB030507	NO
7440-66-6	**ZINC**	**7/7**	**25.9**		**3010**	**J**	**---**	**05SB060608**	**YES**
Miscellaneous Parameters (MEQ/100 g)									
TTNUS014	CATION EXCHANGE CAPACITY	3/3	3.2		11		---	05SB050608	---
Miscellaneous Parameters (S.U.)									
TTNUS002	pH	3/3	7.2	J	7.6	J	---	05SB030507	---
Miscellaneous Parameters (mg/kg)									
TTNUS003	TOTAL ORGANIC CARBON	3/3	1500		72000		---	05SB030507	---

1 - Associated Samples:

05SB010810	05SB050608
05SB020406	05SB060608
05SB030507	05SB070608
05SB040204	

2 - Background Samples

BG1SBP0103	BG1SBP0406-MAX
BG1SBP0204	BG1SBP0505
BG1SBP0206	BG1SBP0603
BG1SBP0305	BG1SBP0804
BG1SBP0806	BG1SBP1004

--- = Not applicable.

Bolding indicates this parameter is in excess of background.

CAS - Chemical absttract services.

MEQ - Milliequivalents per 100 gram.

S.U. - Standard units.

TABLE 5-6

SUMMARY OF POSITIVE GROUND WATER ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Well Number	05-03	05-13	05-01	05-02	05-03	05-04	05-06	05-07	05-08	05-09	05-13	05-15	05-16	05-09	05T01	05T02	05T03
Sample Identification	05GW0301-F	05GW1301-F	05GW0101[1] (upgradient)	05GW0201	05GW0301	05GW0401	05GW0601	05GW0701	05GW0801	05GW0901	05GW1301	05GW1501	05GW1601	05GW1901	05GWT0101	05GWT0201	05GWT0301
Dioxins (pg/L)																	
1,2,3,4,6,7,8,9-OCDD			19.2 U	6.3 U	54.5 U	6.10 J	12.4 J	3.8 UJ	36.5 J	11.4 J	269 J	63.4 J	18.5 J	38.8 J	7.20 U	35.4 J	16.8 J
1,2,3,4,6,7,8,9-OCDF			13.8 U	1.8 UJ	39.3 U	3.60 UJ	6.50 U	3 UJ	2.4 UJ	3.30 UJ	6.8 J	6.60 U	4.7 UJ	2.9 UJ	5.70 U	7.90 U	9.30 U
1,2,3,4,6,7,8-HPCDD			11.2 U	2 U	31.1 U	3.20 U	6.10 U	2.9 U	2.5 U	2.60 U	12.2 J	7.10 J	3.5 U	2.8 U	5.40 U	6.90 U	8.20 U
2,3,7,8-TCDD			2.40 U	1.3 U	5.40 U	1.60 U	3.30 U	1.7 U	1.4 U	1.20 U	1 U	6.30 J	2 U	1.4 U	2.80 U	1.80 U	11.3
TOTAL HPCDD			11.2 U	2 U	31.1 U	3.20 U	6.10 U	2.9 U	2.5 U	2.60 U	17.4 U	16.2	3.5 U	2.8 U	5.40 U	6.90 U	8.20 U
TOTAL HPCDF			6.10 U	1.2 U	16.3 U	1.90 U	3.70 U	1.8 U	1.6 U	1.60 U	2.4	3.60 U	1.9 U	1.6 U	3.40 U	3.90 U	4.90 U
TOTAL TCDD			2.40 U	1.3 U	5.40 U	1.60 U	3.30 U	1.7 U	1.4 U	1.20 U	1 U	6.30	2 U	1.4 U	2.80 U	1.80 U	11.3
TCDD TEQ			5.2	1.9	12.8	2.9	5.4	2.6	2.2	2.2	1.7	9.7	8.1	2.3	4.7	3.8	15.9
Volatile Organics (µg/L)																	
CHLOROFORM			0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	1	0.3 U	0.3 U
CIS-1,2-DICHLOROETHENE			.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3	1 U	1 U	1 U	1 U	1 U
Semi-Volatile Organics (µg/L)																	
BIS(2-ETHYLHEXYL)PHTHALATE			2 U	2 U	2 U	4 BU	2 U	2 U	110	3 BU	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Inorganics (µg+A38/L)																	
ALUMINUM			200 U	200 U	2320 J	200 U	200 U	200 U	200 U	200 U	341 J	200 U	200 U	200 U	200 U	200 U	200 U
ARSENIC			0.14	1.0 U	1.0 U	0.16	0.82	1.2	1.0 U	0.12	1.0 U	1.6	1.0 U	1.0 U	0.16	0.20	0.31
BARIUM			82.1	145	90.6	188	112	227	113	68.1	36.1	118	90.3	62.0	54.5	67.0	36.3
CALCIUM			22900	91500	5000 U	71300	55600	75500	72500	44800	72900	56000	48300	56500	23200	22100	17200
COPPER			2.0 U	2.0 U	4.9	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
IRON			658 J	287	4440	358	312	1170	2190	150	857	2270	512	298	188	100 U	157
LEAD			1.0 U	1.0 U	4.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
MAGNESIUM			7000	11800 J	5000 U	10300 J	16700 J	27600 J	24400 J	6980 J	15100 J	17300 J	8990 J	5000 U	5350 J	6010 J	5000 J
MANGANESE			182 J	15.0 U	141	15.0 U	1170 J	855	1290	15.0 U	183	2270 J	147	18.3	167 J	15.0 U	105 J
SELENIUM			1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.4
SODIUM			5000 U	5000 U	5000 U	5130	5000 U	28800 J	13700 J	5000 U	5530 J	10400	11500 J	14400 J	20400	19500	5120
VANADIUM			2.0 U	2.0 U	4.9	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
ZINC			41.3	10.0 U	25.5	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U
Filtered Metals (µg/L)																	
BARIUM, FILTERED	61.1	33.2															
CALCIUM, FILTERED	5000	61600															
IRON, FILTERED	100 U	137															
MAGNESIUM, FILTERED	5000 U	13200 J															
MANGANESE, FILTERED	15.4	51.2															
SODIUM, FILTERED	5000 U	5010 J															

1 - Sample was designated the SWMU 5 upgradient ground water location.

Blank cells indicate sample was not analyzed for this parameter.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical results reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected n this sample as well as the associated laboratory method blank but has been qualified non-detected resultant of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

TABLE 5-7

GROUND WATER ANALYTICAL SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Site Above Upgradient Concentration?
Dioxins (pg/L)										
3268-87-9	1,2,3,4,6,7,8,9-OCDD	10/14	6.1	J	269	J	3.8 - 54.5	05GW1301	---	---
39001-02-0	1,2,3,4,6,7,8,9-OCDF	1/14	6.8	J	6.8	J	1.8 - 39.3	05GW1301	---	---
35822-46-9	1,2,3,4,6,7,8-HPCDD	2/14	7.1	J	12.2	J	2 - 31.1	05GW1301	---	---
1746-01-6	2,3,7,8-TCDD	2/14	6.3	J	11.3		1 - 5.4	05GWT0301	---	---
37871-00-4	TOTAL HPCDD	1/14	16.2		16.2		2 - 31.1	05GW1501	---	---
38998-75-3	TOTAL HPCDF	1/14	2.4		2.4		1.2 - 16.3	05GW1301	---	---
41903-57-5	TOTAL TCDD	2/14	6.3		11.3		1 - 5.4	05GWT0301	---	---
	TCDD TEQ	14/14	1.7		15.9		---	05GWT0301	---	---
Volatile Organics (µg/L)										
67-66-3	CHLOROFORM	1/14	1		1		0.3	05GWT0101	---	---
156-59-2	CIS-1,2-DICHLOROETHENE	1/14	3		3		1	05GW1501	---	---
Semi-Volatile Organics (µg/L)										
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	1/14	110		110		2 - 4	05GW0801	---	---
Inorganics (µg/L)										
7429-90-5	**ALUMINUM**	**2/14**	**341**	**J**	**2320**	**J**	**200**	**05GW0301**	**ND**	**YES**
7440-38-2	**ARSENIC**	**8/14**	**0.12**		**1.6**		**1**	**05GW1501**	**0.14**	**YES**
7440-39-3	**BARIUM**	**14/14**	**36.1**		**227**		**---**	**05GW0701**	**80.1**	**YES**
7440-70-2	**CALCIUM**	**13/14**	**17200**		**91500**		**5000**	**05GW0201**	**22900**	**YES**
7440-50-8	**COPPER**	**1/14**	**4.9**		**4.9**		**2**	**05GW0301**	**ND**	**YES**
7439-89-6	**IRON**	**13/14**	**150**		**4440**		**100**	**05GW0301**	**658**	**YES**
7439-92-1	**LEAD**	**1/14**	**4.1**		**4.1**		**1**	**05GW0301**	**ND**	**YES**
7439-95-4	**MAGNESIUM**	**12/14**	**5000**	**J**	**27600**	**J**	**5000**	**05GW0701**	**7000**	**YES**
7439-96-5	**MANGANESE**	**10/14**	**18.3**		**2270**	**J**	**15**	**05GW1501**	**182**	**YES**
7782-49-2	**SELENIUM**	**1/14**	**1.4**		**1.4**		**1**	**05GWT0301**	**ND**	**YES**
7440-23-5	**SODIUM**	**10/14**	**5120**		**28800**	**J**	**5000**	**05GW0701**	**ND**	**YES**
7440-62-2	**VANADIUM**	**1/14**	**4.9**		**4.9**		**2**	**05GW0301**	**ND**	**YES**
7440-66-6	ZINC	1/14	25.5		25.5		10	05GW0301	41.3	NO
Filtered Metals (µg/L)										
7440-39-3	BARIUM, FILTERED	2/2	33.2		61.1		---	05GW0301-F	---	---
7440-70-2	CALCIUM, FILTERED	2/2	5000		61600		---	05GW1301-F	---	---
7439-89-6	IRON, FILTERED	1/2	137		137		100	05GW1301-F	---	---

TABLE 5-7

GROUND WATER ANALYTICAL SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Site Above Upgradient Concentration?
7439-95-4	MAGNESIUM, FILTERED	1/2	13200	J	13200	J	5000	05GW1301-F	---	---
7439-96-5	MANGANESE, FILTERED	2/2	15.4		51.2		---	05GW1301-F	---	---
7440-23-5	SODIUM, FILTERED	1/2	5010	J	5010	J	5000	05GW1301-F	---	---

1 - Associated Samples:

05GW0201	05GW0701	05GW1501
05GW0301	05GW0801	05GW1601
05GW0301-F	05GW0901	05GW1901
05GW0401	05GW1301	05GWT0101
05GW0601	05GW1301-F	05GWT0201
		05GWT0301

2 - Upgradient Sample: B05GW0101

--- = Not applicable.
Bolding indicates parameter is in excess of upgradient concentration.
ND = Not detected.
CAS = Chemical abstract services.
pg = picograms.
µg = micrograms.
mg = milligrams.
L = liters.

TABLE 5-8

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Sample Identification	05SW0101-F[1] (upgradient)	05SW0201-F	05SW0301-F	05SW0401-F	05SW0501-F	05SW0101[1] (upgradient)	05SW0201	05SW0301	05SW0401	05SW0501
Dioxins (pg/L)										
TOTAL PECDD						3.30 UJ	6.70 U	7.20 U	9.40	7.00 U
Volatile Organics (µg/L)										
1,1-DICHLOROETHENE						1 U	2	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE						1 U	290	110	1 U	1
TRANS-1,2-DICHLOROETHENE						1 U	9	3	1 U	1 U
TRICHLOROETHENE						1 U	120	48	1 U	1 U
VINYL CHLORIDE						1 U	85	18	1 U	1 U
Semi-Volatile Organics (µg/L)										
BIS(2-ETHYLHEXYL)PHTHALATE						2	2	2 U	2 U	2 UJ
Inorganics (µg/L)										
ALUMINUM						200 U	200 U	200 U	204 J	200 U
ANTIMONY						1.0 U	1.0 U	1.0 U	1.0 U	1.3
ARSENIC						0.55	0.41	0.52	0.64	0.34
BARIUM						67.7 J	68.3 J	80.7 J	84.0 J	184 J
CALCIUM						29200	24300	33600	7570	72600
COPPER						2.0 U	2.7	2.0 U	2.0 U	2.4
IRON						284 J	456 J	762 J	1520 J	337 J
MAGNESIUM						6490 J	9880 J	11900 J	5000 U	11400 J
MANGANESE						41.4	238	315	105	15.0 U
SODIUM						30700	9330	11700	22800	10200
ZINC						10.0 U	19.5	19.9	10.0 U	10.0 U
Filtered Metals (µg/L)										
ANTIMONY, FILTERED	1.0 U	1.0 U	1.0 U	1.0 U	1.3					
ARSENIC, FILTERED	0.51	0.30	0.50	0.56	0.29					
BARIUM, FILTERED	68.0 J	66.1 J	75.6 J	79.0 J	174 J					
CALCIUM, FILTERED	29500	27000	35200	7920	74900					
COPPER, FILTERED	2.0 U	2.0 U	2.0 U	2.0 U	2.1					
IRON, FILTERED	103 J	209 J	577 J	594 J	282 J					
MAGNESIUM, FILTERED	6960 J	10900 J	12500 J	5140 J	11800 J					
MANGANESE, FILTERED	33.9	228	304	85.8	15.0 U					
SODIUM, FILTERED	27900	9150	10900	22800	9530					
ZINC, FILTERED	10.0 U	16.9	20.0	10.0 U	10.0 U					
Miscellaneous Parameters (mg/L)										
HARDNESS						99.0	100	130	38.0	230
TOTAL SUSPENDED SOLIDS						5.0	52.0	2.0 U	15.0	2.0

TABLE 5-8

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

1 - Sample was designated at SWMU 5 upgradient surface water location.

Blank cells indicate sample was not analyzed for this parameter.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical results reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected n this sample as well as the associated laboratory method blank but has been qualified non-detected resultant of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

TABLE 5-9

SURFACE WATER ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Is Site Above Upgradient Concentration?
Dioxins (pg/L)										
36088-22-9	TOTAL PECDD	1/4	9.4		9.4		6.7 - 7.2	05SW0401	---	---
Volatice Organics (µg/L)										
75-35-4	1,1-DICHLOROETHENE	1/4	2		2		1	05SW0201	---	---
156-59-2	CIS-1,2-DICHLOROETHENE	3/4	1		290		1	05SW0201	---	---
156-60-5	TRANS-1,2-DICHLOROETHENE	2/4	3		9		1	05SW0201	---	---
79-01-6	TRICHLOROETHENE	2/4	48		120		1	05SW0201	---	---
75-01-4	VINYL CHLORIDE	2/4	18		85		1	05SW0201	---	---
Semi-Volatile Organics (µg/L)										
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	1/4	2		2		2	05SW0201	----	---
Inorganics (µg/L)										
7429-90-5	ALUMINUM	1/4	204	J	204	J	200	05SW0401	ND	YES
7440-36-0	ANTIMONY	1/4	1.3		1.3		1	05SW0501	ND	YES
7440-38-2	ARSENIC	4/4	0.34		0.64		0	05SW0401	0.55	NO
7440-39-3	BARIUM	4/4	68.3	J	184	J	0	05SW0501	67.7	YES
7440-70-2	CALCIUM	4/4	7570		72600		0	05SW0501	27200	YES
7440-50-8	COPPER	2/4	2.4		2.7		2	05SW0201	ND	YES
7439-89-6	IRON	4/4	337	J	1520	J	0	05SW0401	284	YES
7439-95-4	MAGNESIUM	3/4	9880	J	11900	J	5000	05SW0301	6490	YES
7439-96-5	MANGANESE	3/4	105		315		15	05SW0301	41.4	YES
7440-23-5	SODIUM	4/4	9330		22800		0	05SW0401	30700	NO
7440-66-6	ZINC	2/4	19.5		19.9		10	05SW0301	ND	YES
Filtered Metals (µg/L)										
7440-36-0	ANTIMONY, FILTERED	1/4	1.3		1.3		1	05SW0501-F	ND	YES
7440-38-2	ARSENIC, FILTERED	4/4	0.29		0.56		0	05SW0401-F	0.51	YES
7440-39-3	BARIUM, FILTERED	4/4	66.1	J	174	J	0	05SW0501-F	68	YES
7440-70-2	CALCIUM, FILTERED	4/4	7920		74900		0	05SW0501-F	27500	YES
7440-50-8	COPPER, FILTERED	1/4	2.1		2.1		2	05SW0501-F	ND	YES
7439-89-6	IRON, FILTERED	4/4	209	J	594	J	0	05SW0401-F	103	YES
7439-95-4	MAGNESIUM, FILTERED	4/4	5140	J	12500	J	0	05SW0301-F	6960	YES
7439-96-5	MANGANESE, FILTERED	3/4	85.8		304		15	05SW0301-F	33.9	YES

TABLE 5-9

SURFACE WATER ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Is Site Above Upgradient Concentration?
7440-23-5	SODIUM, FILTERED	4/4	9150		22800		0	05SW0401-F	27900	NO
7440-66-6	**ZINC, FILTERED**	**2/4**	**16.9**		**20**		**10**	**05SW0301-F**	**ND**	**YES**
Miscellaneous Parameters (ng/L)										
TTNUS022	**HARDNESS**	**4/4**	**38**		**230**		**0**	**05SW0501**	**—**	**—**
TTNUS044	**TOTAL SUSPENDED SOLIDS**	**3/4**	**2**		**52**		**2**	**05SW0201**	**—**	**—**

1 - Associated Samples:
05SW0201
05SW0201-F
05SW0301
05SW0301-F
05SW0401
05SW0401-F
05SW0501
05SW0501-F

2 - Upgradient Samples:
B05SW0101-F
B05SW0101

ND = Not detected.
CAS = Chemical abstract services.
--- = Not applicable.
Bolding indicates parameter is in excess of upgradient concentration.
pg = picograms.
ng = nanograms.
µg = micrograms.
L = liters.

TABLE 5-10

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Sample Identification	05SD010006[1] (upgradient)	05SD020006	05SD030006	05SD040006	05SD050006
Dioxins (ng/kg)					
1,2,3,4,6,7,8,9-OCDD	7110 J	6110 J	2440 J	1380 J	1160 J
1,2,3,4,6,7,8,9-OCDF	8.3 UJ	223 J	41.9 J	2.2 J	73.5 J
1,2,3,4,6,7,8-HPCDD	46.3 J	203 J	63.8 J	35.5 J	103 J
1,2,3,4,6,7,8-HPCDF	4.1 BJ	86.1 J	24.2 J	4.5 BJ	47.5 J
1,2,3,4,7,8,9-HPCDF	2.5 UJ	6.5 J	1.6 J	0.32 U	3.2 J
1,2,3,4,7,8-HXCDD	0.61 J	2.7 J	0.95 J	0.5 J	2 J
1,2,3,4,7,8-HXCDF	2.4 BJ	21 J	7.8 J	3.2 BJ	11.3 J
1,2,3,6,7,8-HXCDD	0.88 J	7.2	2.2 J	0.92 J	5.4
1,2,3,6,7,8-HXCDF	1 J	8.3	3 J	1.4 J	5.1
1,2,3,7,8,9-HXCDD	1.2 U	7.7	2.8 J	1.5 J	5.5
1,2,3,7,8,9-HXCDF	0.9 U	1.4 J	0.56 J	0.1 U	0.79 J
1,2,3,7,8-PECDD	0.7 UJ	2.2 J	0.67 J	0.29 U	1.7 J
1,2,3,7,8-PECDF	0.89 J	5.9 J	1.6 J	2.0 U	2.8 J
2,3,4,6,7,8-HXCDF	0.51 U	10.7 J	3.5 J	1.0 J	6.7 J
2,3,4,7,8-PECDF	0.72 J	9.3 J	2.7 J	1.3 J	5.2 J
2,3,7,8-TCDD	0.4 U	1	0.42 J	0.26 J	3.7
2,3,7,8-TCDF	1.4 J	7.0	2.20 J	2.3 J	4.30 J
TOTAL HPCDD	102 J	422	137 J	84 J	221
TOTAL HPCDF	5.8 J	259 U	67.5 U	6.8 U	107 J
TOTAL TCDD	0.75	33 U	9.9 U	6.6 U	16.6 U
TCDD TEQ	2.8	18.3	5.9	2.5	13.9
Volatiles (µg/kg)					
CIS-1,2-DICHLOROETHENE	4 U	1000	4 U	8 U	6 U
METHYLENE CHLORIDE	4 J	5 J	7 J	8 J	6 J
TRICHLOROETHENE	4 U	700	4 U	8 U	6 U
Semi-Volatiles (µg/kg)					
2-METHYLNAPHTHALENE	14.0	10.0 U	10.0 U	14 U	24.0
ACENAPHTHENE	78.0	10.0 U	10.0 U	14 U	10.0 U
ANTHRACENE	95.0	10.0 U	10.0 U	14 U	10.0 U
BENZO(A)ANTHRACENE	360	26.0	19.0	14 U	23.0

TABLE 5-10

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Sample Identification	05SD010006[1] (upgradient)	05SD020006	05SD030006	05SD040006	05SD050006
BENZO(A)PYRENE	300	24.0	22.0	14 U	30.0
BENZO(B)FLUORANTHENE	320	27.0	25.0	14 U	45.0
BENZO(G,H,I)PERYLENE	110	15.0	14.0	14 U	45.0
BENZO(K)FLUORANTHENE	260	22.0	18.0	14 U	33.0
CHRYSENE	370	29.0	25.0	14 U	39.0
DIBENZO(A,H)ANTHRACENE	68.0	10.0 U	10.0 U	14 U	16.0
FLUORANTHENE	960	55.0	45.0	16	38.0
FLUORENE	56.0	10.0 U	10.0 U	14 U	10.0 U
INDENO(1,2,3-CD)PYRENE	120	13.0	12.0	14 U	27.0
NAPHTHALENE	37.0	10.0 U	10.0 U	14 U	16.0
PHENANTHRENE	670	31.0	25.0	14 U	22.0
PYRENE	650	47.0	34.0	14 U	39.0
Pesticides (µg/kg)					
AROCLOR-1260	42 U	49 U	50 U	67 U	170
Herbicides (µg/kg)					
HEXACHLOROPHENE	0.85 U	1.0 U	1.0 U	3.1 J	0.96 UJ
PENTACHLOROPHENOL	0.85 U	1.0 U	1.0 U	1.4 U	6.0 J
Inorganics (mg/kg)					
ALUMINUM	5610 J	4750 J	3790 J	5260 J	7660 J
ANTIMONY	1.0 U	2.2	1.6	1.6 U	5.8
ARSENIC	6.1	3.0	3.3	1.9	5.3
BARIUM	54.5 J	133 J	76.6 J	117 J	148 J
BERYLLIUM	1.1 J	1.1 U	1.1 U	1.6 U	1.1 U
CADMIUM	0.93 U	1.1 U	1.1 U	1.6 U	2.5 J
CALCIUM	12400 J	3050 J	2370 J	1540 J	57300 J
CHROMIUM	13.4 J	13.4 J	9.5 J	6.9 J	17.4 J
COBALT	9.5	5.9	5.7	4	5.8
COPPER	12.0 J	24.3 J	15.0 J	9.5 J	37.1 J
IRON	24400 J	9630 J	10300 J	5030 J	14000 J
LEAD	20.9	30.3	18.8	15.1	130
MAGNESIUM	1540 J	1150 J	734	788 U	4010 J

TABLE 5-10

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Sample Identification	05SD010006[1] (upgradient)	05SD020006	05SD030006	05SD040006	05SD050006
MANGANESE	346 J	712 J	812 J	109 J	328 J
MERCURY	0.03	0.04	0.05 U	0.08 U	0.09 J
NICKEL	22.5	9.2	14.5	10.3	12.8
POTASSIUM	464 U	554 U	544 U	788 U	648
VANADIUM	15.1	10.5	11.0	10.2	16.7
ZINC	53.2	110	77.3	31.7	243
Miscellaneous Parameter (mg/kg)					
TOTAL ORGANIC CARBON	3100	4000	2600	11000	4400

1 - Sample was designated at SWMU 5 as upgradient sediment location.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical results reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected n this sample as well as the associated laboratory method blank but has been qualified non-detected resultant of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is

TABLE 5-11

SEDIMENT ANALTYICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Site Above Upgradient Concentration?
Dioxins (ng/kg)										
3268-87-9	1,2,3,4,6,7,8,9-OCDD	4/4	1160	J	6110	J	---	05SD020006	---	---
39001-02-0	1,2,3,4,6,7,8,9-OCDF	4/4	2.2	J	223	J	---	05SD020006	---	---
35822-46-9	1,2,3,4,6,7,8-HPCDD	4/4	35.5	J	203	J	---	05SD020006	---	---
67562-39-4	1,2,3,4,6,7,8-HPCDF	4/4	4.5		86.1	J	---	05SD020006	---	---
55673-89-7	1,2,3,4,7,8,9-HPCDF	3/4	1.6	J	6.5	J	0.32	05SD020006	---	---
39227-28-6	1,2,3,4,7,8-HXCDD	4/4	0.5	J	2.7	J	---	05SD020006	---	---
70648-26-9	1,2,3,4,7,8-HXCDF	4/4	3.2		21	J	---	05SD020006	---	---
57653-85-7	1,2,3,6,7,8-HXCDD	4/4	0.92	J	7.2		---	05SD020006	---	---
57117-44-9	1,2,3,6,7,8-HXCDF	4/4	1.4	J	8.3		---	05SD020006	---	---
19408-74-3	1,2,3,7,8,9-HXCDD	4/4	1.5	J	7.7		---	05SD020006	---	---
72918-21-9	1,2,3,7,8,9-HXCDF	3/4	0.56	J	1.4	J	0.1	05SD020006	---	---
40321-76-4	1,2,3,7,8-PECDD	3/4	0.67	J	2.2	J	0.29	05SD020006	---	---
57117-41-6	1,2,3,7,8-PECDF	3/4	1.6	J	5.9	J	2	05SD020006	---	---
60851-34-5	2,3,4,6,7,8-HXCDF	4/4	1	J	10.7	J	---	05SD020006	---	---
57117-31-4	2,3,4,7,8-PECDF	4/4	1.3	J	9.3	J	---	05SD020006	---	---
1746-01-6	2,3,7,8-TCDD	4/4	0.26	J	3.7		---	05SD050006	---	---
51207-31-9	2,3,7,8-TCDF	4/4	2.2	J	7		---	05SD020006	---	---
37871-00-4	TOTAL HPCDD	4/4	84	J	422		---	05SD020006	---	---
38998-75-3	TOTAL HPCDF	1/4	107	J	107	J	6.8 - 259	05SD050006	---	---
	TCDD TEQ	4/4	2.5		18.3			05SD020006	---	---
Volatile Organics (µg/kg)										
156-59-2	CIS-1,2-DICHLOROETHENE	1/4	1000		1000		4 - 8	05SD020006	---	---
75-09-2	METHYLENE CHLORIDE	4/4	5	J	8	J	---	05SD040006	---	---
79-01-6	TRICHLOROETHENE	1/4	700		700		4 - 8	05SD020006	---	---
Semi-Volatile Organics (µg/kg)										
91-57-6	2-METHYLNAPHTHALENE	1/4	24		24		10 - 14	05SD050006	---	---
56-55-3	BENZO(A)ANTHRACENE	3/4	19		26		14	05SD020006	---	---
50-32-8	BENZO(A)PYRENE	3/4	22		30		14	05SD050006	---	---
205-99-2	BENZO(B)FLUORANTHENE	3/4	25		45		14	05SD050006	---	---
191-24-2	BENZO(G,H,I)PERYLENE	3/4	14		45		14	05SD050006	---	---
207-08-9	BENZO(K)FLUORANTHENE	3/4	18		33		14	05SD050006	---	---
218-01-9	CHRYSENE	3/4	25		39		14	05SD050006	---	---
53-70-3	DIBENZO(A,H)ANTHRACENE	1/4	16		16		10 - 14	05SD050006	---	---

TABLE 5-11

SEDIMENT ANALTYICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Site Above Upgradient Concentration?
206-44-0	FLUORANTHENE	4/4	16		55		0	05SD020006	---	---
193-39-5	INDENO(1,2,3-CD)PYRENE	3/4	12		27		14	05SD050006	---	---
91-20-3	NAPHTHALENE	1/4	16		16		10 - 14	05SD050006	---	---
85-01-8	PHENANTHRENE	3/4	22		31		14	05SD020006	---	---
129-00-0	PYRENE	3/4	34		47		14	05SD020006	---	---
Pesticides/PCB's (µg/kg)										
11096-82-5	AROCLOR-1260	1/4	170		170		49 - 67	05SD050006	---	---
Herbicides (µg/kg)										
70-30-4	HEXACHLOROPHENE	1/4	3.1	J	3.1	J	0.96 - 1	05SD040006	---	---
87-86-5	PENTACHLOROPHENOL	1/4	6	J	6	J	1 - 1.4	05SD050006	---	---
Inorganics (mg/kg)										
7429-90-5	**ALUMINUM**	**4/4**	**3790**	**J**	**7660**	**J**	**---**	**05SD050006**	**5610**	**YES**
7440-36-0	**ANTIMONY**	**3/4**	**1.6**		**5.8**		**1.6**	**05SD050006**	**ND**	**YES**
7440-38-2	ARSENIC	4/4	1.9		5.3		---	05SD050006	6.1	NO
7440-39-3	**BARIUM**	**4/4**	**76.6**	**J**	**148**	**J**	**---**	**05SD050006**	**54.5**	**YES**
7440-43-9	**CADMIUM**	**1/4**	**2.5**	**J**	**2.5**	**J**	**1.1 - 1.6**	**05SD050006**	**ND**	**YES**
7440-70-2	**CALCIUM**	**4/4**	**1540**	**J**	**57300**	**J**	**---**	**05SD050006**	**12400**	**YES**
7440-47-3	**CHROMIUM**	**4/4**	**6.9**	**J**	**17.4**	**J**	**---**	**05SD050006**	**13.4**	**YES**
7440-48-4	COBALT	4/4	4		5.9		---	05SD020006	9.5	NO
7440-50-8	**COPPER**	**4/4**	**9.5**	**J**	**37.1**	**J**	**---**	**05SD050006**	**12**	**YES**
7439-89-6	IRON	4/4	5030	J	14000	J	---	05SD050006	24400	NO
7439-92-1	**LEAD**	**4/4**	**15.1**		**130**		**---**	**05SD050006**	**20.9**	**YES**
7439-95-4	**MAGNESIUM**	**3/4**	**734**		**4010**	**J**	**788**	**05SD050006**	**1540**	**YES**
7439-96-5	**MANGANESE**	**4/4**	**109**	**J**	**812**	**J**	**---**	**05SD030006**	**346**	**YES**
7439-97-6	**MERCURY**	**2/4**	**0.04**		**0.09**	**J**	**0.05 - 0.08**	**05SD050006**	**0.03**	**YES**
7440-02-0	NICKEL	4/4	9.2		14.5		---	05SD030006	22.5	NO
7440-09-7	**POTASSIUM**	**1/4**	**648**		**648**		**544 - 788**	**05SD050006**	**ND**	**YES**
7440-62-2	**VANADIUM**	**4/4**	**10.2**		**16.7**		**---**	**05SD050006**	**15.1**	**YES**
7440-66-6	**ZINC**	**4/4**	**31.7**		**243**		**---**	**05SD050006**	**53.2**	**YES**
Miscellaneous Parameter (mg/kg)										
	TOTAL ORGANIC CARBON	4/4	2600		11000		---	05SD040006	---	---

TABLE 5-11

SEDIMENT ANALTYICAL RESULTS SUMMARY STATISTICS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Site Above Upgradient Concentration?

1 - Associated Samples:
05SD020006
05SD030006
05SD040006
05SD050006

2 - Upgradient Sample: B05SD010006

--- = Not applicable.
CAS = Chemical abstract services.
Bolding indicates parameter is in excess of upgradient concentration.

TABLE 5-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
VOLATILE ORGANICS																	
75-35-4	1,1-DICHLOROETHENE	0.013	J	0.013	J	mg/kg	05SB060102	1/8	0.003 - 0.004	0.013	NA	0.054	C	0.67	IDEM	No	BSL
71-43-2	BENZENE	0.005	J	0.005	J	mg/kg	05SB060102	1/8	0.003 - 0.004	0.005	NA	0.65	C	8.2	IDEM	No	BSL
156-59-2	CIS-1,2-DICHLOROETHENE	0.008		2.8	J	mg/kg	05SB060102	2/8	0.003 - 0.004	2.8	NA	4.3	N	110	IDEM	No	BSL
75-09-2	METHYLENE CHLORIDE	0.004	J	0.004	J	mg/kg	05SB030102, 05SB080102, 05SB020102	3/8	0.003 - 0.004	0.004	NA	8.9	C	120	IDEM	No	BSL
127-18-4	TETRACHLOROETHENE	0.003		0.007	J	mg/kg	05SB060102	2/8	0.003 - 0.004	0.007	NA	5.7	C	48	IDEM	No	BSL
156-60-5	TRANS-1,2-DICHLOROETHENE	0.029	J	0.029	J	mg/kg	05SB060102	1/8	0.003 - 0.004	0.029	NA	6.3	N	180	IDEM	No	BSL
79-01-6	TRICHLOROETHENE	0.004		5.1	J	mg/kg	05SB060102	5/8	0.003 - 0.003	5.1	NA	2.8	C	45	IDEM	Yes	ASL
75-01-4	VINYL CHLORIDE	0.005	J	0.005	J	mg/kg	05SB060102	1/8	0.003 - 0.004	0.005	NA	0.15	C	0.28	IDEM	No	BSL
SEMIVOLATILE ORGANICS																	
91-57-6	2-METHYLNAPHTHALENE	0.012		0.065		mg/kg	05SB060002	5/8	0.008 - 0.033	0.065	NA	5.6(7)	N	3200(7)	IDEM	No	BSL
83-32-9	ACENAPHTHENE	0.03		0.12		mg/kg	05SB010002	3/8	0.008 - 0.033	0.12	NA	370	N	9500	IDEM	No	BSL
208-96-8	ACENAPHTHYLENE	0.016		0.016		mg/kg	05SB030002	1/8	0.008 - 0.033	0.016	NA	370(8)	N	9500(8)	IDEM	No	BSL
120-12-7	ANTHRACENE	0.009		0.34	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.34	NA	2200	N	47000	IDEM	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.031		0.95	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.95	NA	0.62	C	5	IDEM	Yes	ASL
50-32-8	BENZO(A)PYRENE	0.031		0.82	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.82	NA	0.062	C	0.5	IDEM	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.008		0.79	J	mg/kg	05SB050002	7/8	0.008 - 0.008	0.79	NA	0.62	C	5	IDEM	Yes	ASL
191-24-2	BENZO(G,H,I)PERYLENE	0.017		0.35	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.35	NA	230(9)	N	5500(9)	IDEM	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0		0.67	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.67	NA	6.2	C	50	IDEM	No	BSL
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	0.93		3.4		mg/kg	05SB050002	2/8	0.4 - 0.43	3.4	NA	35	C	300	IDEM	No	BSL
218-01-9	CHRYSENE	0.0		0.91	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.91	NA	62	C	500	IDEM	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.008		0.18	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.18	NA	0.062	C	0.5	IDEM	Yes	ASL
206-44-0	FLUORANTHENE	0.011		2.2	J	mg/kg	05SB050002	7/8	0.008 - 0.008	2.2	NA	230	N	6300	IDEM	No	BSL
86-73-7	FLUORENE	0.02		0.11	J	mg/kg	05SB050002	3/8	0.008 - 0.033	0.11	NA	260	N	6300	IDEM	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.015		0.36	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.36	NA	0.62	C	5	IDEM	No	BSL
91-20-3	NAPHTHALENE	0.023		0.1		mg/kg	05SB060002	5/8	0.008 - 0.033	0.1	NA	5.6	N	3200	IDEM	No	BSL
85-01-8	PHENANTHRENE	0		1.7		mg/kg	05SB050002	6/8	0.008 - 0.008	1.7	NA	230(9)	N	5500(9)	IDEM	No	BSL
129-00-0	PYRENE	0.009		2.4		mg/kg	05SB050002	7/8	0.008 - 0.008	2.4	NA	230	N	5500	IDEM	No	BSL
PESTICIDES/PCBS																	
72-55-9	4,4'-DDE	0.0067		0.0067		mg/kg	05SB080002	1/6	3.9 - 4.3	0.0067	NA	1.7	C	20	IDEM	No	BSL
11097-69-1	AROCLOR-1254	0.1	J	0.24		mg/kg	05SB080002	4/8	39 - 43	0.24	NA	0.22	C	1.8	IDEM	Yes	ASL
HERBICIDES																	
93-76-5	2,4,5-T	0.01	J	0.016	J	mg/kg	05SB080002	2/8	0.0032 - 0.0035	0.016	NA	61	N	NA	IDEM	No	BSL
87-86-5	PENTACHLOROPHENOL	0.0024	J	0.012		mg/kg	05SB050002	5/7	0.0008 - 0.00081	0.012	NA	3	C	20	IDEM	No	BSL
DIOXINS/FURANS																	
3268-87-9	1,2,3,4,6,7,8,9-OCDD	0.000415	J	0.00505	J	mg/kg	05SB080002	8/8	---	0.00505	NA	0.039	C	NA	IDEM	No	BSL
39001-02-0	1,2,3,4,6,7,8,9-OCDF	0.0000085	J	0.000313	J	mg/kg	05SB060002	7/8	0.0000004 - 0.0000004	0.000313	NA	0.039	C	NA	IDEM	No	BSL
35822-46-9	1,2,3,4,6,7,8-HPCDD	0.0000072		0.000359	J	mg/kg	05SB060002	8/8	---	0.000359	NA	0.00039	C	NA	IDEM	No	BSL
67562-39-4	1,2,3,4,6,7,8-HPCDF	0.0000121		0.000541	J	mg/kg	05SB060002	7/8	0.00000054 - 0.00000054	0.000541	NA	0.00039	C	NA	IDEM	Yes	ASL
55673-89-7	1,2,3,4,7,8,9-HPCDF	0.00000088	J	0.0000575		mg/kg	05SB060002	6/8	0.0000003 - 0.0000018	0.0000575	NA	0.00039	C	NA	IDEM	No	BSL
39227-28-6	1,2,3,4,7,8-HXCDD	0.000001	J	0.0000217		mg/kg	05SB060002	5/8	0.0000002 - 0.0000021	0.0000217	NA	0.000039	C	NA	IDEM	No	BSL
70648-26-9	1,2,3,4,7,8-HXCDF	0.0000037		0.000361	J	mg/kg	05SB060002	7/8	0.00000055 - 0.00000055	0.000361	NA	0.000039	C	NA	IDEM	Yes	ASL
57653-85-7	1,2,3,6,7,8-HXCDD	0.0000019	J	0.000053	J	mg/kg	05SB060002	7/8	0.0000003 - 0.0000003	0.000053	NA	0.000039	C	NA	IDEM	Yes	ASL
57117-44-9	1,2,3,6,7,8-HXCDF	0.00000028	J	0.000128		mg/kg	05SB060002	8/8	---	0.000128	NA	0.000039	C	NA	IDEM	Yes	ASL
19408-74-3	1,2,3,7,8,9-HXCDD	0.00000036	J	0.0000691	J	mg/kg	05SB060002	8/8	---	0.0000691	NA	0.000039	C	NA	IDEM	Yes	ASL
72918-21-9	1,2,3,7,8,9-HXCDF	0.00000041	J	0.0000098	J	mg/kg	05SB060002	3/8	0.0000002 - 0.0000032	0.0000098	NA	0.000039	C	NA	IDEM	No	BSL
40321-76-4	1,2,3,7,8-PECDD	0.0000014	J	0.0000221		mg/kg	05SB060002	5/8	0.0000003 - 0.0000009	0.0000221	NA	0.0000039	C	NA	IDEM	Yes	ASL
57117-41-6	1,2,3,7,8-PECDF	0.0000013	J	0.000105		mg/kg	05SB060002	4/8	0.0000002 - 0.0000304	0.000105	NA	0.000078	C	NA	IDEM	Yes	ASL

TABLE 5-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
60851-34-5	2,3,4,6,7,8-HXCDF	0.0000024	J	0.000146		mg/kg	05SB060002	7/8	0.0000002 - 0.0000002	0.000146	NA	0.000039	C	NA	IDEM	Yes	ASL
57117-31-4	2,3,4,7,8-PECDF	0.0000022	J	0.000143		mg/kg	05SB060002	7/8	0.0000002 - 0.0000002	0.000143	NA	0.0000078	C	NA	IDEM	Yes	ASL
1746-01-6	2,3,7,8-TCDD	0.00000049	J	0.0000061		mg/kg	05SB060002	5/8	0.0000003 - 0.00000045	0.0000061	NA	0.0000039	C	NA	IDEM	Yes	ASL
51207-31-9	2,3,7,8-TCDF	0.0000028		0.000325		mg/kg	05SB060002	7/8	0.0000002 - 0.0000002	0.000325	NA	0.000039	C	NA	IDEM	Yes	ASL
1746-01-6	2,3,7,8-TCDD TEQ	0.00000068		0.000226		mg/kg	05SB060002	8/8	-	0.000226	NA	0.0000039	C	NA	IDEM	Yes	ASL
37871-00-4	TOTAL HPCDD	0.0000151		0.000803	J	mg/kg	05SB060002	8/8	---	0.000803	NA	NA	C	NA	IDEM	No	NTX
38998-75-3	TOTAL HPCDF	0.0000219	J	0.000792	J	mg/kg	05SB060002	6/8	0.00000054 - 0.000106	0.000792	NA	NA	C	NA	IDEM	No	NTX
34465-46-8	TOTAL HXCDD	0.0000254	J	0.00089	J	mg/kg	05SB060002	5/8	0.00000065 - 0.0000686	0.00089	NA	NA	C	NA	IDEM	No	NTX
55684-94-1	TOTAL HXCDF	0.0000254	J	0.0000254	J	mg/kg	05SB020002	1/8	0.0000015 - 0.00139	0.0000254	NA	NA	C	NA	IDEM	No	NTX
30402-15-4	TOTAL PECDF	0.0000013	J	0.0000013	J	mg/kg	05SB040002	1/8	0.0000312 - 0.00197	0.0000013	NA	NA	C	NA	IDEM	No	NTX
41903-57-5	TOTAL TCDD	0.000133		0.000404		mg/kg	05SB060002	2/8	0.0000003 - 0.0000661	0.000404	NA	NA	C	NA	IDEM	No	NTX
55722-27-5	TOTAL TCDF	0.0000524		0.0000524		mg/kg	05SB080002	1/8	0.0000002 - 0.0021	0.0000524	NA	NA	C	NA	IDEM	No	NTX
INORGANICS																	
7429-90-5	ALUMINUM	3580	J	14800	J	mg/kg	05SB040002	8/8	---	14800	No	7600	N	NA	IDEM	No	BKG
7440-36-0	ANTIMONY	3.2	J	301	J	mg/kg	05SB060002	7/8	0.9 - 0.9	301	Yes	3.1	N	140	IDEM	Yes	ASL
7440-38-2	ARSENIC	5.1	J	26.8	J	mg/kg	05SB060002	8/8	---	26.8	No	0.39	C	3.9	IDEM	No	BKG
7440-39-3	BARIUM	74.7	J	2020		mg/kg	05SB060002	8/8	---	2020	Yes	540	N	23000	IDEM	Yes	ASL
7440-43-9	CADMIUM	1.6	J	31.1	J	mg/kg	05SB060002	6/8	0.83 - 0.84	31.1	Yes	3.7	N	12	IDEM	Yes	ASL
7440-70-2	CALCIUM	685	J	241000	J	mg/kg	05SB050002	7/8	413 - 413	241000	Yes	NA		NA	IDEM	No	NUT
7440-47-3	CHROMIUM	10.4		112	J	mg/kg	05SB060002	8/8	---	112	Yes	2(10)	C	430(10)	IDEM	Yes	ASL
7440-48-4	COBALT	5.8		35.8		mg/kg	05SB060002	8/8	---	35.8	No	470	N	NA	IDEM	No	BSL,BKG
7440-50-8	COPPER	11.7		1520	J	mg/kg	05SB060002	8/8	---	1520	Yes	290	N	13000	IDEM	Yes	ASL
7439-89-6	IRON	15600	J	105000	J	mg/kg	05SB060002	8/8	---	105000	Yes	2300	N	NA	IDEM	Yes	ASL
7439-92-1	LEAD	15.2	J	16900	J	mg/kg	05SB060002	8/8	---	16900	Yes	400(11)	N	400	IDEM	Yes	ASL
7439-95-4	MAGNESIUM	660	J	4900	J	mg/kg	05SB050002	8/8	---	4900	No	NA		NA	IDEM	No	NUT, BKG
7439-96-5	MANGANESE	264		1170		mg/kg	05SB040002	8/8	---	1170	No	180	N	NA	IDEM	No	BKG
7439-97-6	MERCURY	0.04	J	0.43		mg/kg	05SB010002	8/8	---	0.43	Yes	2.3(12)	N	55	IDEM	No	BSL
7440-02-0	NICKEL	12		62.6		mg/kg	05SB060002	8/8	---	62.6	No	160	N	6900	IDEM	No	BSL,BKG
7440-09-7	POTASSIUM	464	J	1050	J	mg/kg	05SB060002	5/8	413 - 462	1050	No	NA		NA	IDEM	No	NUT, BKG
7440-22-4	SILVER	1.8	J	7.5	J	mg/kg	05SB060002	3/8	0.83 - 0.92	7.5	Yes	39	N	1700	IDEM	No	BSL
7440-31-5	TIN	13.2	J	849		mg/kg	05SB080002	7/8	4.5 - 4.5	849	Yes	4700	N	NA	IDEM	No	BSL
7440-62-2	VANADIUM	9.9		22.9		mg/kg	05SB040002	8/8	---	22.9	No	55	N	NA	IDEM	No	BSL,BKG
7440-66-6	ZINC	26.6		5110	J	mg/kg	05SB060002	8/8	---	5110	Yes	2300	N	100000	IDEM	Yes	ASL
MISCELLANEOUS PARAMETERS																	
	CATION EXCHANGE CAPACITY	13	J	13	J	meq/100 g	05SB040002	1/1	---	13	NA	NA		NA	IDEM	No	NTX
	pH	5.1	J	5.1	J	S.U.	05SB040002	1/1	---	5.1	NA	NA		NA	IDEM	No	NTX
	TOTAL ORGANIC CARBON	1700		1700		mg/kg	05SB040002	1/1	---	1700	NA	NA		NA	IDEM	No	NTX

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TtNUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 The risk-based soil COPC screening level for residential land use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, November 2000).

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001).
J = Estimated value.
N = Nocarcinogen.
NA = Not applicable/bot available.
sat = Soil saturation concentration.

TABLE 5-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)

6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Naphthalene is used as a surrogate for 2-methylnaphthalene.
8 Acenaphthene is used as a surrogate for acenaphthylene.
9 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
10 Hexavalent chromium.
11 OSWER soil screening level for residential land use (U.S. EPA, July 1994)
12 Value is for mercuric chloride (U.S. EPA, Region 3, October 2001)

Associated Samples:

05SB010002	05SB050002
05SB010102	05SB050102
05SB020002	05SB060002
05SB020102	05SB060102
05SB030002	05SB070002
05SB030102	05SB070102
05SB040002	05SB080002
05SB040102	05SB080102

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

BSL = Below screening level
ASL = Above screenng level.
CAS = Chemical abstract services.

TABLE 5-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE SOIL
SWMU 5, OLD BURN PIT
NWSC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)		USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
VOLATILE ORGANICS														1			
75-35-4	1,1-DICHLOROETHENE	0.013	J	0.013	J	mg/kg	05SB060102	1/8	0.003 - 0.004	0.013	NA	0.003	C	0.07	0.058	Yes	ASL
71-43-2	BENZENE	0.005	J	0.005	J	mg/kg	05SB060102	1/8	0.003 - 0.004	0.005	NA	0.002	C	0.8	0.034	Yes	ASL
156-59-2	CIS-1,2-DICHLOROETHENE	0.008		2.8	J	mg/kg	05SB060102	2/8	0.003 - 0.004	2.8	NA	0.02	N	1200	0.4	Yes	ASL
75-09-2	METHYLENE CHLORIDE	0.004	J	0.004	J	mg/kg	05SB030102, 05SB080102, 05SB020102	3/8	0.003 - 0.004	0.004	NA	0.001	C	13	0.023	Yes	ASL
127-18-4	TETRACHLOROETHENE	0.003		0.007	J	mg/kg	05SB060102	2/8	0.003 - 0.004	0.007	NA	0.003	C	11	0.058	Yes	ASL
156-60-5	TRANS-1,2-DICHLOROETHENE	0.029	J	0.029	J	mg/kg	05SB060102	1/8	0.003 - 0.004	0.029	NA	0.03	N	3100	0.68	No	BSL
79-01-6	TRICHLOROETHENE	0.004		5.1	J	mg/kg	05SB060102	5/8	0.003 - 0.003	5.1	NA	0.003	C	5	0.057	Yes	ASL
75-01-4	VINYL CHLORIDE	0.005	J	0.005	J	mg/kg	05SB060102	1/8	0.003 - 0.004	0.005	NA	0.0007	C	0.03	0.013	Yes	ASL
SEMIVOLATILE ORGANICS																	
91-57-6	2-METHYLNAPHTHALENE	0.012		0.065		mg/kg	05SB060002	5/8	0.008 - 0.033	0.065	NA	4(8)	N	NA	0.7(8)	No	BSL
83-32-9	ACENAPHTHENE	0.03		0.12		mg/kg	05SB010002	3/8	0.008 - 0.033	0.12	NA	29	N	NA	130	No	BSL
208-96-8	ACENAPHTHYLENE	0.016		0.016		mg/kg	05SB030002	1/8	0.008 - 0.033	0.016	NA	29(9)	N	NA	130(9)	No	BSL
120-12-7	ANTHRACENE	0.009		0.34	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.34	NA	590	N	NA	51	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.031		0.95	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.95	NA	0.08	C	NA	19	Yes	ASL
50-32-8	BENZO(A)PYRENE	0.031		0.82	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.82	NA	0.4	C	NA	8.2	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.008		0.79	J	mg/kg	05SB050002	7/8	0.008 - 0.008	0.79	NA	0.2	C	NA	57	Yes	ASL
191-24-2	BENZO(G,H,I)PERYLENE	0.017		0.35	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.35	NA	210(10)	N	NA	570(10)	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0		0.67	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.67	NA	2	C	NA	39	No	BSL
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	0.93		3.4		mg/kg	05SB050002	2/8	0.4 - 0.43	3.4	NA	180	C	31000	3600	No	BSL
218-01-9	CHRYSENE	0.0		0.91	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.91	NA	8	C	NA	25	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.008		0.18	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.18	NA	0.08	C	NA	18	Yes	ASL
206-44-0	FLUORANTHENE	0.011		2.2	J	mg/kg	05SB050002	7/8	0.008 - 0.008	2.2	NA	210	N	NA	880	No	BSL
86-73-7	FLUORENE	0.02		0.11	J	mg/kg	05SB050002	3/8	0.008 - 0.033	0.11	NA	28	N	NA	170	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.015		0.36	J	mg/kg	05SB050002	6/8	0.008 - 0.008	0.36	NA	0.7	C	NA	3.1	No	BSL
91-20-3	NAPHTHALENE	0.023		0.1		mg/kg	05SB060002	5/8	0.008 - 0.033	0.1	NA	4	N	NA	0.7	No	BSL
85-01-8	PHENANTHRENE	0		1.7		mg/kg	05SB050002	6/8	0.008 - 0.008	1.7	NA	210(10)	N	NA	570(10)	No	BSL
129-00-0	PYRENE	0.009		2.4		mg/kg	05SB050002	7/8	0.008 - 0.008	2.4	NA	210	N	NA	570	No	BSL
PESTICIDES/PCBS																	
72-55-9	4,4'-DDE	0.0067		0.0067		mg/kg	05SB080002	1/6	3.9 - 4.3	0.0067	NA	3	C	NA	450	No	BSL
11097-69-1	AROCLOR-1254	0.1	J	0.24		mg/kg	05SB080002	4/8	39 - 43	0.24	NA	NA	C	NA	6.2	No	BSL
HERBICIDES																	
93-76-5	2,4,5-T	0.01	J	0.016	J	mg/kg	05SB080002	2/8	0.0032 - 0.0035	0.016	NA	NA	N	NA	NA	No	NTX
87-86-5	PENTACHLOROPHENOL	0.0024	J	0.012		mg/kg	05SB050002	5/7	0.0008 - 0.00081	0.012	NA	0.001	C	NA	0.028	Yes	ASL
DIOXINS/FURANS																	
3268-87-9	1,2,3,4,6,7,8,9-OCDD	0.000415	J	0.00505	J	mg/kg	05SB080002	8/8	---	0.00505	NA	NA	C	NA	NA	No	NTX
39001-02-0	1,2,3,4,6,7,8,9-OCDF	0.0000085	J	0.000313	J	mg/kg	05SB060002	7/8	0.0000004 - 0.0000004	0.000313	NA	NA	C	NA	NA	No	NTX
35822-46-9	1,2,3,4,6,7,8-HPCDD	0.0000072		0.000359	J	mg/kg	05SB060002	8/8	---	0.000359	NA	NA	C	NA	NA	No	NTX
67562-39-4	1,2,3,4,6,7,8-HPCDF	0.0000121		0.000541	J	mg/kg	05SB060002	7/8	0.00000054 - 0.00000054	0.000541	NA	NA	C	NA	NA	No	NTX
55673-89-7	1,2,3,4,7,8,9-HPCDF	0.00000088	J	0.0000575		mg/kg	05SB060002	6/8	0.0000003 - 0.0000018	0.0000575	NA	NA	C	NA	NA	No	NTX
39227-28-6	1,2,3,4,7,8-HXCDD	0.000001	J	0.0000217		mg/kg	05SB060002	5/8	0.0000002 - 0.0000021	0.0000217	NA	NA	C	NA	NA	No	NTX
70648-26-9	1,2,3,4,7,8-HXCDF	0.0000037		0.000361	J	mg/kg	05SB060002	7/8	0.00000055 - 0.00000055	0.000361	NA	NA	C	NA	NA	No	NTX
57653-85-7	1,2,3,6,7,8-HXCDD	0.0000019	J	0.000053	J	mg/kg	05SB060002	7/8	0.0000003 - 0.0000003	0.000053	NA	NA	C	NA	NA	No	NTX
57117-44-9	1,2,3,6,7,8-HXCDF	0.00000028	J	0.000128		mg/kg	05SB060002	8/8	---	0.000128	NA	NA	C	NA	NA	No	NTX
19408-74-3	1,2,3,7,8,9-HXCDD	0.00000036	J	0.0000691	J	mg/kg	05SB060002	8/8	---	0.0000691	NA	NA	C	NA	NA	No	NTX
72918-21-9	1,2,3,7,8,9-HXCDF	0.00000041	J	0.0000098	J	mg/kg	05SB060002	3/8	0.0000002 - 0.0000032	0.0000098	NA	NA	C	NA	NA	No	NTX
40321-76-4	1,2,3,7,8-PECDD	0.0000014	J	0.0000221		mg/kg	05SB060002	5/8	0.0000003 - 0.0000009	0.0000221	NA	NA	C	NA	NA	No	NTX
57117-41-6	1,2,3,7,8-PECDF	0.0000013	J	0.000105		mg/kg	05SB060002	4/8	0.0000002 - 0.0000304	0.000105	NA	NA	C	NA	NA	No	NTX

TABLE 5-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE SOIL
SWMU 5, OLD BURN PIT
NWSC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)		USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
60851-34-5	2,3,4,6,7,8-HXCDF	0.0000024	J	0.000146		mg/kg	05SB060002	7/8	0.0000002 - 0.0000002	0.000146	NA	NA	C	NA	NA	No	NTX
57117-31-4	2,3,4,7,8-PECDF	0.0000022	J	0.000143		mg/kg	05SB060002	7/8	0.0000002 - 0.0000002	0.000143	NA	NA	C	NA	NA	No	NTX
1746-01-6	2,3,7,8-TCDD	0.00000049	J	0.0000061		mg/kg	05SB060002	5/8	0.0000003 - 0.00000045	0.0000061	NA	NA	C	NA	NA	No	NTX
51207-31-9	2,3,7,8-TCDF	0.0000028		0.000325		mg/kg	05SB060002	7/8	0.0000002 - 0.0000002	0.000325	NA	NA	C	NA	NA	No	NTX
1746-01-6	2,3,7,8-TCDD TEQ	0.00000068		0.000226		mg/kg	05SB060002	8/8	-	0.000226	NA	NA	C	NA	NA	No	NTX
37871-00-4	TOTAL HPCDD	0.0000151		0.000803	J	mg/kg	05SB060002	8/8	---	0.000803	NA	NA	C	NA	NA	No	NTX
38998-75-3	TOTAL HPCDF	0.0000219	J	0.000792	J	mg/kg	05SB060002	6/8	0.00000054 - 0.000106	0.000792	NA	NA	C	NA	NA	No	NTX
34465-46-8	TOTAL HXCDD	0.0000254	J	0.00089	J	mg/kg	05SB060002	5/8	0.00000065 - 0.0000686	0.00089	NA	NA	C	NA	NA	No	NTX
55684-94-1	TOTAL HXCDF	0.0000254	J	0.0000254	J	mg/kg	05SB020002	1/8	0.0000015 - 0.00139	0.0000254	NA	NA	C	NA	NA	No	NTX
30402-15-4	TOTAL PECDF	0.0000013	J	0.0000013	J	mg/kg	05SB040002	1/8	0.0000312 - 0.00197	0.0000013	NA	NA	C	NA	NA	No	NTX
41903-57-5	TOTAL TCDD	0.000133		0.000404		mg/kg	05SB060002	2/8	0.0000003 - 0.0000661	0.000404	NA	NA	C	NA	NA	No	NTX
55722-27-5	TOTAL TCDF	0.0000524		0.0000524		mg/kg	05SB080002	1/8	0.0000002 - 0.0021	0.0000524	NA	NA	C	NA	NA	No	NTX
INORGANICS																	
7429-90-5	ALUMINUM	3580	J	14800	J	mg/kg	05SB040002	8/8	---	14800	No	NA	N	NA	NA	No	NTX, BKG
7440-36-0	ANTIMONY	3.2	J	301	J	mg/kg	05SB060002	7/8	0.9 - 0.9	301	Yes	0.3	N	NA	5.4	Yes	ASL
7440-38-2	ARSENIC	5.1	J	26.8	J	mg/kg	05SB060002	8/8	---	26.8	No	1	C	750	29	No	BKG
7440-39-3	BARIUM	74.7	J	2020		mg/kg	05SB060002	8/8	---	2020	Yes	82	N	690000	1600	Yes	ASL
7440-43-9	CADMIUM	1.6	J	31.1	J	mg/kg	05SB060002	6/8	0.83 - 0.84	31.1	Yes	0.4	N	1800	7.5	Yes	ASL
7440-70-2	CALCIUM	685	J	241000	J	mg/kg	05SB050002	7/8	413 - 413	241000	Yes	NA		NA	NA	No	NUT
7440-47-3	CHROMIUM	10.4		112	J	mg/kg	05SB060002	8/8	---	112	Yes	2	C	270	38	Yes	ASL
7440-48-4	COBALT	5.8		35.8		mg/kg	05SB060002	8/8	---	35.8	No	NA	N	NA	NA	No	NTX, BKG
7440-50-8	COPPER	11.7		1520	J	mg/kg	05SB060002	8/8	---	1520	Yes	NA	N	NA	580	Yes	ASL
7439-89-6	IRON	15600	J	105000	J	mg/kg	05SB060002	8/8	---	105000	Yes	NA	N	NA	NA	No	NTX
7439-92-1	LEAD	15.2	J	16900	J	mg/kg	05SB060002	8/8	---	16900	Yes	NA	N	NA	81	Yes	ASL
7439-95-4	MAGNESIUM	660	J	4900	J	mg/kg	05SB050002	8/8	---	4900	No	NA		NA	NA	No	NUT, BKG
7439-96-5	MANGANESE	264		1170		mg/kg	05SB040002	8/8	---	1170	No	NA	N	NA	NA	No	NTX, BKG
7439-97-6	MERCURY	0.04	J	0.43		mg/kg	05SB010002	8/8	---	0.43	Yes	0.1	N	10	2.1	Yes	ASL
7440-02-0	NICKEL	12		62.6		mg/kg	05SB060002	8/8	---	62.6	No	7	N	13000	950	No	BKG
7440-09-7	POTASSIUM	464	J	1050	J	mg/kg	05SB060002	5/8	413 - 462	1050	No	NA		NA	NA	No	NUT, BKG
7440-22-4	SILVER	1.8	J	7.5	J	mg/kg	05SB060002	3/8	0.83 - 0.92	7.5	Yes	2	N	NA	31	Yes	ASL
7440-31-5	TIN	13.2	J	849		mg/kg	05SB080002	7/8	4.5 - 4.5	849	Yes	NA	N	NA	NA	No	NTX
7440-62-2	VANADIUM	9.9		22.9		mg/kg	05SB040002	8/8	---	22.9	No	300	N	NA	NA	No	BSL,BKG
7440-66-6	ZINC	26.6		5110	J	mg/kg	05SB060002	8/8	---	5110	Yes	620	N	NA	14000	Yes	ASL
MISCELLANEOUS PARAMETERS																	
	CATION EXCHANGE CAPACITY	13	J	13	J	meq/1	05SB040002	1/1	---	13	NA	NA		NA	NA	No	NTX
	PH	5.1	J	5.1	J	S.U.	05SB040002	1/1	---	5.1	NA	NA		NA	NA	No	NTX
	TOTAL ORGANIC CARBON	1700		1700		mg/kg	05SB040002	1/1	---	1700	NA	NA		NA	NA	No	NTX

TABLE 5-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE SOIL
SWMU 5, OLD BURN PIT
NWSC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)	USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TINUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 Soil Screening Guidance: Technical Background Document. (U.S. EPA, May 1996). The migration to groundwater value represents a dilution and attenuation factor (DAF) of 1.
6 Residential levels for migration from soil to groundwater (IDEM, July 2001).
7 The chemical is selected as a COPC if the maximum detected concentration exceeds any screening level.
8 Naphthalene is used as a surrogate for 2-methylnaphthalene.
9 Acenaphthene is used as a surrogate for acenaphthylene.
10 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.

Associated Samples:

05SB010002	05SB050002
05SB010102	05SB050102
05SB020002	05SB060002
05SB020102	05SB060102
05SB030002	05SB070002
05SB030102	05SB070102
05SB040002	05SB080002
05SB040102	05SB080102

Shaded cells indicate that the specified criterion or background level hs been exceeded or that the chemical has been selected as a COPC.

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen,
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for migration from soil to ground water (IDEM, July 2001).
J = Estimated value.
N = Nocarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.

NTX = No toxicity information.
NUT = Essential nutrient.

ASL = Above screening level.
BSL = Below screening level.
CAS = Chemical abstract services.

TABLE 5-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE/SUBSURFACE SOIL
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
VOLATILE ORGANICS																	
75-34-3	1,1-DICHLOROETHANE	0.14		0.14		mg/kg	05SB030507	1/15	0.003 - 0.004	0.14	NA	59	N	1300	IDEM	No	BSL
75-35-4	1,1-DICHLOROETHENE	0.013	J	0.013	J	mg/kg	05SB060102	1/15	0.003 - 0.004	0.013	NA	0.054	C	0.67	IDEM	No	BSL
67-64-1	ACETONE	0.048		0.054		mg/kg	05SB030507	2/15	0.014 - 0.018	0.054	NA	160	N	3900	IDEM	No	BSL
71-43-2	BENZENE	0.003		0.017		mg/kg	05SB030507	3/15	0.003 - 0.004	0.017	NA	0.65	C	8.2	IDEM	No	BSL
75-00-3	CHLOROETHANE	0.048		0.048		mg/kg	05SB030507	1/15	0.003 - 0.004	0.048	NA	3	C	46	IDEM	No	BSL
156-59-2	CIS-1,2-DICHLOROETHENE	0.005		2.8	J	mg/kg	05SB060102	6/15	0.003 - 0.004	2.8	NA	4.3	N	110	IDEM	No	BSL
100-41-4	ETHYLBENZENE	0.019		0.019		mg/kg	05SB030507	1/15	0.003 - 0.004	0.019	NA	230	sat	4600	IDEM	No	BSL
75-09-2	METHYLENE CHLORIDE	0.004	J	0.042		mg/kg	05SB030507	5/15	0.003 - 0.004	0.042	NA	8.9	C	120	IDEM	No	BSL
127-18-4	TETRACHLOROETHENE	0.003		0.007	J	mg/kg	05SB060102	2/15	0.003 - 0.004	0.007	NA	5.7	C	48	IDEM	No	BSL
108-88-3	TOLUENE	0.027		0.027		mg/kg	05SB030507	1/15	0.003 - 0.004	0.027	NA	520	sat	1700	IDEM	No	BSL
156-60-5	TRANS-1,2-DICHLOROETHENE	0.007		0.029	J	mg/kg	05SB060102	2/15	0.003 - 0.004	0.029	NA	6.3	N	180	IDEM	No	BSL
79-01-6	TRICHLOROETHENE	0.004		5.1	J	mg/kg	05SB060102	8/15	0.003 - 0.004	5.1	NA	2.8	C	45	IDEM	Yes	ASL
75-01-4	VINYL CHLORIDE	0.005	J	0.16		mg/kg	05SB060608	5/15	0.003 - 0.004	0.16	NA	0.15	C	0.28	IDEM	Yes	ASL
1330-20-7	XYLENES, TOTAL	0.01		0.061		mg/kg	05SB030507	2/15	0.003 - 0.004	0.061	NA	210	sat	4800	IDEM	No	BSL
SEMIVOLATILE ORGANICS																	
91-57-6	2-METHYLNAPHTHALENE	0.012		2.5	J	mg/kg	05SB030507	10/15	0.007 - 0.033	2.5	NA	5.6(7)	N	3200(7)	IDEM	No	BSL
106-44-5	4-METHYLPHENOL	0.46		0.77	J	mg/kg	05SB060608	2/15	0.36 - 5.9	0.77	NA	31	N	910	IDEM	No	BSL
83-32-9	ACENAPHTHENE	0.01		0.12		mg/kg	05SB010002	6/15	0.007 - 5.9	0.12	NA	370	N	9500	IDEM	No	BSL
208-96-8	ACENAPHTHYLENE	0.009		0.052	J	mg/kg	05SB050608	5/15	0.007 - 5.9	0.052	NA	370(8)	N	9500(8)	IDEM	No	BSL
120-12-7	ANTHRACENE	0.009		0.34	J	mg/kg	05SB050002	9/15	0.007 - 5.9	0.34	NA	2200	N	47000	IDEM	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.031		0.95	J	mg/kg	05SB050002	10/15	0.007 - 5.9	0.95	NA	0.62	C	5	IDEM	Yes	ASL
50-32-8	BENZO(A)PYRENE	0.031		0.82	J	mg/kg	05SB050002	10/15	0.007 - 5.9	0.82	NA	0.062	C	0.5	IDEM	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.008		0.96		mg/kg	05SB070608	12/15	0.008 - 5.9	0.96	NA	0.62	C	5	IDEM	Yes	ASL
191-24-2	BENZO(G,H,I)PERYLENE	0.017		0.35	J	mg/kg	05SB050002	10/15	0.007 - 5.9	0.35	NA	230(9)	N	5500(9)	IDEM	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.028		0.67	J	mg/kg	05SB050002	8/15	0.007 - 5.9	0.67	NA	6.2	C	50	IDEM	No	BSL
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	0.93		3.4		mg/kg	05SB050002	6/15	0.36 - 0.43	3.4	NA	35	C	300	IDEM	No	BSL
218-01-9	CHRYSENE	0.035		1.5	J	mg/kg	05SB030507	11/15	0.007 - 0.008	1.5	NA	62	C	500	IDEM	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.008		0.18	J	mg/kg	05SB050002	7/15	0.007 - 5.9	0.18	NA	0.062	C	0.5	IDEM	Yes	ASL
206-44-0	FLUORANTHENE	0.01		2.2	J	mg/kg	05SB050002	12/15	0.008 - 5.9	2.2	NA	230	N	6300	IDEM	No	BSL
86-73-7	FLUORENE	0.02		0.11	J	mg/kg	05SB050002	6/15	0.007 - 5.9	0.11	NA	260	N	6300	IDEM	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.015		0.36	J	mg/kg	05SB050002	10/15	0.007 - 5.9	0.36	NA	0.62	C	5	IDEM	No	BSL
91-20-3	NAPHTHALENE	0.023		1.2	J	mg/kg	05SB030507	10/15	0.007 - 0.033	1.2	NA	5.6	N	3200	IDEM	No	BSL
85-01-8	PHENANTHRENE	0.012		2.8	J	mg/kg	05SB030507	12/15	0.008 - 0.008	2.8	NA	230(9)	N	5500(9)	IDEM	No	BSL
129-00-0	PYRENE	0.009		3.1	J	mg/kg	05SB030507	13/15	0.008 - 0.008	3.1	NA	230	N	5500	IDEM	No	BSL
PESTICIDES/PCBs																	
72-54-8	4,4'-DDD	0.008		0.008		mg/kg	05SB020406	1/14	0.0035 - 0.058	0.008	NA	2.4	C	28	IDEM	No	BSL
72-55-9	4,4'-DDE	0.0067		0.0067		mg/kg	05SB080002	1/12	0.0035 - 0.058	0.0067	NA	1.7	C	20	IDEM	No	BSL
11097-69-1	AROCLOR-1254	0.1	J	0.67		mg/kg	05SB060608	6/15	0.035 - 0.58	0.67	NA	0.22	C	1.8	IDEM	Yes	ASL
11096-82-5	AROCLOR-1260	0.64		0.64		mg/kg	05SB050608	1/15	0.035 - 0.58	0.64	NA	0.22	C	1.8	IDEM	Yes	ASL
60-57-1	DIELDRIN	0.0074		0.0074		mg/kg	05SB050608	1/15	0.0035 - 0.058	0.0074	NA	0.03	C	0.27	IDEM	No	BSL
72-43-5	METHOXYCHLOR	0.028	J	0.049	J	mg/kg	05SB070608	2/15	0.018 - 0.3	0.049	NA	31	N	910	IDEM	No	BSL
HERBICIDES																	
93-76-5	2,4,5-T	0.01	J	0.016	J	mg/kg	05SB080002	2/15	0.0029 - 0.047	0.016	NA	61	N	NA	IDEM	No	BSL
87-86-5	PENTACHLOROPHENOL	0.0015	J	0.012		mg/kg	05SB050002	10/14	0.0008 - 0.012	0.012	NA	3	C	20	IDEM	No	BSL

TABLE 5-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE/SUBSURFACE SOIL
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
DIOXINS/FURANS																	
3268-87-9	1,2,3,4,6,7,8,9-OCDD	0.0000581	J	0.00505	J	mg/kg	05SB080002	15/15	---	0.00505	NA	0.039	C	NA	IDEM	No	BSL
39001-02-0	1,2,3,4,6,7,8,9-OCDF	0.00000026	J	0.000477	J	mg/kg	05SB070608	14/15	0.0000004 - 0.0000004	0.000477	NA	0.039	C	NA	IDEM	No	BSL
35822-46-9	1,2,3,4,6,7,8-HPCDD	0.0000072		0.000736	J	mg/kg	05SB030507	13/15	0.0000057 - 0.000009	0.000736	NA	0.00039	C	NA	IDEM	Yes	ASL
67562-39-4	1,2,3,4,6,7,8-HPCDF	0.0000121		0.00159	J	mg/kg	05SB030507	12/15	0.00000054 - 0.0000024	0.00159	NA	0.00039	C	NA	IDEM	Yes	ASL
55673-89-7	1,2,3,4,7,8,9-HPCDF	0.00000049	J	0.0000686		mg/kg	05SB070608	9/15	0.0000001 - 0.0000077	0.0000686	NA	0.00039	C	NA	IDEM	No	BSL
39227-28-6	1,2,3,4,7,8-HXCDD	0.00000026	J	0.0000849	J	mg/kg	05SB030507	8/15	0.00000013 - 0.000005	0.0000849	NA	0.000039	C	NA	IDEM	Yes	ASL
70648-26-9	1,2,3,4,7,8-HXCDF	0.0000037		0.00101	J	mg/kg	05SB030507	12/15	0.00000055 - 0.0000011	0.00101	NA	0.000039	C	NA	IDEM	Yes	ASL
57653-85-7	1,2,3,6,7,8-HXCDD	0.0000019	J	0.000192	J	mg/kg	05SB030507	12/15	0.00000014 - 0.00000062	0.000192	NA	0.000039	C	NA	IDEM	Yes	ASL
57117-44-9	1,2,3,6,7,8-HXCDF	0.00000028	J	0.000447	J	mg/kg	05SB030507	14/15	0.0000024 - 0.0000024	0.000447	NA	0.000039	C	NA	IDEM	Yes	ASL
19408-74-3	1,2,3,7,8,9-HXCDD	0.00000036	J	0.0000934	J	mg/kg	05SB070608	12/15	0.00000065 - 0.000022	0.0000934	NA	0.000039	C	NA	IDEM	Yes	ASL
72918-21-9	1,2,3,7,8,9-HXCDF	0.00000041	J	0.0000098	J	mg/kg	05SB060002	5/15	0.0000001 - 0.0000038	0.0000098	NA	0.000039	C	NA	IDEM	No	BSL
40321-76-4	1,2,3,7,8-PECDD	0.0000014	J	0.0000977	J	mg/kg	05SB030507	9/15	0.0000001 - 0.0000024	0.0000977	NA	0.0000039	C	NA	IDEM	Yes	ASL
57117-41-6	1,2,3,7,8-PECDF	0.00000032	J	0.000378	J	mg/kg	05SB030507	8/15	0.0000002 - 0.0000304	0.000378	NA	0.000078	C	NA	IDEM	Yes	ASL
60851-34-5	2,3,4,6,7,8-HXCDF	0.0000024	J	0.000191		mg/kg	05SB070608	11/15	0.00000014 - 0.0000026	0.000191	NA	0.000039	C	NA	IDEM	Yes	ASL
57117-31-4	2,3,4,7,8-PECDF	0.00000022	J	0.000189		mg/kg	05SB070608	13/15	0.0000002 - 0.0000017	0.000189	NA	0.0000078	C	NA	IDEM	Yes	ASL
1746-01-6	2,3,7,8-TCDD	0.00000049	J	0.0000335	J	mg/kg	05SB030507	8/15	0.00000006 - 0.0000013	0.0000335	NA	0.0000039	C	NA	IDEM	Yes	ASL
51207-31-9	2,3,7,8-TCDF	0.00000036	J	0.000453	J	mg/kg	05SB030507	13/15	0.0000002 - 0.0000031	0.000453	NA	0.000039	C	NA	IDEM	Yes	ASL
1746-01-6	2,3,7,8-TCDD TEQ	0.00000068		0.000464		mg/kg	05SB030507	15/15	-	0.000464	NA	0.0000039	C	NA	IDEM	Yes	ASL
37871-00-4	TOTAL HPCDD	0.0000151		0.00169	J	mg/kg	05SB030507	13/15	0.0000102 - 0.0000174	0.00169	NA	NA	C	NA	IDEM	No	NTX
38998-75-3	TOTAL HPCDF	0.0000219	J	0.00185	J	mg/kg	05SB030507	11/15	0.00000054 - 0.000106	0.00185	NA	NA	C	NA	IDEM	No	NTX
34465-46-8	TOTAL HXCDD	0.000005	J	0.00304	J	mg/kg	05SB030507	8/15	0.00000065 - 0.0000686	0.00304	NA	NA	C	NA	IDEM	No	NTX
55684-94-1	TOTAL HXCDF	0.0000254	J	0.00394	J	mg/kg	05SB030507	4/15	0.0000015 - 0.00201	0.00394	NA	NA	C	NA	IDEM	No	NTX
36088-22-9	TOTAL PECDD	0.00228	J	0.00228	J	mg/kg	05SB030507	1/15	0.0000003 - 0.00084	0.00228	NA	NA	C	NA	IDEM	No	NTX
30402-15-4	TOTAL PECDF	0.0000013	J	0.00574	J	mg/kg	05SB030507	3/15	0.0000027 - 0.00291	0.00574	NA	NA	C	NA	IDEM	No	NTX
41903-57-5	TOTAL TCDD	0.000133		0.000404		mg/kg	05SB060002	2/15	0.00000028 - 0.00176	0.000404	NA	NA	C	NA	IDEM	No	NTX
55722-27-5	TOTAL TCDF	0.0000524		0.03684	J	mg/kg	05SB030507	2/15	0.0000002 - 0.00304	0.03684	NA	NA	C	NA	IDEM	No	NTX
INORGANICS																	
7429-90-5	ALUMINUM	3580	J	15700	J	mg/kg	05SB040204	15/15	---	15700	No	7600	N	NA	IDEM	No	BKG
7440-36-0	ANTIMONY	0.9	J	301	J	mg/kg	05SB060002	13/15	0.84 - 0.9	301	Yes	3.1	N	140	IDEM	Yes	ASL
7440-38-2	ARSENIC	2.9	J	26.8	J	mg/kg	05SB060002	15/15	---	26.8	Yes	0.39	C	3.9	IDEM	Yes	ASL
7440-39-3	BARIUM	30.3		2020		mg/kg	05SB060002	15/15	---	2020	Yes	540	N	23000	IDEM	Yes	ASL
7440-43-9	CADMIUM	1.6	J	31.1	J	mg/kg	05SB060002	11/15	0.8 - 0.9	31.1	Yes	3.7	N	12	IDEM	Yes	ASL
7440-70-2	CALCIUM	685	J	241000	J	mg/kg	05SB050002	12/15	399 - 449	241000	Yes	NA		NA	IDEM	No	NUT
7440-47-3	CHROMIUM	5.7	J	112	J	mg/kg	05SB060002	15/15	---	112	Yes	30(10)	C	430(10)	IDEM	Yes	ASL
7440-48-4	COBALT	5.5		35.8		mg/kg	05SB060002	15/15	---	35.8	No	470	N	NA	IDEM	No	BSL,BKG
7440-50-8	COPPER	8.1	J	6370	J	mg/kg	05SB060608	15/15	---	6370	Yes	290	N	13000	IDEM	Yes	ASL
7439-89-6	IRON	11400	J	105000	J	mg/kg	05SB060002	15/15	---	105000	Yes	2300	N	NA	IDEM	Yes	ASL
7439-92-1	LEAD	8.2	J	16900	J	mg/kg	05SB060002	15/15	---	16900	Yes	400(11)	N	400	IDEM	Yes	ASL
7439-95-4	MAGNESIUM	496	J	4900	J	mg/kg	05SB050002	15/15	---	4900	No	NA		NA	IDEM	No	NUT
7439-96-5	MANGANESE	157	J	1170		mg/kg	05SB040002	15/15	---	1170	Yes	180	N	NA	IDEM	Yes	ASL
7439-97-6	MERCURY	0.04	J	93.2		mg/kg	05SB050608	13/15	0.04 - 0.04	93.2	Yes	2.3(12)	N	55	IDEM	Yes	ASL
7440-02-0	NICKEL	8.8		62.6		mg/kg	05SB060002	15/15	---	62.6	Yes	160	N	6900	IDEM	No	BSL
7440-09-7	POTASSIUM	464	J	1520	J	mg/kg	05SB060608	10/15	399 - 462	1520	No	NA		NA	IDEM	No	NUT, BKG
7440-22-4	SILVER	1.7	J	16.1	J	mg/kg	05SB030507	7/15	0.8 - 0.92	16.1	Yes	39	N	1700	IDEM	No	BSL
7440-23-5	SODIUM	500		1300	J	mg/kg	05SB030507	3/15	399 - 478	1300	Yes	NA		NA	IDEM	No	NUT, BKG
7440-31-5	TIN	13.2	J	849		mg/kg	05SB080002	12/15	4.1 - 4.5	849	Yes	4700	N	NA	IDEM	No	BSL
7440-62-2	VANADIUM	9.6		22.9		mg/kg	05SB040002	15/15	---	22.9	No	55	N	NA	IDEM	No	BSL,BKG
7440-66-6	ZINC	25.9		5110	J	mg/kg	05SB060002	15/15	---	5110	Yes	2300	N	100000	IDEM	Yes	ASL

TABLE 5-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE/SUBSURFACE SOIL
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
MISCELLANEOUS PARAMETERS																	
	CATION EXCHANGE CAPACITY	3.2		13	J	meq/100 g	05SB040002	4/4	---	13	NA	NA		NA	IDEM	No	NTX
	pH	5.1	J	7.6	J	S.U.	05SB030507	4/4	---	7.6	NA	NA		NA	IDEM	No	NTX
	TOTAL ORGANIC CARBON	1500		72000		mg/kg	05SB030507	4/4	---	72000	NA	NA		NA	IDEM	No	NTX

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to Base-wide background data presented in the Basewide Background Soil Investigation Report (TtNUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 The risk-based soil COPC screening level for residential land use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, November 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Naphthalene is used as a surrogate for 2-methylnaphthalene.
8 Acenaphthene is used as a surrogate for acenaphthylene.
9 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
10 Hexavalent chromium.
11 OSWER soil screening level for residential land use (U.S. EPA, July 1994).
12 Value is for mercuric chloride (U.S. EPA, Region 3, October 2001).

Associated Samples:

05SB010002	05SB050002	05SB010810	05SB050608
05SB010102	05SB050102	05SB020406	05SB060608
05SB020002	05SB060002	05SB030507	05SB070608
05SB020102	05SB060102	05SB040204	
05SB030002	05SB070002		
05SB030102	05SB070102		
05SB040002	05SB080002		
05SB040102	05SB080102		

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001).
J = Estimated value.
N = Nocarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

ASL = Above screening level.
BSL = Below screening level.
CAS = Chemical abstract services.

Shaded cells indicate that the specified criteriono r background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 5-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE/SUBSURFACE SOIL
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)		USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
VOLATILE ORGANICS																	
75-34-3	1,1-DICHLOROETHANE	0.14		0.14		mg/kg	05SB030507	1/15	0.003 - 0.004	0.14	NA	1	N	1300	5.6	No	BSL
75-35-4	1,1-DICHLOROETHENE	0.013	J	0.013	J	mg/kg	05SB060102	1/15	0.003 - 0.004	0.013	NA	0.003	C	0.07	0.058	Yes	ASL
67-64-1	ACETONE	0.048		0.054		mg/kg	05SB030507	2/15	0.014 - 0.018	0.054	NA	0.8	N	100000	3.1	No	BSL
71-43-2	BENZENE	0.003		0.017		mg/kg	05SB030507	3/15	0.003 - 0.004	0.017	NA	0.002	C	0.8	0.034	Yes	ASL
75-00-3	CHLOROETHANE	0.048		0.048		mg/kg	05SB030507	1/15	0.003 - 0.004	0.048	NA	NA	C	NA	0.32	No	BSL
156-59-2	CIS-1,2-DICHLOROETHENE	0.005		2.8	J	mg/kg	05SB060102	6/15	0.003 - 0.004	2.8	NA	0.02	N	1200	0.4	Yes	ASL
100-41-4	ETHYLBENZENE	0.019		0.019		mg/kg	05SB030507	1/15	0.003 - 0.004	0.019	NA	0.7	N	400	13	No	BSL
75-09-2	METHYLENE CHLORIDE	0.004	J	0.042		mg/kg	05SB030507	5/15	0.003 - 0.004	0.042	NA	0.001	C	13	0.023	Yes	ASL
127-18-4	TETRACHLOROETHENE	0.003		0.007	J	mg/kg	05SB060102	2/15	0.003 - 0.004	0.007	NA	0.003	C	11	0.058	Yes	ASL
108-88-3	TOLUENE	0.027		0.027		mg/kg	05SB030507	1/15	0.003 - 0.004	0.027	NA	0.6	N	650	12	No	BSL
156-60-5	TRANS-1,2-DICHLOROETHENE	0.007		0.029	J	mg/kg	05SB060102	2/15	0.003 - 0.004	0.029	NA	0.03	N	3100	0.68	No	BSL
79-01-6	TRICHLOROETHENE	0.004		5.1	J	mg/kg	05SB060102	8/15	0.003 - 0.004	5.1	NA	0.003	C	5	0.057	Yes	ASL
75-01-4	VINYL CHLORIDE	0.005	J	0.16		mg/kg	05SB060608	5/15	0.003 - 0.004	0.16	NA	0.0007	C	0.03	0.013	Yes	ASL
1330-20-7	XYLENES, TOTAL	0.01		0.061		mg/kg	05SB030507	2/15	0.003 - 0.004	0.061	NA	10	N	410	190	No	BSL
SEMIVOLATILE ORGANICS																	
91-57-6	2-METHYLNAPHTHALENE	0.012		2.5	J	mg/kg	05SB030507	10/15	0.007 - 0.033	2.5	NA	4(8)	N	NA	0.7(8)	Yes	ASL
106-44-5	4-METHYLPHENOL	0.46		0.77	J	mg/kg	05SB060608	2/15	0.36 - 5.9	0.77	NA	NA	N	NA	1.1	No	BSL
83-32-9	ACENAPHTHENE	0.01		0.12		mg/kg	05SB010002	6/15	0.007 - 5.9	0.12	NA	29	N	NA	130	No	BSL
208-96-8	ACENAPHTHYLENE	0.009		0.052	J	mg/kg	05SB050608	5/15	0.007 - 5.9	0.052	NA	29(9)	N	NA	130(9)	No	BSL
120-12-7	ANTHRACENE	0.009		0.34	J	mg/kg	05SB050002	9/15	0.007 - 5.9	0.34	NA	590	N	NA	51	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.031		0.95	J	mg/kg	05SB050002	10/15	0.007 - 5.9	0.95	NA	0.08	C	NA	19	Yes	ASL
50-32-8	BENZO(A)PYRENE	0.031		0.82	J	mg/kg	05SB050002	10/15	0.007 - 5.9	0.82	NA	0.4	C	NA	8.2	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.008		0.96		mg/kg	05SB070608	12/15	0.008 - 5.9	0.96	NA	0.2	C	NA	57	Yes	ASL
191-24-2	BENZO(G,H,I)PERYLENE	0.017		0.35	J	mg/kg	05SB050002	10/15	0.007 - 5.9	0.35	NA	210(10)	N	NA	570(10)	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.028		0.67	J	mg/kg	05SB050002	8/15	0.007 - 5.9	0.67	NA	2	C	NA	39	No	BSL
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	0.93		3.4		mg/kg	05SB050002	6/15	0.36 - 0.43	3.4	NA	180	C	31000	3600	No	BSL
218-01-9	CHRYSENE	0.035		1.5	J	mg/kg	05SB030507	11/15	0.007 - 0.008	1.5	NA	8	C	NA	25	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.008		0.18	J	mg/kg	05SB050002	7/15	0.007 - 5.9	0.18	NA	0.08	C	NA	18	Yes	ASL
206-44-0	FLUORANTHENE	0.01		2.2	J	mg/kg	05SB050002	12/15	0.008 - 5.9	2.2	NA	210	N	NA	880	No	BSL
86-73-7	FLUORENE	0.02		0.11	J	mg/kg	05SB050002	6/15	0.007 - 5.9	0.11	NA	28	N	NA	170	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.015		0.36	J	mg/kg	05SB050002	10/15	0.007 - 5.9	0.36	NA	0.7	C	NA	3.1	No	BSL
91-20-3	NAPHTHALENE	0.023		1.2	J	mg/kg	05SB030507	10/15	0.007 - 0.033	1.2	NA	4	N	NA	0.7	Yes	ASL
85-01-8	PHENANTHRENE	0.012		2.8	J	mg/kg	05SB030507	12/15	0.008 - 0.008	2.8	NA	210(10)	N	NA	570(10)	No	BSL
129-00-0	PYRENE	0.009		3.1	J	mg/kg	05SB030507	13/15	0.008 - 0.008	3.1	NA	210	N	NA	570	No	BSL
PESTICIDES/PCBs																	
72-54-8	4,4'-DDD	0.008		0.008		mg/kg	05SB020406	1/14	0.0035 - 0.058	0.008	NA	0.8	C	NA	140	No	BSL
72-55-9	4,4'-DDE	0.0067		0.0067		mg/kg	05SB080002	1/12	0.0035 - 0.058	0.0067	NA	3	C	NA	450	No	BSL
11097-69-1	AROCLOR-1254	0.1	J	0.67		mg/kg	05SB060608	6/15	0.035 - 0.58	0.67	NA	NA	C	NA	6.2	No	BSL
11096-82-5	AROCLOR-1260	0.64		0.64		mg/kg	05SB050608	1/15	0.035 - 0.58	0.64	NA	NA	C	NA	6.2	No	BSL
60-57-1	DIELDRIN	0.0074		0.0074		mg/kg	05SB050608	1/15	0.0035 - 0.058	0.0074	NA	0.0002	C	1	0.046	Yes	ASL
72-43-5	METHOXYCHLOR	0.028	J	0.049	J	mg/kg	05SB070608	2/15	0.018 - 0.3	0.049	NA	8	N	NA	160	No	BSL
HERBICIDES																	
93-76-5	2,4,5-T	0.01	J	0.016	J	mg/kg	05SB080002	2/15	0.0029 - 0.047	0.016	NA	NA	N	NA	NA	No	NTX
87-86-5	PENTACHLOROPHENOL	0.0015	J	0.012		mg/kg	05SB050002	10/14	0.0008 - 0.012	0.012	NA	0.001	C	NA	0.028	Yes	ASL

TABLE 5-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE/SUBSURFACE SOIL
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)		USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
DIOXINS/FURANS																	
3268-87-9	1,2,3,4,6,7,8,9-OCDD	0.0000581	J	0.00505	J	mg/kg	05SB080002	15/15	---	0.00505	NA	NA	C	NA	NA	No	NTX
39001-02-0	1,2,3,4,6,7,8,9-OCDF	0.00000026	J	0.000477	J	mg/kg	05SB070608	14/15	0.0000004 - 0.0000004	0.000477	NA	NA	C	NA	NA	No	NTX
35822-46-9	1,2,3,4,6,7,8-HPCDD	0.0000072		0.000736	J	mg/kg	05SB030507	13/15	0.0000057 - 0.000009	0.000736	NA	NA	C	NA	NA	No	NTX
67562-39-4	1,2,3,4,6,7,8-HPCDF	0.0000121		0.00159	J	mg/kg	05SB030507	12/15	0.00000054 - 0.0000024	0.00159	NA	NA	C	NA	NA	No	NTX
55673-89-7	1,2,3,4,7,8,9-HPCDF	0.00000049	J	0.0000686		mg/kg	05SB070608	9/15	0.0000001 - 0.0000077	0.0000686	NA	NA	C	NA	NA	No	NTX
39227-28-6	1,2,3,4,7,8-HXCDD	0.00000026	J	0.0000849	J	mg/kg	05SB030507	8/15	0.00000013 - 0.000005	0.0000849	NA	NA	C	NA	NA	No	NTX
70648-26-9	1,2,3,4,7,8-HXCDF	0.0000037		0.00101	J	mg/kg	05SB030507	12/15	0.00000055 - 0.0000011	0.00101	NA	NA	C	NA	NA	No	NTX
57653-85-7	1,2,3,6,7,8-HXCDD	0.0000019	J	0.000192	J	mg/kg	05SB030507	12/15	0.00000014 - 0.00000062	0.000192	NA	NA	C	NA	NA	No	NTX
57117-44-9	1,2,3,6,7,8-HXCDF	0.00000028	J	0.000447	J	mg/kg	05SB030507	14/15	0.0000024 - 0.0000024	0.000447	NA	NA	C	NA	NA	No	NTX
19408-74-3	1,2,3,7,8,9-HXCDD	0.00000036	J	0.0000934	J	mg/kg	05SB070608	12/15	0.00000065 - 0.000022	0.0000934	NA	NA	C	NA	NA	No	NTX
72918-21-9	1,2,3,7,8,9-HXCDF	0.00000041	J	0.0000098	J	mg/kg	05SB060002	5/15	0.0000001 - 0.0000038	0.0000098	NA	NA	C	NA	NA	No	NTX
40321-76-4	1,2,3,7,8-PECDD	0.0000014	J	0.0000977	J	mg/kg	05SB030507	9/15	0.0000001 - 0.0000024	0.0000977	NA	NA	C	NA	NA	No	NTX
57117-41-6	1,2,3,7,8-PECDF	0.00000032	J	0.000378	J	mg/kg	05SB030507	8/15	0.0000002 - 0.0000304	0.000378	NA	NA	C	NA	NA	No	NTX
60851-34-5	2,3,4,6,7,8-HXCDF	0.0000024	J	0.000191		mg/kg	05SB070608	11/15	0.00000014 - 0.0000026	0.000191	NA	NA	C	NA	NA	No	NTX
57117-31-4	2,3,4,7,8-PECDF	0.00000022	J	0.000189		mg/kg	05SB070608	13/15	0.0000002 - 0.0000017	0.000189	NA	NA	C	NA	NA	No	NTX
1746-01-6	2,3,7,8-TCDD	0.00000049	J	0.0000335	J	mg/kg	05SB030507	8/15	0.00000006 - 0.0000013	0.0000335	NA	NA	C	NA	NA	No	NTX
51207-31-9	2,3,7,8-TCDF	0.00000036	J	0.000453	J	mg/kg	05SB030507	13/15	0.0000002 - 0.0000031	0.000453	NA	NA	C	NA	NA	No	NTX
1746-01-6	2,3,7,8-TCDD TEQ	0.00000068		0.000464		mg/kg	05SB030507	15/15	-	0.000464	NA	NA	C	NA	NA	No	NTX
37871-00-4	TOTAL HPCDD	0.0000151		0.00169	J	mg/kg	05SB030507	13/15	0.0000102 - 0.0000174	0.00169	NA	NA	C	NA	NA	No	NTX
38998-75-3	TOTAL HPCDF	0.0000219	J	0.00185	J	mg/kg	05SB030507	11/15	0.00000054 - 0.000106	0.00185	NA	NA	C	NA	NA	No	NTX
34465-46-8	TOTAL HXCDD	0.000005	J	0.00304	J	mg/kg	05SB030507	8/15	0.00000065 - 0.0000686	0.00304	NA	NA	C	NA	NA	No	NTX
55684-94-1	TOTAL HXCDF	0.0000254	J	0.00394	J	mg/kg	05SB030507	4/15	0.0000015 - 0.00201	0.00394	NA	NA	C	NA	NA	No	NTX
36088-22-9	TOTAL PECDD	0.00228	J	0.00228	J	mg/kg	05SB030507	1/15	0.0000003 - 0.00084	0.00228	NA	NA	C	NA	NA	No	NTX
30402-15-4	TOTAL PECDF	0.0000013	J	0.00574	J	mg/kg	05SB030507	3/15	0.0000027 - 0.00291	0.00574	NA	NA	C	NA	NA	No	NTX
41903-57-5	TOTAL TCDD	0.000133		0.000404		mg/kg	05SB060002	2/15	0.00000028 - 0.00176	0.000404	NA	NA	C	NA	NA	No	NTX
55722-27-5	TOTAL TCDF	0.0000524		0.03684	J	mg/kg	05SB030507	2/15	0.0000002 - 0.00304	0.03684	NA	NA	C	NA	NA	No	NTX
INORGANICS																	
7429-90-5	ALUMINUM	3580	J	15700	J	mg/kg	05SB040204	15/15	---	15700	No	NA	N	NA	NA	No	NTX, BKG
7440-36-0	ANTIMONY	0.9	J	301	J	mg/kg	05SB060002	13/15	0.84 - 0.9	301	Yes	0.3	N	NA	5.4	Yes	ASL
7440-38-2	ARSENIC	2.9	J	26.8	J	mg/kg	05SB060002	15/15	---	26.8	Yes	1	C	750	29	Yes	ASL
7440-39-3	BARIUM	30.3		2020		mg/kg	05SB060002	15/15	---	2020	Yes	82	N	690000	1600	Yes	ASL
7440-43-9	CADMIUM	1.6	J	31.1	J	mg/kg	05SB060002	11/15	0.8 - 0.9	31.1	Yes	0.4	N	1800	7.5	Yes	ASL
7440-70-2	CALCIUM	685	J	241000	J	mg/kg	05SB050002	12/15	399 - 449	241000	Yes	NA	0	NA	NA	No	NUT
7440-47-3	CHROMIUM	5.7	J	112	J	mg/kg	05SB060002	15/15	---	112	Yes	2	C	270	38	Yes	ASL
7440-48-4	COBALT	5.5		35.8		mg/kg	05SB060002	15/15	---	35.8	No	NA	N	NA	NA	No	NTX, BKG
7440-50-8	COPPER	8.1	J	6370	J	mg/kg	05SB060608	15/15	---	6370	Yes	NA	N	NA	580	Yes	ASL
7439-89-6	IRON	11400	J	105000	J	mg/kg	05SB060002	15/15	---	105000	Yes	NA	N	NA	NA	No	NTX
7439-92-1	LEAD	8.2	J	16900	J	mg/kg	05SB060002	15/15	---	16900	Yes	NA	N	NA	81	Yes	ASL
7439-95-4	MAGNESIUM	496	J	4900	J	mg/kg	05SB050002	15/15	---	4900	No	NA	0	NA	NA	No	NUT, BKG
7439-96-5	MANGANESE	157	J	1170		mg/kg	05SB040002	15/15	---	1170	Yes	NA	N	NA	NA	No	NTX
7439-97-6	MERCURY	0.04	J	93.2		mg/kg	05SB050608	13/15	0.04 - 0.04	93.2	Yes	0.1	N	10	2.1	Yes	ASL
7440-02-0	NICKEL	8.8		62.6		mg/kg	05SB060002	15/15	---	62.6	Yes	7	N	13000	950	Yes	ASL
7440-09-7	POTASSIUM	464	J	1520	J	mg/kg	05SB060608	10/15	399 - 462	1520	No	NA	0	NA	NA	No	NUT, BKG
7440-22-4	SILVER	1.7	J	16.1	J	mg/kg	05SB030507	7/15	0.8 - 0.92	16.1	Yes	2	N	NA	31	Yes	ASL
7440-23-5	SODIUM	500		1300	J	mg/kg	05SB030507	3/15	399 - 478	1300	Yes	NA	0	NA	NA	No	NUT
7440-31-5	TIN	13.2	J	849		mg/kg	05SB080002	12/15	4.1 - 4.5	849	Yes	NA	N	NA	NA	No	NTX
7440-62-2	VANADIUM	9.6		22.9		mg/kg	05SB040002	15/15	---	22.9	No	300	N	NA	NA	No	BSL,BKG
7440-66-6	ZINC	25.9		5110	J	mg/kg	05SB060002	15/15	---	5110	Yes	620	N	NA	14000	Yes	ASL

TABLE 5-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE/SUBSURFACE SOIL
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)	USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
MISCELLANEOUS PARAMETERS																
	CATION EXCHANGE CAPACITY	3.2		13	J	meq/100 g	05SB040002	4/4	---	13	NA	NA	NA	NA	No	NTX
	pH	5.1	J	7.6	J	S.U.	05SB030507	4/4	---	7.6	NA	NA	NA	NA	No	NTX
	TOTAL ORGANIC CARBON	1500		72000		mg/kg	05SB030507	4/4	---	72000	NA	NA	NA	NA	No	NTX

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TtNUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 Soil Screening Guidance: Technical Background Document. (U.S. EPA, May 1996). The migration to groundwater value represents a dilution and attenuation factor (DAF) of 1.
6 Residential levels for migration from soil to groundwater (IDEM, July 2001).
7 The chemical is selected as a COPC if the maximum detected concentration exceeds any screening level.
8 Naphthalene is used as a surrogate for 2-methylnaphthalene.
9 Acenaphthene is used as a surrogate for acenaphthylene.
10 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.

Associated Samples:

05SB010002	05SB050002	05SB010810	05SB050608
05SB010102	05SB050102	05SB020406	05SB060608
05SB020002	05SB060002	05SB030507	05SB070608
05SB020102	05SB060102	05SB040204	
05SB030002	05SB070002		
05SB030102	05SB070102		
05SB040002	05SB080002		
05SB040102	05SB080102		

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for migration from soil to groundwater (IDEM, July 2001).
J = Estimated value.
N = Nocarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.

NTX = No toxicity information.
NUT = Essential nutrient.

ASL = Above screening level.
BSL = Below screening level.
CAS = Chemical abstract services.

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 5-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUND WATER
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
VOLATILE ORGANICS																	
67-66-3	CHLOROFORM	1		1		µg/L	05GWT0101	1/14	0.3	1	NA	0.16	C	80 100	FED-MCL IDEM	Yes	ASL
156-59-2	CIS-1,2-DICHLOROETHENE	3		3		µg/L	05GW1501	1/14	1	3	NA	6.1	N	70 70	FED-MCL IDEM	No	BSL
SEMIVOLATILE ORGANICS																	
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	110		110		µg/L	05GW0801	1/14	2 - 4	110	NA	4.8	C	6 6	FED-MCL IDEM	Yes	ASL
DIOXINS / FURANS																	
3268-87-9	OCDD	6.1	J	269	J	pg/L	05GW1301	10/14	3.8 - 54.5	269	NA	4500	C	NA NA	FED-MCL IDEM	No	BSL
39001-02-0	OCDF	6.8	J	6.8	J	pg/L	05GW1301	1/14	1.8 - 39.3	6.8	NA	4500	C	NA NA	FED-MCL IDEM	No	BSL
35822-46-9	1,2,3,4,6,7,8-HPCDD	7.1	J	12.2	J	pg/L	05GW1301	2/14	2 - 31.1	12.2	NA	45	C	NA NA	FED-MCL IDEM	No	BSL
1746-01-6	2,3,7,8-TCDD	6.3	J	11.3		pg/L	05GWT0301	2/14	1 - 5.4	11.3	NA	0.45	C	30 NA	FED-MCL IDEM	Yes	ASL
37871-00-4	TOTAL HPCDD	16.2		16.2		pg/L	05GW1501	1/14	2 - 31.1	16.2	NA	NA		NA NA	FED-MCL IDEM	No	BSL
38998-75-3	TOTAL HPCDF	2.4		2.4		pg/L	05GW1301	1/14	1.2 - 16.3	2.4	NA	NA		NA NA	FED-MCL IDEM	No	BSL
41903-57-5	TOTAL TCDD	6.3		11.3		pg/L	05GWT0301	2/14	1 - 5.4	11.3	NA	NA		NA NA	FED-MCL IDEM	No	BSL
	2,3,7,8-TCDD EQUIVALENT	1.71		15.9		pg/L	05GWT0301	10/14	NA	15.9	NA	0.45	C	30 NA	FED-MCL IDEM	Yes	ASL
INORGANICS																	
7429-90-5	ALUMINUM	341	J	2320	J	µg/L	05GW0301	2/14	200	2320.	ND	3600	N	50 to 200(7) NA	FED-MCL IDEM	Yes	ASL
7440-38-2	ARSENIC	0.12		1.6		µg/L	05GW1501	8/14	1	1.6	0.14	0.045	C	50 50	FED-AL IDEM	Yes	ASL
7440-39-3	BARIUM	36.1		227		µg/L	05GW0701	14/14	---	227	82.1	260	N	2000 2000	FED-MCL IDEM	No	BSL
7440-70-2	CALCIUM	17200		91500		µg/L	05GW0201	13/14	5000	91500	22900	NA		NA NA	FED-MCL IDEM	No	NUT
7440-50-8	COPPER	4.9		4.9		µg/L	05GW0301	1/14	2	4.9	ND	140	N	1000(7) 1300	FED-MCL IDEM	No	BSL
7439-89-6	IRON	150		4440		µg/L	05GW0301	13/14	100	4440	658	1100	N	300(7) NA	FED-MCL IDEM	Yes	ASL
7439-92-1	LEAD	4.1		4.1		µg/L	05GW0301	1/14	1	4.1	ND	15		15 NA	FED-AL IDEM	No	BSL
7439-95-4	MAGNESIUM	5000	J	27600	J	µg/L	05GW0701	12/14	5000	27600	7000	NA		NA NA	FED-MCL IDEM	No	NUT
7439-96-5	MANGANESE	18.3		2270	J	µg/L	05GW1501	10/14	15	2270	182	88	N	50(7) NA	FED-MCL IDEM	Yes	ASL
7782-49-2	SELENIUM	1.4		1.4		µg/L	05GWT0301	1/14	1	1.4	ND	18	N	50 50	FED-MCL IDEM	No	BSL
7440-23-5	SODIUM	5120		28800	J	µg/L	05GW0701	10/14	5000	28800	ND	NA		NA NA	FED-MCL IDEM	No	NUT
7440-62-2	VANADIUM	4.9		4.9		µg/L	05GW0301	1/14	2	4.9	ND	26	N	NA NA	FED-MCL IDEM	No	BSL
7440-66-6	ZINC	25.5		25.5		µg/L	05GW0301	1/14	10	25.5	41.3	1100	N	5000(7) 11000	FED-MCL IDEM	No	BSL,BKG

TABLE 5-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUND WATER
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
FILTERED METALS																
7440-39-3	BARIUM, FILTERED	33.2		61.1		µg/L	05GW0301-F	2/2	---	61.1	NA	260 N	2000 2000	FED-MCL IDEM	No	BSL
7440-70-2	CALCIUM, FILTERED	5000		61600		µg/L	05GW1301-F	2/2	---	61600	NA	NA	NA NA	FED-MCL IDEM	No	NUT
7439-89-6	IRON, FILTERED	137		137		µg/L	05GW1301-F	1/2	100	137	NA	1100 N	300(7) NA	FED-MCL IDEM	No	BSL
7439-95-4	MAGNESIUM, FILTERED	13200	J	13200	J	µg/L	05GW1301-F	1/2	5000	13200	NA	NA	NA NA	FED-MCL IDEM	No	NUT
7439-96-5	MANGANESE, FILTERED	15.4		51.2		µg/L	05GW1301-F	2/2	---	51.2	NA	88 N	50(7) NA	FED-MCL IDEM	Yes	ASL
7440-23-5	SODIUM, FILTERED	5010	J	5010	J	µg/L	05GW1301-F	1/2	5000	5010	NA	NA	NA NA	FED-MCL IDEM	No	NUT

Footnotes:

1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, maximum groundwater concentrations were compared to concentrations in upgradient groundwater sample 05GW0101. If the concentration in the site groundwater concentration was less than the upgradient concentration, that metal was not selcted as a COPC.
5 The risk-based COPC screening level for tap water use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.SEPA, Region 9, October 2000)..
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Secondary MCL, based on aesthetic water quality (i.e., color, odor, taste, etc.).

Associated Samples:

05GW0201	05GW0701	05GW1501
05GW0301	05GW0801	05GW1601
05GW0301-F	05GW0901	05GW1901
05GW0401	05GW1301	05GWT0101
05GW0601	05GW1301-F	05GWT0201
		05GWT0301

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
COPC = Chemical of potential concern.
J = Estimated value.
N = Noncarcinogen.
NA = Not analyzed / not applicable.
ND = Not detected.
FED-AL = Federal action level (U.S. EPA, 2000).
FED-MCL = Federal Maximum Contaminant Level (U.S. EPA, 2000).
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential closure levels for ground water (IDEM, July 2001).

Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

ASL = Above screening level.
BSL = Below screening level.
CAS = Chemical abstract services.

TABLE 5-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
VOLATILE ORGANICS																
75-35-4	1,1-DICHLOROETHENE	2		2		µg/L	05SW0201	1/4	1	2	NA	0.046 C	7 7	FED-MCL IDEM	Yes	ASL
156-59-2	CIS-1,2-DICHLOROETHENE	1		290		µg/L	05SW0201	3/4	1	290	NA	6.1 N	70 70	FED-MCL IDEM	Yes	ASL
156-60-5	TRANS-1,2-DICHLOROETHENE	3		9		µg/L	05SW0201	2/4	1	9	NA	12 N	100 100	FED-MCL IDEM	No	BSL
79-01-6	TRICHLOROETHENE	48		120		µg/L	05SW0201	2/4	1	120	NA	1.6 C	5 5	FED-MCL IDEM	Yes	ASL
75-01-4	VINYL CHLORIDE	18		85		µg/L	05SW0201	2/4	1	85	NA	0.041 C	2 2	FED-MCL IDEM	Yes	ASL
SEMIVOLATILE ORGANICS																
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	2		2		µg/L	05SW0201	1/4	2	2	NA	4.8 C	6 6	FED-MCL IDEM	No	BSL
DIOXINS / FURANS																
36088-22-9	TOTAL PECDD	9.4		9.4		pg/L	05SW0401	1/4	6.7 - 7.2	9.4	NA	NA C	NA NA	FED-MCL IDEM	No	BSL
INORGANICS																
7429-90-5	ALUMINUM	204	J	204	J	µg/L	05SW0401	1/4	200	204	ND	3600 N	50 to 200(7) NA	FED-AL IDEM	Yes	ASL
7440-36-0	ANTIMONY	1.3		1.3		µg/L	05SW0501	1/4	1	1.3	ND	1.5 N	6 NA	FED-MCL IDEM	No	NUT
7440-38-2	ARSENIC	0.34		0.64		µg/L	05SW0401	4/4	---	0.64	0.55	0.045 C	50 50	FED-MCL IDEM	Yes	ASL
7440-39-3	BARIUM	68.3	J	184	J	µg/L	05SW0501	4/4	---	184	67.7	260 N	2000 2000	FED-MCL IDEM	No	BSL
7440-70-2	CALCIUM	7570		72600		µg/L	05SW0501	4/4	---	72600	29200	NA	NA NA	FED-MCL IDEM	No	NUT
7440-50-8	COPPER	2.4		2.7		µg/L	05SW0201	2/4	2	2.7	ND	140 N	1000(7) 1300	FED-MCL IDEM	No	BSL
7439-89-6	IRON	337	J	1520	J	µg/L	05SW0401	4/4	---	1520	284	1100 N	300(7) NA	FED-MCL IDEM	Yes	ASL
7439-95-4	MAGNESIUM	9880	J	11900	J	µg/L	05SW0301	3/4	5000	11900	6490	NA	NA NA	FED-MCL IDEM	No	NUT
7439-96-5	MANGANESE	105		315		µg/L	05SW0301	3/4	15	315	41.4	88 N	50(7) NA	FED-MCL IDEM	Yes	ASL
7440-23-5	SODIUM	9330		22800		µg/L	05SW0401	4/4	---	22800	30700	NA	NA NA	FED-MCL IDEM	No	NUT, BKG
7440-66-6	ZINC	19.5		19.9		µg/L	05SW0301	2/4	10	19.9	ND	1100 N	5000(7) 11000	FED-MCL IDEM	No	BSL
FILTERED METALS																
7440-36-0	ANTIMONY, FILTERED	1.3		1.3		µg/L	05SW0501-F	1/4	1	1.3	ND	1.5 N	6 NA	FED-MCL IDEM	No	BSL
7440-38-2	ARSENIC, FILTERED	0.29		0.56		µg/L	05SW0401-F	4/4	---	0.56	0.51	0.045 C	50 50	FED-MCL IDEM	Yes	ASL
7440-39-3	BARIUM, FILTERED	66.1	J	174	J	µg/L	05SW0501-F	4/4	---	174	68	260 N	2000 2000	FED-MCL IDEM	No	BSL
7440-70-2	CALCIUM, FILTERED	7920		74900		µg/L	05SW0501-F	4/4	---	74900	29500	NA	NA NA	FED-MCL IDEM	No	NUT
7440-50-8	COPPER, FILTERED	2.1		2.1		µg/L	05SW0501-F	1/4	2	2.1	ND	140 N	1000(7) 1300	FED-MCL IDEM	No	BSL
7439-89-6	IRON, FILTERED	209	J	594	J	µg/L	05SW0401-F	4/4	---	594	103	1100 N	300(7) NA	FED-MCL IDEM	Yes	ASL
7439-95-4	MAGNESIUM, FILTERED	5140	J	12500	J	µg/L	05SW0301-F	4/4	---	12500	6960	NA	NA NA	FED-MCL IDEM	No	NUT

TABLE 5-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
7439-96-5	MANGANESE, FILTERED	85.8		304		µg/L	05SW0301-F	3/4	15	304	33.9	88 N	50(7) NA	FED-MCL IDEM	Yes	ASL
7440-23-5	SODIUM, FILTERED	9150		22800		µg/L	05SW0401-F	4/4	---	22800	27900	NA	NA NA	FED-MCL IDEM	No	NUT, BKG
7440-66-6	ZINC, FILTERED	16.9		20		µg/L	05SW0301-F	2/4	10	20	ND	1100 N	5000(7) 11000	FED-MCL IDEM	No	BSL
MISCELLANEOUS PARAMETERS																
	HARDNESS	38000		230000		µg/L	05SW0501	4/4	---	230000	99000	NA	NA NA	FED-MCL IDEM	No	NTX
	TOTAL SUSPENDED SOLIDS	2000		52000		µg/L	05SW0201	3/4	2000	52000	5000	NA	NA NA	FED-MCL IDEM	No	NTX

Footnotes:

1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, maximum surface water concentrations were compared to concentrations in upgradient surface water sample 05SW0101. If the concentration in the site surface water concentration was less than the upgradient concentration, that metal was not selcted as a COPC.
5 The risk-based COPC screening level for tap water use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (USEPA, Region 9, October 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Secondary MCL, based on aesthetic water quality (i.e., color, odor, taste, etc.).

Associated Samples:

05SW0201	05SW0201-F
05SW0301	05SW0301-F
05SW0401	05SW0401-F
05SW0501	05SW0501-F

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
COPC = Chemical of potential concern.
J = Estimated value.
N = Noncarcinogen.
NA = Not analyzed / not applicable.
ND = Not detected.
FED-AL = Federal action level (U.S. EPA, 2000).
FED-MCL = Federal Maximum Contaminant Level (U.S. EPA, 2000).
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential closure levels for ground water (IDEM, July 2001).

Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.
For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

CAS = Chemical abstract services.

TABLE 5-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
VOLATILE ORGANICS																	
156-59-2	CIS-1,2-DICHLOROETHENE	1		1		mg/kg	05SD020006	1/4	0.004 -0.008	1	NA	4.3	N	110	IDEM	No	BSL
75-09-2	METHYLENE CHLORIDE	0.005	J	0.008	J	mg/kg	05SD040006	4/4	---	0.008	NA	8.9	C	120	IDEM	No	BSL
79-01-6	TRICHLOROETHENE	0.7		0.7		mg/kg	05SD020006	1/4	0.004 -0.008	0.7	NA	2.8	C	45	IDEM	No	BSL
SEMIVOLATILE ORGANICS																	
91-57-6	2-METHYLNAPHTHALENE	0.024		0.024		mg/kg	05SD050006	1/4	0.010 - 0.014	0.024	NA	5.6(7)	N	3200(7)	IDEM	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.019		0.026		mg/kg	05SD020006	3/4	0.014	0.026	NA	0.62	C	5	IDEM	No	BSL
50-32-8	BENZO(A)PYRENE	0.022		0.03		mg/kg	05SD050006	3/4	0.014	0.03	NA	0.062	C	0.5	IDEM	No	BSL
205-99-2	BENZO(B)FLUORANTHENE	0.025		0.045		mg/kg	05SD050006	3/4	0.014	0.045	NA	0.62	C	5	IDEM	No	BSL
191-24-2	BENZO(G,H,I)PERYLENE	0.014		0.045		mg/kg	05SD050006	3/4	0.014	0.045	NA	230(8)	N	5500(8)	IDEM	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.018		0.033		mg/kg	05SD050006	3/4	0.014	0.033	NA	6.2	C	50	IDEM	No	BSL
218-01-9	CHRYSENE	0.025		0.039		mg/kg	05SD050006	3/4	0.014	0.039	NA	62	C	500	IDEM	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.016		0.016		mg/kg	05SD050006	1/4	0.010 - 0.014	0.016	NA	0.062	C	0.5	IDEM	No	BSL
206-44-0	FLUORANTHENE	0.016		0.055		mg/kg	05SD020006	4/4	---	0.055	NA	230	N	6300	IDEM	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.012		0.027		mg/kg	05SD050006	3/4	0.014	0.027	NA	0.62	C	5	IDEM	No	BSL
91-20-3	NAPHTHALENE	0.016		0.016		mg/kg	05SD050006	1/4	0.010 - 0.014	0.016	NA	5.6	N	3200	IDEM	No	BSL
85-01-8	PHENANTHRENE	0.022		0.031		mg/kg	05SD020006	3/4	0.014	0.031	NA	230(8)	N	5500(8)	IDEM	No	BSL
129-00-0	PYRENE	0.034		0.047		mg/kg	05SD020006	3/4	0.014	0.047	NA	230	N	5500	IDEM	No	BSL
PESTICIDES/PCBs																	
11096-82-5	AROCLOR-1260	0.17		0.17		mg/kg	05SD050006	1/4	0.049 -0.067	0.17	NA	0.22	C	1.8	IDEM	No	BSL
HERBICIDES																	
70-30-4	HEXACHLOROPHENE	0.0031	J	0.0031	J	mg/kg	05SD040006	1/4	0.00096 -0.001	0.0031	NA	1.8	N	NA	IDEM	No	BSL
87-86-5	PENTACHLOROPHENOL	0.006	J	0.006	J	mg/kg	05SD050006	1/4	1 - 1.4	0.006	NA	3	C	20	IDEM	No	BSL
DIOXINS/FURANS																	
3268-87-9	1,2,3,4,6,7,8,9-OCDD	0.00116	J	0.00611	J	mg/kg	05SD020006	4/4	---	0.00611	NA	0.039	C	NA	IDEM	No	BSL
39001-02-0	1,2,3,4,6,7,8,9-OCDF	0.0000022	J	0.000223	J	mg/kg	05SD020006	4/4	---	0.000223	NA	0.039	C	NA	IDEM	No	BSL
35822-46-9	1,2,3,4,6,7,8-HPCDD	0.0000355	J	0.000203	J	mg/kg	05SD020006	4/4	---	0.000203	NA	0.00039	C	NA	IDEM	No	BSL
67562-39-4	1,2,3,4,6,7,8-HPCDF	0.0000045		0.0000861	J	mg/kg	05SD020006	4/4	---	0.0000861	NA	0.00039	C	NA	IDEM	No	BSL
55673-89-7	1,2,3,4,7,8,9-HPCDF	0.0000016	J	0.0000065	J	mg/kg	05SD020006	3/4	0.00000032	0.0000065	NA	0.00039	C	NA	IDEM	No	BSL
39227-28-6	1,2,3,4,7,8-HXCDD	0.0000005	J	0.0000027	J	mg/kg	05SD020006	4/4	---	0.0000027	NA	0.000039	C	NA	IDEM	No	BSL
70648-26-9	1,2,3,4,7,8-HXCDF	0.0000032		0.000021	J	mg/kg	05SD020006	4/4	---	0.000021	NA	0.000039	C	NA	IDEM	No	BSL
57653-85-7	1,2,3,6,7,8-HXCDD	0.00000092	J	0.0000072		mg/kg	05SD020006	4/4	---	0.0000072	NA	0.000039	C	NA	IDEM	No	BSL
57117-44-9	1,2,3,6,7,8-HXCDF	0.0000014	J	0.0000083		mg/kg	05SD020006	4/4	---	0.0000083	NA	0.000039	C	NA	IDEM	No	BSL
19408-74-3	1,2,3,7,8,9-HXCDD	0.0000015	J	0.0000077		mg/kg	05SD020006	4/4	---	0.0000077	NA	0.000039	C	NA	IDEM	No	BSL
72918-21-9	1,2,3,7,8,9-HXCDF	0.00000056	J	0.0000014	J	mg/kg	05SD020006	3/4	0.0000001	0.0000014	NA	0.000039	C	NA	IDEM	No	BSL
40321-76-4	1,2,3,7,8-PECDD	0.00000067	J	0.0000022	J	mg/kg	05SD020006	3/4	0.00000029	0.0000022	NA	0.0000039	C	NA	IDEM	No	BSL
57117-41-6	1,2,3,7,8-PECDF	0.0000016	J	0.0000059	J	mg/kg	05SD020006	3/4	0.000002	0.0000059	NA	0.000078	C	NA	IDEM	No	BSL
60851-34-5	2,3,4,6,7,8-HXCDF	0.000001	J	0.0000107	J	mg/kg	05SD020006	4/4	---	0.0000107	NA	0.000039	C	NA	IDEM	No	BSL
57117-31-4	2,3,4,7,8-PECDF	0.0000013	J	0.0000093	J	mg/kg	05SD020006	4/4	---	0.0000093	NA	0.0000078	C	NA	IDEM	Yes	ASL
1746-01-6	2,3,7,8-TCDD	0.00000026	J	0.0000037		mg/kg	05SD050006	4/4	---	0.0000037	NA	0.0000039	C	NA	IDEM	No	BSL
51207-31-9	2,3,7,8-TCDF	0.0000022	J	0.000007		mg/kg	05SD020006	4/4	---	0.000007	NA	0.000039	C	NA	IDEM	No	BSL
1746-01-6	2,3,7,8-TCDD TEQ	0.0000025		0.0000183		mg/kg	05SD020006	4/4	-	0.0000183	NA	0.0000039	C	NA	IDEM	Yes	ASL
37871-00-4	TOTAL HPCDD	0.000084	J	0.000422		mg/kg	05SD020006	4/4	---	0.000422	NA	NA	C	NA	IDEM	No	NTX
38998-75-3	TOTAL HPCDF	0.000107	J	0.000107	J	mg/kg	05SD050006	1/4	0.0000068 - 0.000259	0.000107	NA	NA	C	NA	IDEM	No	NTX

TABLE 5-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
SWMU 5, OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
INORGANICS																	
7429-90-5	ALUMINUM	3790	J	7660	J	mg/kg	05SD050006	4/4	---	7660	5610	7600	N	NA	IDEM	Yes	ASL
7440-36-0	ANTIMONY	1.6		5.8		mg/kg	05SD050006	3/4	1.6	5.8	ND	3.1	N	140	IDEM	Yes	ASL
7440-38-2	ARSENIC	1.9		5.3		mg/kg	05SD050006	4/4	---	5.3	6.1	0.39	C	3.9	IDEM	No	BKG
7440-39-3	BARIUM	76.6	J	148	J	mg/kg	05SD050006	4/4	---	148	54.5	540	N	23000	IDEM	No	BSL
7440-43-9	CADMIUM	2.5	J	2.5	J	mg/kg	05SD050006	1/4	1.1 - 1.6	2.5	ND	3.7	N	12	IDEM	No	BSL
7440-70-2	CALCIUM	1540	J	57300	J	mg/kg	05SD050006	4/4	---	57300	12400	NA		NA	IDEM	No	NUT
7440-47-3	CHROMIUM	6.9	J	17.4	J	mg/kg	05SD050006	4/4	---	17.4	13.4	30(9)	C	430(9)	IDEM	No	BSL
7440-48-4	COBALT	4		5.9		mg/kg	05SD020006	4/4	---	5.9	9.5	470	N	NA	IDEM	No	BSL,BKG
7440-50-8	COPPER	9.5	J	37.1	J	mg/kg	05SD050006	4/4	---	37.1	12	290	N	13000	IDEM	No	BSL
7439-89-6	IRON	5030	J	14000	J	mg/kg	05SD050006	4/4	---	14000	24400	2300	N	NA	IDEM	No	BKG
7439-92-1	LEAD	15.1		130		mg/kg	05SD050006	4/4	---	130	20.9	400(10)	N	400	IDEM	No	BSL
7439-95-4	MAGNESIUM	734		4010	J	mg/kg	05SD050006	3/4	788	4010	1540	NA		NA	IDEM	No	NUT
7439-96-5	MANGANESE	109	J	812	J	mg/kg	05SD030006	4/4	---	812	346	180	N	NA	IDEM	Yes	ASL
7439-97-6	MERCURY	0.04		0.09	J	mg/kg	05SD050006	2/4	0.05 - 0.08	0.09	0.03	2.3(11)	N	55	IDEM	No	BSL
7440-02-0	NICKEL	9.2		14.5		mg/kg	05SD030006	4/4	---	14.5	22.5	160	N	6900	IDEM	No	BSL,BKG
7440-09-7	POTASSIUM	648		648		mg/kg	05SD050006	1/4	544 - 788	648	464	NA		NA	IDEM	No	NUT
7440-62-2	VANADIUM	10.2		16.7		mg/kg	05SD050006	4/4	---	16.7	15.1	55	N	NA	IDEM	No	BSL
7440-66-6	ZINC	31.7		243		mg/kg	05SD050006	4/4	---	243	53.2	2300	N	100000	IDEM	No	BSL
MISCELLANEOUS PARAMETERS																	
	TOTAL ORGANIC CARBON	2600		11000		mg/kg	05SD040006	4/4	---	11000	NA	NA		NA	IDEM	No	NTX

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, maximum sediment concentrations were compared to concentrations in upgradient sediment sample 05SD01. If the concentration in the site sediment concentration was less than the upgradient concentration, that metal was not selcted as a COPC.
5 The risk-based soil COPC screening level for residential land use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, November 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Naphthalene is used as a surrogate for 2-methylnaphthalene.
8 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
9 Hexavalent chromium.
10 OSWER soil screening level for residential land use (U.S. EPA, July 1994)
11 Value is for mercuric chloride (U.S. EPA, Region 3, October 2001)

Associated Samples:

05SD020006	05SD040006
05SD030006	05SD050006

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001).
J = Estimated value.
N = Nocarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

ASL = Above screening level.
BSL = Below screening level.
CAS = Chemical abstract services.

TABLE 5-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil(1)	Surface Soil	Entire Site	Trespassers	Adolescent	Ingestion	On-site	Quant(2)	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
						Dermal	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
					Adult	Ingestion	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
						Dermal	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
		Air	Vapors and Particulates in Air - Entire Site	Trespassers	Adult and Adolescent	Inhalation	On-site	Qual(3)	Exposure is evaluated qualitatively by a comparison of site data to U.S. EPA generic SSLs(4) for transfers from soil to air.
	Groundwater	Groundwater/Air	Surficial Aquifer	Trespassers	Adult and Adolescent	Ingestion	On-site	None	Direct contact with groundwater does not occur under current land use. Shallow groundwater is not expected to be used as a domestic water supply.
						Dermal	On-site	None	Direct contact with groundwater does not occur under current land use. Shallow groundwater is not expected to be used as a domestic water supply.
						Inhalation	On-site	None	Direct contact with groundwater does not occur under current land use. Shallow groundwater is not expected to be used as a domestic water supply.
	Surface Water	Surface Water	On-site Streams, Ponded Water and Draingeways	Trespassers	Adolescent	Ingestion	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
						Dermal	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
					Adult	Ingestion	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
						Dermal	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
		Air	On-site Streams, Ponded Water and Draingeways	Trespassers	Adult and Adolescent	Inhalation	On-site	None	Minimal exposure to vapors emitted from surface water is anticipated (i.e., so low that it is not worth quantifying).
	Sediment	Sediment	On-site Streams, Ponded Water and Draingeways	Trespassers	Adolescent	Ingestion	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
						Dermal	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
					Adult	Ingestion	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
						Dermal	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
		Air	Vapors and Particulates in Air - Entire Site	Trespassers	Adult and Adolescent	Inhalation	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).

TABLE 5-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Surface/ Subsurface Soil (5)	Surface/ Subsurface Soil	Entire Site	Excavation/Construction Workers	Adult	Ingestion	On-site	Quant	Excavation/construction activities may occur at the site in the future.
						Dermal	On-site	Quant	Excavation/construction activities may occur at the site in the future.
		Air	Vapors and Particulates in Air - Entire Site	Excavation/Construction Workers	Adult	Inhalation	On-site	Qual	Exposure is evaluated qualitatively by a comparison of site data to U.S. EPA generic SSLs for transfers from soil to air.
	Surface Soil	Surface Soil	Entire Site	Maintenance Workers	Adult	Ingestion	On-site	Quant	Although maintenance activities are not currently performed on the site, activities, such as groundkeeping, may occur in the future.
						Dermal	On-site	Quant	Although maintenance activities are not currently performed on the site, activities, such as groundkeeping, may occur in the future.
				Occupational Workers	Adult	Ingestion	On-site	None	Because of the nature of the Site 5, the site is not likely to be developed for occupational use in the future.
						Dermal	On-site	None	Because of the nature of the Site 5, the site is not likely to be developed for occupational use in the future.
				Recreational Users	Adult	Ingestion	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
						Dermal	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
				Residents	Child and Adult	Ingestion	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
		Air	Vapors and Particulates in Air - Entire Site	Maintenance/Occupational Workers, Recreational Users, and Residents	Child and Adult	Inhalation	On-site	Qual	Exposure is evaluated qualitatively by a comparison of site data to USEPA generic SSLs for transfers from soil to air.
	Groundwater	Groundwater	Surficial Aquifer	Excavation/Construction and Maintenance Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Workers		Dermal	On-site	Quant	Excavation/construction activities may occur at the site and workers may be exposed by direct contact with groundwater.
				Occupational Workers	Adult	Ingestion	On-site	None	Because of the nature of the Site 4, the site is not likely to be developed for occupational use in the future.
						Dermal	On-site	None	Because of the nature of the Site 4, the site is not likely to be developed for occupational use in the future.
				Recreational Users	Adult	Ingestion	On-site	None	Direct contact with groundwater is not expected to occur for future recreational users.
						Dermal	On-site	None	Direct contact with groundwater is not expected to occur for future recreational users.
				Residents	Child and Adult	Ingestion	On-site	Quant	Although it is unlikely that shallow groundwater at the site would be used as a domestic water supply. This scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although it is unlikely that shallow groundwater at the site would be used as a domestic water supply. This scenario is included to aid in future risk management decisions.
		Air	Vapors	Excavation/Construction/ Maintenance/Occupational Workers and Recreational Users	Adult	Inhalation	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Residents	Child and Adult	Inhalation	On-site	Quant	Although it is unlikely that shallow groundwater at the site would be used as a domestic water supply. This scenario is included to aid in future risk management decisions.
Future	Surface Water	Surface Water	On-site Streams, Ponded Water and Draingeways	Excavation/Construction and Maintenance Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).

TABLE 5-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
				Workers		Dermal	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Occupational Workers	Adult	Ingestion	On-site	None	Because of the nature of the Site 4, the site is not likely to be developed for occupational use in the future.
						Dermal	On-site	None	Because of the nature of the Site 4, the site is not likely to be developed for occupational use in the future.
				Recreational Users	Adult	Ingestion	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
						Dermal	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
				Residents	Child and Adult	Ingestion	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
		Air	On-site Streams, Ponded Water and Draingeways	Excavation/Constuction/ Maintenance/Occupational Workers, Recreational Users, and Residents	Child and Adult	Inhalation	On-site	None	Minimal exposure to vapors emitted from surface water is anticipated (i.e., so low that it is not worth quantifying).
	Sediment	Sediment	On-site Streams, Ponded Water and Draingeways	Excavation/Construction and Maintenance Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Workers		Dermal	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Occupational Workers	Adult	Ingestion	On-site	None	Because of the nature of the Site 4, the site is not likely to be developed for occupational use in the future.
						Dermal	On-site	None	Because of the nature of the Site 4, the site is not likely to be developed for occupational use in the future.
				Recreational Users	Adult	Ingestion	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
						Dermal	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
				Residents	Adult and Child	Ingestion	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
		Air	On-site Streams, Ponded Water and Draingeways	Excavation/Constuction/ Maintenance/Occupational Workers, Recreational Users, and Residents	Child and Adult	Inhalation	On-site	None	Minimal exposure to vapors emitted from surface water is anticipated (i.e., so low that it is not worth quantifying).

Footnotes:
1 Surface soil is defined as soil collected from 0 to 2 feet below ground surface (bgs).
2 Quantitative.
3 Qualitative.
4 Soil Screening Levels (U.S. EPA, May 1996).
5 Surface/subsurface soil is defined as soil collected from 0 to 10 feet bgs; no exposure to soil at depths below 10 feet bgs is anticipated.

TABLE 5-20

EXPOSURE POINT CONCENTRATIONS (EPCs) FOR COPCs
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Chemical of Potential Concern	Exposure Point Concentration				
	Surface Soil[1]	Surface/ Subsurface Soil[2]	Surface Water[1]	Sediment[1]	Groundwater[2]
	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)
1,1-DICHLOROETHENE	0.013	0.0029	0.002	NA	NA
BENZENE	0.005	0.0039	NA	NA	NA
CIS-1,2-DICHLOROETHENE	2.8	2.18	0.29	NA	NA
CHLOROFORM	NA[4]	NA	NA	NA	0.000263
METHYLENE CHLORIDE	0.004	0.0069	NA	NA	NA
TETRACHLOROETHENE	0.007	0.0025	NA	NA	NA
TRICHLOROETHENE	5.1	5.1[3]	0.12	NA	NA
VINYL CHLORIDE	0.005	0.067	0.085	NA	NA
2-METHYLNAPHTHALENE	NA	2.09	NA	NA	NA
BENZO(A)ANTHRACENE	0.95	0.95[3]	NA	NA	NA
BENZO(A)PYRENE	0.82	0.82[3]	NA	NA	NA
BENZO(B)FLUORANTHENE	0.79	0.96[3]	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	0.18	0.18[3]	NA	NA	NA
NAPHTHALENE	NA	1.2[3]	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	0.01
DIELDRIN	NA	0.0055	NA	NA	NA
AROCLOR-1254	0.24	0.44	NA	NA	NA
AROCLOR-1260	NA	0.13	NA	NA	NA
PENTACHLOROPHENOL	0.012	0.0099	NA	NA	NA
2,3,7,8-TCDD TEQ	2.26E-04	0.00046[3]	NA	1.83E-05	8.12E-09
ALUMINUM	NA	NA	0.204	7660	0.379
ANTIMONY	301	301[3]	NA	5.8	NA
ARSENIC	NA	10.5	0.00064	NA	0.00093
BARIUM	2020	1620	NA	NA	NA
CADMIUM	31.1	31.1[3]	NA	NA	NA
CHROMIUM	112	65.2	NA	NA	NA
COPPER	1520	6370[3]	NA	NA	NA
IRON	105000	46300	1.52	NA	3.1
LEAD	2275[5]	1710[5]	NA	NA	NA
MANGANESE	NA	676	0.315	812	2.27[3]
MERCURY	0.43	12.5	NA	NA	NA
NICKEL	NA	30.3	NA	NA	NA
SILVER	7.5	7.2	NA	NA	NA
ZINC	5110	5110	NA	NA	NA

1 Because of the limited number of samples (i.e., less than 10 samples), the exposure concentration is set at the maximum detected concentration.
2 The exposure concentration is the 95% upper confidence limit (UCL) based on distribution of the data set (best fit of normal or lognormal), unless otherwise noted.
3 Maximum detected concentration is used because the UCL exceeeds the maximum.
4 NA - Not applicable. Chemical is not a chemical of potential concern for this medium.
5 Average concentration.

TABLE 5-21

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURE
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Exposure Route	Construction Worker	Maintenance Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
HAZARD INDEX						
Ingestion of Groundwater	NA	NA	NA	NA	2.8E+00	1.0E+01
Dermal Contact with Groundwater	1.7E-01	NA	NA	NA	3.6E-01	1.1E+00
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	2.2E-02	1.0E-01
Incidental Ingestion of Surface Soil	NA	1.1E-01	2.3E-01	1.9E-01	1.5E+00	1.4E+01
Dermal Contact with Surface Soil	NA	2.6E-03	3.4E-03	5.3E-03	2.3E-02	1.1E-01
Incidental Ingestion of Surface/Subsurface Soil	3.5E+00	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	6.8E-02	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	3.9E-02	6.3E-03	2.6E-01	2.4E-01
Dermal Contact with Surface Water	NA	NA	8.1E-02	2.8E-02	5.4E-01	5.6E-01
Incidental Ingestion of Sediment	NA	NA	6.9E-03	5.6E-03	4.6E-02	4.3E-01
Dermal Contact with Sediment	NA	NA	NA	NA	NA	NA
Total Hazard:	**3.7E+00**	**1.1E-01**	**3.6E-01**	**2.3E-01**	**5.6E+00**	**2.7E+01**

TABLE 5-21

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURE
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

INCREMENTAL CANCER RISK

Exposure Route	Construction Worker	Maintenance Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
Ingestion of Groundwater	NA	NA	NA	NA	2.6E-05	2.3E-05
Dermal Contact with Groundwater	2.7E-06	NA	NA	NA	2.5E-04	1.4E-04
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	5.2E-08	6.0E-08
Incidental Ingestion of Surface Soil	NA	1.4E-06	3.8E-06	1.1E-06	2.0E-05	4.7E-05
Dermal Contact with Surface Soil	NA	4.9E-07	7.8E-07	4.4E-07	4.2E-06	4.8E-06
Incidental Ingestion of Surface/Subsurface Soil	3.8E-06	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	5.6E-07	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	2.3E-05	1.4E-06	1.2E-04	2.9E-05
Dermal Contact with Surface Water	NA	NA	2.7E-05	3.4E-06	1.4E-04	3.7E-05
Incidental Ingestion of Sediment	NA	NA	2.4E-07	7.2E-08	1.3E-06	3.0E-06
Dermal Contact with Sediment	NA	NA	6.5E-07	1.6E-08	1.6E-07	1.8E-07
Total Risk:	**7.1E-06**	**1.9E-06**	**5.5E-05**	**6.4E-06**	**5.7E-04**	**2.9E-04**

NOTES
NA - Not applicable; exposure route is not applicable for this receptor.
Chemical-specific risks presented in Appendix G-3.

TABLE 5-22

CUMULATIVE RISK SUMMARY - CENTRAL TENDENCY EXPOSURE
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Exposure Route	Construction Worker	Maintenance Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
HAZARD INDEX						
Ingestion of Groundwater	NA	NA	NA	NA	2.0E+00	4.4E+00
Dermal Contact with Groundwater	1.1E-01	NA	NA	NA	1.6E-01	3.6E-01
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	8.0E-03	3.7E-02
Incidental Ingestion of Surface Soil	NA	2.7E-02	5.7E-02	4.7E-02	7.7E-01	4.8E+00
Dermal Contact with Surface Soil	NA	1.3E-04	2.1E-04	4.3E-04	2.9E-03	1.2E-02
Incidental Ingestion of Surface/Subsurface Soil	1.7E+00	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	1.9E-02	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	9.7E-03	1.6E-03	8.8E-02	8.2E-02
Dermal Contact with Surface Water	NA	NA	2.3E-02	6.3E-03	2.0E-01	1.8E-01
Incidental Ingestion of Sediment	NA	NA	1.7E-03	1.4E-03	1.5E-02	1.4E-01
Dermal Contact with Sediment	NA	NA	NA	NA	NA	NA
Total Hazard:	**1.9E+00**	**2.7E-02**	**9.2E-02**	**5.7E-02**	**3.2E+00**	**1.0E+01**

TABLE 5-22

CUMULATIVE RISK SUMMARY - CENTRAL TENDENCY EXPOSURE
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

INCREMENTAL CANCER RISK

Exposure Route	Construction Worker	Maintenance Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
Ingestion of Groundwater	NA	NA	NA	NA	5.3E-06	3.3E-06
Dermal Contact with Groundwater	2.0E-06	NA	NA	NA	4.9E-05	2.7E-05
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	5.6E-09	7.5E-09
Incidental Ingestion of Surface Soil	NA	1.3E-07	2.8E-07	2.8E-07	2.9E-06	5.3E-06
Dermal Contact with Surface Soil	NA	8.8E-09	1.4E-08	3.5E-08	1.5E-07	1.9E-07
Incidental Ingestion of Surface/Subsurface Soil	1.9E-06	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	1.6E-07	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	1.7E-06	3.4E-07	1.2E-05	3.2E-06
Dermal Contact with Surface Water	NA	NA	2.2E-06	7.6E-07	1.6E-05	4.0E-06
Incidental Ingestion of Sediment	NA	NA	1.8E-08	1.8E-08	1.3E-07	3.4E-07
Dermal Contact with Sediment	NA	NA	2.0E-08	1.3E-09	3.8E-09	7.0E-09
Total Risk:	**4.1E-06**	**1.4E-07**	**4.3E-06**	**1.4E-06**	**8.5E-05**	**4.4E-05**

NOTES
NA - Not applicable; exposure route is not applicable for this receptor.
Chemical-specific risks presented in Appendix G-3.

TABLE 5-23

SUMMARY OF CONCLUSIONS
SWMU 5 - OLD BURN PIT
HUMAN HEALTH RISK ASSESSMENT
NSWC CRANE, CRANE, INDIANA

Chemical of Concern[1]	Impact on Human Receptors	Comments
GROUND WATER		
Dioxins/Furans	Construction Worker ILCR = 2.7E-6, Residential ILCR = 4.1E -4	Risks from dioxins in ground water are based on the hypothetical future residential use. but do not pose a risk under current and industrial and use. Dioxins were detected in 10 of 14 ground water samples indicating that ground water has been impacted by site activities. Concentrations of dioxins (as TEQs) in all samples were less than the MCL for 2,3,7,8-TCDD.
Bis(2-ethylhexyl)phthalate	Residential ILCR = 6.0E-6	Bis(2-ethylhexyl)phthate was detected in 1 of 14 samples and is a common laboratory contaminant. Estimated risks are based on future residential use of ground water.
Arsenic	Residential ILCR = 2.5E-5	Risks for arsenic are based on the hypothetical future residential use of ground water. The maximum concentration in ground water (1.6 mg/L) is less than the current (50 mg/L) and recently proposed (10 mg/L) MCLs. In addition, the concentrations of arsenic in ground water samples are similar to the concentrations in the upgradient well.
Manganese	Adult resident HQ = 2.9, Child resident HQ = 10	Risks for manganese are based on the hypothetical future residential use of ground water.
SURFACE WATER		
1,1-Dichloroethene	Residential ILCR = 5.0E-6	Risks from chlorinated volatiles (especially, vinyl chloride) in surface water are based on the hypothetical future land use but do not pose a risk under current or industrial land use. The risks are overestimated based on potential residential exposure to surface water which assumes that future residents are assumed to be exposed to surface water 350 days/year. Vinyl chloride was detected in 2 of 4 samples which appear to be hydraulically connected.
cis-1,2-Dichloroethene	Adult resident HQ = 0.21; Child resident HQ = 0.21	
Trichloroethene	Adult resident HQ = 0.21; Child resident HQ = 0.21, Residential ILCR = 5.8E-6	
Vinyl Chloride	Adult resident HQ = 0.17, Child resident HQ = 0.16, Residential ILCR = 3.2E-4	
SURFACE SOIL		
Dioxins/Furans	Maintenance Worker ILCR = 1.4E-6, Recreational User ILCR = 3.3E-6, Trespasser ILCR = 1.1E-6, Residential ILCR = 5.7E-5	Dioxins were detected in 8 of 8 soil samples. Elevated risks (across all pathways) for dioxins are based on the hypothetical future residential land use. Risks calculated for receptors under current and industrial land use are within the EPA's target risk range. Concentrations of dioxins/furans (as TEQs) in all surfce soil samples were less than the 1 µg/kg preliminary remediation goal established by the U.S. EPA.
Polyaromatic hydrocarbons	Residential ILCR = 1.8E-5	Risks calculated for receptors under current land use are within the EPA's target risk range. Total risks from PAHs in soil are less than 1.0E-4 for all receptors. Concentrations of PAHs in soil are within levels occurring in soil in the U.S.

TABLE 5-23

SUMMARY OF CONCLUSIONS
SWMU 5 - OLD BURN PIT
HUMAN HEALTH RISK ASSESSMENT
NSWC CRANE, CRANE, INDIANA

Chemical of Concern[1]	Impact on Human Receptors	Comments
Antimony	Adult resident HQ = 1.0, Child resident HQ = 9.6	Risks for antimony are based on the hypothetical future residential land use based on the concentration in one soil sample. The sample may represent a "hotspot" at the site.
Iron	Adult resident HQ = 0.24, Child resident HQ = 2.2	Risks for iron are based on the hypothetical future residential land use but do not pose a risk under current land use. Risks calculated for iron are not based on adverse health effects but rather on recommended daily allowances.
Lead	Future Residents - Predicted blood lead levels in children greater than U.S. EPA recommemded levels	Risks for lead are based on the hypothetical future residential land use driven by the concentration in one surface soil sample. The sample may represent a "hotspot" at the site.
SURFACE/SUBSURFACE SOIL		
Dioxins/Furans	Construction Worker ILCR = 2.7E-6	Total lifetime cancer risk for future construction workers across all exposure pathways is within the U.S.EPA's target risk range (1.0E-6 to 1.0E-4). Concentrations of dioxins/furans (as TEQs) in all surface/subsurface soil samples were less than the 1 µg/kg preliminary remediation goal established by the U.S. EPA.
Antimony	Construction Worker HQ = 2.1	Risks for the construction wokrer are based on the concentration in one surface soil sample. The sample may represent a "hotspot" at the site.
Lead	Construction Worker - More than 5 % of the fetuses born to construction workers predicted to have blood lead levels greater than 10 µg/dL	Risks to the future construction worker are based on the average concentration in soil samples (>1,000 mg/kg). Lead concentrations in approximately 1/2 of subsurface soil samples were greater than 1,000 mg/kg.

HQ Hazard Quotient.
ILCR Incremental Lifetime Cancer Risk
1 Any carcinogenic chemical with a ILCR greater than 1.0E-6 or a noncarcinogenic chemical contributing to target organ hazard indices (HI) greater than 1.0.

TABLE 5-24

ECOLOGICAL RISK SCREENING - SURFACE SOIL
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Site Above Background Concentration?	Surface Soil COPC Screening Level (3)	Ecological Effects Quotient (4)	COPC Flag (5)	Rationale for Contaminant Deletion or Selection(5)
Dioxins (mg/kg)										
1,2,3,4,6,7,8,9-OCDD	8/8	0.000415 J	0.0051 J	05SB080002	0.001495	---	0.0000002	25377	Yes	ASL
1,2,3,4,6,7,8,9-OCDF	7/8	8.5E-06 J	0.0003 J	05SB060002	0.000088	---	0.0000386	8.1	Yes	ASL
1,2,3,4,6,7,8-HPCDD	8/8	7.2E-06	0.0004 J	05SB060002	0.000107	---	0.0000002	1804	Yes	ASL
1,2,3,4,6,7,8-HPCDF	7/8	1.21E-05	0.0005 J	05SB060002	0.000114	---	0.0000386	14.0	Yes	ASL
1,2,3,4,7,8,9-HPCDF	6/8	8.8E-07 J	6E-05	05SB060002	0.000011	---	0.0000386	1.5	Yes	ASL
1,2,3,4,7,8-HXCDD	5/8	0.000001 J	2E-05	05SB060002	0.000004	---	0.0000002	109	Yes	ASL
1,2,3,4,7,8-HXCDF	7/8	3.7E-06	0.0004 J	05SB060002	0.000065	---	0.0000386	9.4	Yes	ASL
1,2,3,6,7,8-HXCDD	7/8	1.9E-06 J	5E-05 J	05SB060002	0.000012	---	0.0000002	266	Yes	ASL
1,2,3,6,7,8-HXCDF	8/8	2.8E-07 J	0.0001	05SB060002	0.000024	---	0.0000386	3.3	Yes	ASL
1,2,3,7,8,9-HXCDD	8/8	3.6E-07 J	7E-05 J	05SB060002	0.000015	---	0.0000002	347	Yes	ASL
1,2,3,7,8,9-HXCDF	3/8	4.1E-07 J	1E-05 J	05SB060002	0.000002	---	0.0000386	0.25	No	BSL
1,2,3,7,8-PECDD	5/8	1.4E-06 J	2E-05	05SB060002	0.000005	---	0.0000002	111	Yes	ASL
1,2,3,7,8-PECDF	4/8	1.3E-06 J	0.0001	05SB060002	0.000017	---	0.0000386	2.7	Yes	ASL
2,3,4,6,7,8-HXCDF	7/8	2.4E-06 J	0.0001	05SB060002	0.000027	---	0.0000386	3.8	Yes	ASL
2,3,4,7,8-PECDF	7/8	2.2E-06 J	0.0001	05SB060002	0.000027	---	0.0000386	3.7	Yes	ASL
2,3,7,8-TCDD	5/8	4.9E-07 J	6E-06	05SB060002	0.000001	---	0.0000002	31	Yes	ASL
2,3,7,8-TCDF	7/8	2.8E-06	0.0003	05SB060002	0.000054	---	0.0000386	8.4	Yes	ASL
TOTAL HPCDD	8/8	1.51E-05	0.0008 J	05SB060002	0.000227	---	0.0000002	4035	Yes	ASL
TOTAL HPCDF	6/8	2.19E-05 J	0.0008 J	05SB060002	0.000176	---	0.0000386	20.5	Yes	ASL
TOTAL HXCDD	5/8	2.54E-05 J	0.0009 J	05SB060002	0.000171	---	0.0000002	4472	Yes	ASL
TOTAL HXCDF	1/8	2.54E-05 J	3E-05 J	05SB020002	0.000138	---	0.0000002	128	Yes	ASL
TOTAL PECDF	1/8	1.3E-06 J	1E-06 J	05SB040002	0.000195	---	0.0000386	0.03	No	BSL
TOTAL TCDD	2/8	0.000133	0.0004	05SB060002	0.000076	---	0.0000002	2030	Yes	ASL
TOTAL TCDF	1/8	5.24E-05	5E-05	05SB080002	0.000216	---	0.0000386	1.4	Yes	ASL
Volatiles (mg/kg)										
1,1-DICHLOROETHENE	1/8	0.013 J	0.013 J	05SB060102	0.000003	---	8.28	0.002	No	BSL
BENZENE	1/8	0.005 J	0.005 J	05SB060102	0.000002	---	0.25462	0.020	No	BSL
CIS-1,2-DICHLOROETHENE	2/8	0.008	2.8 J	05SB060102	0.000352	---	0.78373	3.573	Yes	ASL
METHYLENE CHLORIDE	3/8	0.004 J	0.004 J	05SB030102, 05SB080102, 05SB020102	0.000003	---	4.05	0.001	No	BSL
TETRACHLOROETHENE	2/8	0.003	0.007 J	05SB060102	0.000002	---	9.92	0.001	No	BSL
TRANS-1,2-DICHLOROETHENE	1/8	0.029 J	0.029 J	05SB060102	0.000005	---	0.78373	0.037	No	BSL
TRICHLOROETHENE	5/8	0.004	5.1 J	05SB060102	0.000834	---	12.4	0.411	No	BSL
VINYL CHLORIDE	1/8	0.005 J	0.005 J	05SB060102	0.000002	---	0.64614	0.008	No	BSL
Semi-Volatiles (mg/kg)										
2-METHYLNAPHTHALENE	5/8	0.012	0.065	05SB060002	0.022	---	3.24	0.02	No	BSL
ACENAPHTHENE	3/8	0.03	0.12	05SB010002	0.037	---	682	0.0002	No	BSL
ACENAPHTHYLENE	1/8	0.016	0.016	05SB030002	0.009	---	682	0.00002	No	BSL
ANTHRACENE	6/8	0.009	0.34 J	05SB050002	0.097	---	1480	0.0002	No	BSL
BENZO(A)ANTHRACENE	6/8	0.031	0.95 J	05SB050002	0.280	---	5.21	0.182	No	BSL
BENZO(A)PYRENE	6/8	0.031	0.82 J	05SB050002	0.275	---	1.52	0.539	No	BSL
BENZO(B)FLUORANTHENE	7/8	0.008	0.79 J	05SB050002	0.276	---	59.8	0.013	No	BSL
BENZO(G,H,I)PERYLENE	6/8	0.017	0.35 J	05SB050002	0.136	---	119	0.003	No	BSL
BENZO(K)FLUORANTHENE	6/8	0.028	0.67 J	05SB050002	0.230	---	1480	0.0005	No	BSL
BIS(2-ETHYLHEXYL)PHTHALATE	2/8	0.93	3.4	05SB050002	0.694	---	0.93	3.7	Yes	ASL
CHRYSENE	6/8	0.035	0.91 J	05SB050002	0.272	---	4.73	0.192	No	BSL
DIBENZO(A,H)ANTHRACENE	6/8	0.008	0.18 J	05SB050002	0.064	---	18.4	0.010	No	BSL
FLUORANTHENE	7/8	0.011	2.2 J	05SB050002	0.557	---	122	0.018	No	BSL
FLUORENE	3/8	0.02	0.11 J	05SB050002	0.029	---	122	0.001	No	BSL
INDENO(1,2,3-CD)PYRENE	6/8	0.015	0.36 J	05SB050002	0.117	---	109	0.003	No	BSL
NAPHTHALENE	5/8	0.023	0.1	05SB060002	0.034	---	0.10	1.006	Yes	ASL
PHENANTHRENE	6/8	0.048	1.7	05SB050002	0.397	---	45.7	0.037	No	BSL
PYRENE	7/8	0.009	2.4	05SB050002	0.572	---	78.5	0.031	No	BSL

TABLE 5-24

ECOLOGICAL RISK SCREENING - SURFACE SOIL
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Site Above Background Concentration?	Surface Soil COPC Screening Level (3)	Ecological Effects Quotient (4)	COPC Flag (5)	Rationale for Contaminant Deletion or Selection(5)
Pesticides (mg/kg)										
4,4'-DDE	1/6	0.0067	0.0067	05SB080002	0.003	---	0.60	0.011	No	BSL
AROCLOR-1254	4/8	0.1 J	0.24	05SB080002	0.099	---	0.68	0.353	No	BSL
Herbicides (mg/kg)										
2,4,5-T	2/8	0.01 J	0.016 J	05SB080002	0.004	---	0.59634	0.027	No	BSL
PENTACHLOROPHENOL	5/7	0.0024 J	0.012	05SB050002	0.004	---	0.11927	0.101	No	BSL
Inorganics (mg/kg)										
ALUMINUM	8/8	3580 J	14800 J	05SB040002	9403	NO	NA	NA	No	BKG
ANTIMONY	7/8	3.2 J	301 J	05SB060002	55.3	YES	0.1423	2115	Yes	ASL
ARSENIC	8/8	5.1 J	26.8 J	05SB060002	8.6	NO	5.7	4.7	No	BKG
BARIUM	8/8	74.7 J	2020	05SB060002	515	YES	1.04	1942	Yes	ASL
CADMIUM	6/8	1.6 J	31.1 J	05SB060002	6.3	YES	0.00222	14009	Yes	ASL
CALCIUM	7/8	685 J	241000 J	05SB050002	40498	YES	NA	NA	No	NT
CHROMIUM	8/8	10.4	112 J	05SB060002	34.0	YES	0.4	280	Yes	ASL
COBALT	8/8	5.8	35.8	05SB060002	11.3	NO	0.14033	255	No	BKG
COPPER	8/8	11.7	1520 J	05SB060002	269	YES	2.96	514	Yes	ASL
IRON	8/8	15600 J	105000 J	05SB060002	30788	YES	NA	NA	Yes	NTX
LEAD	8/8	15.2 J	16900 J	05SB060002	2276	YES	0.05373	314536	Yes	ASL
MAGNESIUM	8/8	660 J	4900 J	05SB050002	1991	NO	NA	NA	No	NT, BKG
MANGANESE	8/8	264	1170	05SB040002	511	NO	NA	NA	No	BKG
MERCURY	8/8	0.04 J	0.43	05SB010002	0.17	YES	0.073	5.9	Yes	ASL
NICKEL	8/8	12	62.6	05SB060002	22	NO	13.6	4.6	No	BKG
POTASSIUM	5/8	464 J	1050 J	05SB060002	495	NO	NA	NA	No	NT, BKG
SILVER	3/8	1.8 J	7.5 J	05SB060002	1.8	YES	4.04	1.9	Yes	ASL
TIN	7/8	13.2 J	849	05SB080002	171	YES	7.62	111	Yes	ASL
VANADIUM	8/8	9.9	22.9	05SB040002	18.8	NO	1.59	14.4	No	BKG
ZINC	8/8	26.6	5110 J	05SB060002	957	YES	6.62	772	Yes	ASL
Miscellaneous Parameters										
CATION EXCHANGE CAPACITY (MEQ/1)	1/1	13 J	13 J	05SB040002	13.0	---	NA	NA	No	NT
PH (S.U.)	1/1	5.1 J	5.1 J	05SB040002	5.1	---	NA	NA	No	NT
TOTAL ORGANIC CARBON (mg/kg)	1/1	1700	1700	05SB040002	1700	---	NA	NA	No	NT

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.
The table only includes parameters that were detected in downgradient samples (if applicable).

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 As presented in Table 3-14.
4 Refer to Section 3.4 for ecological effects quotient calculation.

Definitions:
COPC = Chemical of potential concern.
NA = Not available.

Associated Samples:

05SB010002	05SB050002
05SB010102	05SB050102
05SB020002	05SB060002
05SB020102	05SB060102
05SB030002	05SB070002
05SB030102	05SB070102
05SB040002	05SB080002
05SB040102	05SB080102

5 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.

For Elimination as a COPC:
BKG = Below site background levels.
BSL = Below COPC screening level.
NT = Nontoxic.

TABLE 5-25

ECOLOGICAL RISK SCREENING - SEDIMENT
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA
PAGE 1 OF 2

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Upgradient Sample Concentration(3)	Sediment COPC Screening Level(4)	Ecological Effects Quotient (5)	COPC Flag (6)	Rationale for Contaminant Deletion or Selection(6)
Dioxins (mg/kg)										
1,2,3,4,6,7,8,9-OCDD	4/4	1.2E-03 J	6.1E-03 J	05SD020006	2.8E-03	7.1E-03 J	3.30E-06	1852	Yes	ASL
1,2,3,4,6,7,8,9-OCDF	4/4	2.2E-06 J	2.2E-04 J	05SD020006	8.5E-05	8.3E-06 UJ	1.29E-08	17287	Yes	ASL
1,2,3,4,6,7,8-HPCDD	4/4	3.6E-05 J	2.0E-04 J	05SD020006	1.0E-04	4.6E-05 J	3.30E-06	61.5	Yes	ASL
1,2,3,4,6,7,8-HPCDF	4/4	4.5E-06	8.6E-05 J	05SD020006	4.1E-05	4.1E-06 BJ	1.29E-08	6674	Yes	ASL
1,2,3,4,7,8,9-HPCDF	3/4	1.6E-06 J	6.5E-06 J	05SD020006	2.9E-06	2.5E-06 UJ	1.29E-08	504	Yes	ASL
1,2,3,4,7,8-HXCDD	4/4	5.0E-07 J	2.7E-06 J	05SD020006	1.5E-06	6.1E-07 J	3.30E-06	0.82	No	BSL
1,2,3,4,7,8-HXCDF	4/4	3.2E-06	2.1E-05 J	05SD020006	1.1E-05	2.4E-06 BJ	1.29E-08	1628	Yes	ASL
1,2,3,6,7,8-HXCDD	4/4	9.2E-07 J	7.2E-06	05SD020006	3.9E-06	8.8E-07 J	3.30E-06	2.18	Yes	ASL
1,2,3,6,7,8-HXCDF	4/4	1.4E-06 J	8.3E-06	05SD020006	4.5E-06	1.0E-06 J	1.29E-08	643	Yes	ASL
1,2,3,7,8,9-HXCDD	4/4	1.5E-06 J	7.7E-06	05SD020006	4.4E-06	1.2E-06 U	3.30E-06	2.33	Yes	ASL
1,2,3,7,8,9-HXCDF	3/4	5.6E-07 J	1.4E-06 J	05SD020006	7.0E-07	9.0E-07 U	1.29E-08	109	Yes	ASL
1,2,3,7,8-PECDD	3/4	6.7E-07 J	2.2E-06 J	05SD020006	1.2E-06	7.0E-07 UJ	3.30E-06	0.67	No	BSL
1,2,3,7,8-PECDF	3/4	1.6E-06 J	5.9E-06 J	05SD020006	2.8E-06	8.9E-07 J	1.29E-08	457	Yes	ASL
2,3,4,6,7,8-HXCDF	4/4	1.0E-06 J	1.1E-05 J	05SD020006	5.5E-06	5.1E-07 U	1.29E-08	829	Yes	ASL
2,3,4,7,8-PECDF	4/4	1.3E-06 J	9.3E-06 J	05SD020006	4.6E-06	7.2E-07 J	1.29E-08	721	Yes	ASL
2,3,7,8-TCDD	4/4	2.6E-07 J	3.7E-06	05SD050006	1.3E-06	4.0E-07 U	3.30E-06	1.12	Yes	ASL
2,3,7,8-TCDF	4/4	2.2E-06 J	7.0E-06	05SD020006	4.0E-06	1.4E-06 J	1.29E-08	543	Yes	ASL
TOTAL HPCDD	4/4	8.4E-05 J	4.2E-04	05SD020006	2.2E-04	1.0E-04 J	3.30E-06	128	Yes	ASL
TOTAL HPCDF	1/4	1.1E-04 J	1.1E-04 J	05SD050006	6.8E-05	5.8E-06 J	1.29E-08	8295	Yes	ASL
Volatiles (mg/kg)										
CIS-1,2-DICHLOROETHENE	1/4	1	1	05SD020006	0.25	4.00 U	0.21	4.8	Yes	ASL
METHYLENE CHLORIDE	4/4	0.005 J	0.008 J	05SD040006	0.01	0.004 J	1.26	0.01	No	BSL
TRICHLOROETHENE	1/4	0.7	0.7	05SD020006	0.18	4.00 U	0.18	3.9	Yes	ASL
Semi-Volatiles (mg/kg)										
2-METHYLNAPHTHALENE	1/4	0.024	0.024	05SD050006	0.010	0.014	0.020	1.19	Yes	ASL
BENZO(A)ANTHRACENE	3/4	0.019	0.026	05SD020006	0.019	0.360	0.032	0.8	No	BSL
BENZO(A)PYRENE	3/4	0.022	0.03	05SD050006	0.021	0.300	0.032	0.9	No	BSL
BENZO(B)FLUORANTHENE	3/4	0.025	0.045	05SD050006	0.026	0.320	10.4	0.004	No	BSL
BENZO(G,H,I)PERYLENE	3/4	0.014	0.045	05SD050006	0.020	0.110	0.17	0.26	No	BSL
BENZO(K)FLUORANTHENE	3/4	0.018	0.033	05SD050006	0.020	0.260	0.24	0.14	No	BSL
CHRYSENE	3/4	0.025	0.039	05SD050006	0.025	0.370	0.057	0.68	No	BSL
DIBENZO(A,H)ANTHRACENE	1/4	0.016	0.016	05SD050006	0.008	0.068	0.006	2.6	Yes	ASL
FLUORANTHENE	4/4	0.016	0.055	05SD020006	0.039	0.960	0.111	0.49	No	BSL
INDENO(1,2,3-CD)PYRENE	3/4	0.012	0.027	05SD050006	0.015	0.120	0.200	0.14	No	BSL
NAPHTHALENE	1/4	0.016	0.016	05SD050006	0.008	0.037	0.035	0.46	No	BSL
PHENANTHRENE	3/4	0.022	0.031	05SD020006	0.021	0.670	0.042	0.7	No	BSL
PYRENE	3/4	0.034	0.047	05SD020006	0.032	0.650	0.053	0.9	No	BSL
Pesticides (mg/kg)										
AROCLOR-1260	1/4	0.17	0.17	05SD050006	0.063	0.420 U	0.034	4.99	Yes	ASL
Herbicides (mg/kg)										
HEXACHLOROPHENE	1/4	0.0031 J	0.0031 J	05SD040006	0.0011	0.0085 U	231	0.00001	No	BSL
PENTACHLOROPHENOL	1/4	0.006 J	0.006 J	05SD050006	0.0019	0.0085 U	30.1	0.0002	No	BSL

TABLE 5-25

ECOLOGICAL RISK SCREENING - SEDIMENT
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Upgradient Sample Concentration(3)	Sediment COPC Screening Level(4)	Ecological Effects Quotient (5)	COPC Flag (6)	Rationale for Contaminant Deletion or Selection(6)
Inorganics (mg/kg)										
ALUMINUM	4/4	3790 J	7660 J	05SD050006	5365	5610 J	NA	NA	Yes	NTX
ANTIMONY	3/4	1.6	5.8	05SD050006	2.6	1 U	NA	NA	Yes	NTX
ARSENIC	4/4	1.9	5.3	05SD050006	3.4	6.1	5.9	0.90	No	BKG
BARIUM	4/4	76.6 J	148 J	05SD050006	119	55 J	NA	NA	Yes	NTX
CADMIUM	1/4	2.5 J	2.5 J	05SD050006	1.1	0.93 U	0.596	4.19	Yes	ASL
CALCIUM	4/4	1540 J	57300 J	05SD050006	16065	12400 J	NA	NA	No	NT
CHROMIUM	4/4	6.9 J	17.4 J	05SD050006	11.8	13.4 J	26	0.67	No	BSL
COBALT	4/4	4	5.9	05SD020006	5.4	9.5	50	0.12	No	BSL, BKG
COPPER	4/4	9.5 J	37.1 J	05SD050006	21.5	12.0 J	16	2.32	Yes	ASL
IRON	4/4	5030 J	14000 J	05SD050006	9740	24400 J	NA	NA	No	BKG
LEAD	4/4	15.1	130	05SD050006	48.6	20.9	31	4.19	Yes	ASL
MAGNESIUM	3/4	734	4010 J	05SD050006	1572	1540 J	NA	NA	No	NT
MANGANESE	4/4	109 J	812 J	05SD030006	490	346 J	NA	NA	Yes	NTX
MERCURY	2/4	0.04	0.09 J	05SD050006	0.049	0.030	0.174	0.52	No	BSL
NICKEL	4/4	9.2	14.5	05SD030006	11.7	22.5	16	0.91	No	BKG
POTASSIUM	1/4	648	648	05SD050006	398	464 U	NA	NA	No	NT
VANADIUM	4/4	10.2	16.7	05SD050006	12.1	15.1	NA	NA	Yes	NTX
ZINC	4/4	31.7	243	05SD050006	116	53	120	2.03	Yes	ASL
Miscellaneous Parameters (mg/kg)										
TOTAL ORGANIC CARBON	4/4	2600	11000	05SD040006	5500	3100	NA	NA	No	NT

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.
The table only includes parameters that were detected in downgradient samples (if applicable).

Footnotes:

1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 Location of upgradient sample was 05SD010006
4 As presented in Table 3-14.
5 Refer to Section 3.4 for ecological effects quotient calculation.

Definitions:

COPC = Chemical of Potential Concern
NA = Not Available

6 Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.

For Elimination as a COPC:
BKG = Below site background level.
BSL = Below COPC screening level.
NT = Nontoxic.

TABLE 5-26

ECOLOGICAL RISK SCREENING - SURFACE WATER
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Upgradient Sample Concentration(3)	Surface Water COPC Screening Level(4)	Ecological Effects Quotient (5)	COPC Flag (6)	Rationale for Contaminant Deletion or Selection(6)
Dioxins (ug/L)										
TOTAL PECDD	1/4	9.4E-06	9.4E-06	05SW0401	5.0E-06	0.0000033 UJ	2.78E-07	33.8	Yes	ASL
Volatile Organics (ug/L)										
1,1-DICHLOROETHENE	1/4	2	2	05SW0201	0.88	1 U	78	0.03	No	BSL
CIS-1,2-DICHLOROETHENE	3/4	1	290	05SW0201	100	1 U	NA	NA	Yes	NTX
TRANS-1,2-DICHLOROETHENE	2/4	3	9	05SW0201	3.3	1 U	310	0.03	No	BSL
TRICHLOROETHENE	2/4	48	120	05SW0201	42.3	1 U	75	1.60	Yes	ASL
VINYL CHLORIDE	2/4	18	85	05SW0201	26	1 U	9.2	9.24	Yes	ASL
Semi-Volatile Organics (ug/L)										
BIS(2-ETHYLHEXYL)PHTHALATE	1/4	2	2	05SW0201	1.3	2	2.1	0.95	No	BSL
Inorganics (ug/L)										
ALUMINUM	1/4	204 J	204 J	05SW0401	126	200 U	NA	NA	Yes	NTX
ANTIMONY	1/4	1.3	1.3	05SW0501	0.70	1.0 U	31	0.04	No	BSL
ARSENIC	4/4	0.34	0.64	05SW0401	0.48	0.55	53	0.01	No	BSL
BARIUM	4/4	68.3 J	184 J	05SW0501	104	67.7 J	5000	0.04	No	BSL
CALCIUM	4/4	7570	72600	05SW0501	34518	29200	NA	NA	No	NT
COPPER	2/4	2.4	2.7	05SW0201	1.8	2.0 U	5	0.54	No	BSL
IRON	4/4	337 J	1520 J	05SW0401	769	284 J	NA	NA	Yes	NTX
MAGNESIUM	3/4	9880 J	11900 J	05SW0301	8920	6490 J	NA	NA	No	NT
MANGANESE	3/4	105	315	05SW0301	166	41.4	NA	NA	Yes	NTX
SODIUM	4/4	9330	22800	05SW0401	13508	30700	NA	NA	No	NT, BKG
ZINC	2/4	19.5	19.9	05SW0301	12.4	10.0 U	58.9	0.34	No	BSL
Filtered Inorganics (ug/L)										
ANTIMONY	1/4	1.3	1.3	05SW0501-F	0.70	1.0 U	31	0.04	No	BSL
ARSENIC	4/4	0.29	0.56	05SW0401-F	0.41	0.51	53	0.01	No	BSL
BARIUM	4/4	66.1 J	174 J	05SW0501-F	98.7	68.0 J	5000	0.03	No	BSL
CALCIUM	4/4	7920	74900	05SW0501-F	36255	29500	NA	NA	No	NT
COPPER	1/4	2.1	2.1	05SW0501-F	1.3	2.0 U	5	0.42	No	BSL
IRON	4/4	209 J	594 J	05SW0401-F	416	103 J	NA	NA	Yes	NTX
MAGNESIUM	4/4	5140 J	12500 J	05SW0301-F	10085	6960 J	NA	NA	No	NT
MANGANESE	3/4	85.8	304	05SW0301-F	156	33.9	NA	NA	Yes	NTX
SODIUM	4/4	9150	22800	05SW0401-F	13095	27900	NA	NA	No	NT, BKG
ZINC	2/4	16.9	20	05SW0301-F	11.7	10.0 U	58.9	0.34	No	BSL
Micellaneous Parameters (ug/L)										
HARDNESS	4/4	38000	230000	05SW0501	124500	99000	NA	NA	No	NT
TOTAL SUSPENDED SOLIDS	3/4	2000	52000	05SW0201	17500	5000	NA	NA	No	NT

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.
The table only includes parameters that were detected in downgradient samples (if applicable).

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 Location of upgradient sample was 05SW0101
4 As presented in Table 3-15.
5 Refer to Section 3.4 for ecological effects quotient calculation.

6 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level,
NTX = No toxicity information available.

For Elimination as a COPC:
BKG = Below site background level.
BSL = Below COPC screening level.
NT = Nontoxic.

Definitions:
COPC = Chemical of potential concern.
NA = Not available.

Associated Samples:

05SW0101	05SW0301-F
05SW0101-F	05SW0401
05SW0201	05SW0401-F
05SW0201-F	05SW0501
05SW0301	05SW0501-F

TABLE 5-27

CHEMICALS OF POTENTIAL CONCERN RETAINED FOR FOOD-CHAIN MODELING
SWMU 5 - OLD BURN PIT
NSWC CRANE
CRANE, INDIANA

Parameters	Media		
	Surface Water	Sediment	Surface Soil
Dioxins			
1,2,3,4,6,7,8,9-OCDD		X	X
1,2,3,4,6,7,8,9-OCDF		X	X
1,2,3,4,6,7,8-HPCDD		X	X
1,2,3,4,6,7,8-HPCDF		X	X
1,2,3,4,7,8,9-HPCDF		X	X
1,2,3,4,7,8-HXCDD			X
1,2,3,4,7,8-HXCDF		X	X
1,2,3,6,7,8-HXCDD		X	X
1,2,3,6,7,8-HXCDF		X	X
1,2,3,7,8,9-HXCDD		X	X
1,2,3,7,8,9-HXCDF		X	
1,2,3,7,8-PECDD			X
1,2,3,7,8-PECDF		X	X
2,3,4,6,7,8-HXCDF		X	X
2,3,4,7,8-PECDF		X	X
2,3,7,8-TCDD		X	X
2,3,7,8-TCDF		X	X
TOTAL PECDD			
TOTAL HPCDD		X	X
TOTAL HPCDF		X	X
TOTAL HXCDD			X
TOTAL HXCDF			X
TOTAL TCDD			X
TOTAL TCDF			X
Semi-Volatiles			
Dibenzo(a,h)anthracene		X	
PCBs			
Aroclor-1260		X	
Inorganics			
Cadmium		X	X
Chromium			X
Copper		X	X
Lead		X	X
Mercury			X
Silver			X
Zinc		X	X

COPCs retained in surface water and sediment were used to evaluate potential risk to piscivorous receptors.

COPCs retained in surface soil were used to evaluate potential risk to terrestrial wildlife.

TABLE 5-28

STEP 3A EVALUATION FOR RISKS TO PLANTS AND INVERTEBRATES - SURFACE SOIL COPCs
SWMU 5 - OLD BURN PIT
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Screening Level (mg/kg)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation: Alternate Benchmarks: Eco-SSL Plant	Eco-SSL Earthworm	Canadian SQG[3]	ORNL Benchmarks[3] Plant	ORNL Benchmarks[3] Earthworm	Other Step 3a Factors Considered in Evaluation[4,5]	Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
Dioxins													
1,2,3,4,6,7,8,9-OCDD	8/8	0.00505	0.0000002	25377	8	NA	NA	NA	NA	NA	- A study in the literature found that two species of earthworms showed no adverse effects from soil containing 5 mg/kg of 2,3,7,8-TCDD. - Dioxins are not harmful to invertebrates at "high" levels because they lack the aryl hydrocarbon (Ah) receptor; invertebrates are not likely to be impacted by dioxin concentrations in the soil. - Plants also lack the Ah receptors so they are not likely to be impacted by the concentrations of dioxins in the soil.	Acceptable	No
1,2,3,4,6,7,8,9-OCDF	7/8	0.000313	0.0000386	8.11	4	NA	NA	NA	NA	NA			
1,2,3,4,6,7,8-HPCDD	8/8	0.000359	0.0000002	1804	8	NA	NA	NA	NA	NA			
1,2,3,4,6,7,8-HPCDF	7/8	0.000541	0.0000386	14.0	4	NA	NA	NA	NA	NA			
1,2,3,4,7,8,9-HPCDF	6/8	0.0000575	0.0000386	1.49	1	NA	NA	NA	NA	NA			
1,2,3,4,7,8-HXCDD	5/8	0.0000217	0.0000002	109	5	NA	NA	NA	NA	NA			
1,2,3,4,7,8-HXCDF	7/8	0.000361	0.0000386	9.35	3	NA	NA	NA	NA	NA			
1,2,3,6,7,8-HXCDD	7/8	0.000053	0.0000002	266	7	NA	NA	NA	NA	NA			
1,2,3,6,7,8-HXCDF	8/8	0.000128	0.0000386	3.32	1	NA	NA	NA	NA	NA			
1,2,3,7,8,9-HXCDD	8/8	0.0000691	0.0000002	347	8	NA	NA	NA	NA	NA			
1,2,3,7,8-PECDD	5/8	0.0000221	0.0000002	111	5	NA	NA	NA	NA	NA			
1,2,3,7,8-PECDF	4/8	0.000105	0.0000386	2.72	1	NA	NA	NA	NA	NA			
2,3,4,6,7,8-HXCDF	7/8	0.000146	0.0000386	3.78	1	NA	NA	NA	NA	NA			
2,3,4,7,8-PECDF	7/8	0.000143	0.0000386	3.70	1	NA	NA	NA	NA	NA			
2,3,7,8-TCDD	5/8	0.0000061	0.0000002	30.7	5	NA	NA	NA	NA	NA			
2,3,7,8-TCDF	7/8	0.000325	0.0000386	8.42	2	NA	NA	NA	NA	NA			
TOTAL HPCDD	8/8	0.000803	0.0000002	4035	8	NA	NA	NA	NA	NA			
TOTAL HPCDF	6/8	0.000792	0.0000386	20.5	4	NA	NA	NA	NA	NA			
TOTAL HXCDD	5/8	0.00089	0.0000002	4472	5	NA	NA	NA	NA	NA			
TOTAL HXCDF	1/8	0.0000254	0.0000002	128	1	NA	NA	NA	NA	NA			
TOTAL TCDD	2/8	0.000404	0.0000002	2030	2	NA	NA	NA	NA	NA			
TOTAL TCDF	1/8	0.0000524	0.0000386	1.36	1	NA	NA	NA	NA	NA			
Volatiles													
CIS-1,2-DICHLOROETHENE	2/8	2.8	0.78373	3.57	1	NA	NA	NA	NA	NA	- VOCs are generally not detected in surface soil because they are volatile. - The samples were collected in winter, when volatilization is low. - Few receptors are active in winter; VOCs are not expected to be detected in the surface soil in the warmer months when receptors are present.	Acceptable	No
Semivolatiles													
BIS(2-ETHYLHEXYL)PHTHALATE	2/8	3.4	0.93	3.67	1	NA	NA	NA	100	NA	- The maximum detected concentration is less than the ORNL plant value. - Maximum concentration less than earthworm values reported for dimethylphthalate (200 mg/kg).	Acceptable	No
NAPHTHALENE	5/8	0.1	0.099	1.01	1	NA	NA	0.6[4]	NA	NA	- The maximum detection is less than the Canadian SQG.	Acceptable	No
Inorganics													
ANTIMONY	7/8	301	0.1423	2115	7	NA	78	NA	5	NA	- Only the maximum detected concentration is greater than the Eco-SSL for invertebrates. - Several detected concentrations are greater than the ORNL plant benchmark; however, the site is heavily vegetated.	Unacceptable	Yes
BARIUM	8/8	2,020	1.04	1942	8	NA	330	NA	500	NA	- Several detections are greater than the Eco-SSL for soil invertebrates. - Several detected concentrations are greater than the ORNL plant benchmark.	Unacceptable	Yes
CADMIUM	6/8	31.1	0.00222	14009	6	32	140	NA	NA	NA	- The maximum detection is less than the Eco-SSLs for plants and invertebrates.	Acceptable	No
CHROMIUM	8/8	112	0.4	280	8	NA	NA	64	NA	NA	- The maximum detected concentration is less than the NOECs reported for invertebrates indicating they are not likely being adversely impacted from chromium in soil. - Only the maximum detected concentration is greater than the SQG, which is based on effects to plants.	Acceptable (for invertebrates) Unacceptable (for plants)	Yes
COPPER	8/8	1,520	2.96	514	8	NA	NA	63	100	60	- Several detected concentrations were greater than the Canadian SQG.	Unacceptable	Yes
IRON	8/8	105,000	NA	NA	NA	NA	NA	NA	NA	200[5]	- Iron is not expected to be toxic to plants in well aerated soils with pH levels between 5 and 8 S.U.; the soil pH at the site is likely within that range. - Iron is generally considered a non-toxic metal in soil.	Acceptable	No

TABLE 5-28

STEP 3A EVALUATION FOR RISKS TO PLANTS AND INVERTEBRATES - SURFACE SOIL COPCs
SWMU 5 - OLD BURN PIT
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Screening Level (mg/kg)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation						Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						Alternate Benchmarks					Other Step 3a Factors Considered in Evaluation[4,5]		
						Eco-SSL		Canadian SQG[3]	ORNL Benchmarks[3]				
						Plant	Earthworm		Plant	Earthworm			
LEAD	8/8	16,900	0.05373	314536	8	115	1,700	NA	NA	NA	- Only the maximum detected concentration is greater than the Eco-SSL for invertebrates. - Several detected concentrations are greater than the Eco-SSL for plants.	Unacceptable	Yes
MERCURY	8/8	0.43	0.073	5.89	6	NA	NA	12	NA	NA	- The maximum detected concentration is less than the Canadian SQG.	Acceptable	No
SILVER	3/8	7.5	4.04	1.86	1	NA	NA	NA	2	50[6]	- Several detected concentrations are greater than the ORNL plant benchmark. - Maximum detection is well below ORNL benchmark for microorganisms which have shown similar sensitivities to metals as earthworms.	Acceptable (for invertebrates) Unacceptable (for plants)	Yes
TIN	7/8	849	7.62	111	7	NA	NA	NA	50	2000[6]	- Several detected concentrations are greater than the ORNL plant benchmark. - Maximum detection is well below ORNL benchmark for microorganisms which have shown similar sensitivities to metals as earthworms.	Acceptable (for invertebrates) Unacceptable (for plants)	Yes
ZINC	8/8	5,110	6.62	772	8	NA	NA	200	NA	NA	- Several detected concentrations were greater than the Canadian SQG.	Unacceptable	Yes

Footnotes:
1 Maximum EEQ = Maximum detection divided by the screening level.
2 Number of samples with concentrations greater than the screening level.
3 Canadian and ORNL benchmarks were used only in the absence of Eco-SSLs.
4 See Section 5.7.6 for a more detailed Step 3a evaluation.
5 Several general notes were made for several of the chemicals and are summarized as follows so that they do not have to be repeated for each chemical:
- Metal shavings in the sample collected at 05SB06 likely contributed to the elevated levels of several metals in this sample, where the maximum concentrations of most metals were found.
- The site is heavily vegetated so even though the detected concentrations for several metals exceed plant benchmarks, the metals do not appear to be significantely impacting the plant community at the SWMU.
6 Based on risks to microorganisms.

Acronyms:
COPC = Chemical of Potential Concern
Eco-SSL = Ecological Soil Screening Level
EEQ = Ecological Effects Quotient
NA = Not Available or Not Applicable
ORNL = Oak Ridge National Laboratory
SQG = Soil Quality Guideline

TABLE 5-29

STEP 3A EVALUATION FOR RISKS TO BENTHIC ORGANISMS - SEDIMENT COPCs
SWMU 5 - OLD BURN PIT
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Screening Level (mg/kg)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation: Alternate Benchmarks: Consensus-based TEC	Consensus-based PEC	ER-L	Canadian LEL	AET	ESL	TEL	Other Step 3a Factors Considered in Evaluation[3,4]	Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
Dioxins															
1,2,3,4,6,7,8,9-OCDD	4/4	6.11E-03	3.30E-06	1852	4	NA	NA	NA	NA	NA	NA	NA	- The sum dioxin TEQ value is less than the sediment level that would cause a low risk to fish (60 ng/kg). - Aquatic invertebrates are much less sensitive to dioxins than are fish.	Acceptable	No
1,2,3,4,6,7,8,9-OCDF	4/4	2.23E-04	1.29E-08	17287	4	NA	NA	NA	NA	NA	NA	NA			
1,2,3,4,6,7,8-HPCDD	4/4	2.03E-04	3.30E-06	62	4	NA	NA	NA	NA	NA	NA	NA			
1,2,3,4,6,7,8-HPCDF	4/4	8.61E-05	1.29E-08	6674	4	NA	NA	NA	NA	NA	NA	NA			
1,2,3,4,7,8,9-HPCDF	3/4	6.50E-06	1.29E-08	504	3	NA	NA	NA	NA	NA	NA	NA			
1,2,3,4,7,8-HXCDF	4/4	2.10E-05	1.29E-08	1628	4	NA	NA	NA	NA	NA	NA	NA			
1,2,3,6,7,8-HXCDD	4/4	7.20E-06	3.30E-06	2.18	2	NA	NA	NA	NA	NA	NA	NA			
1,2,3,6,7,8-HXCDF	4/4	8.30E-06	1.29E-08	643	4	NA	NA	NA	NA	NA	NA	NA			
1,2,3,7,8,9-HXCDD	4/4	7.70E-06	3.30E-06	2.33	2	NA	NA	NA	NA	NA	NA	NA			
1,2,3,7,8,9-HXCDF	3/4	1.40E-06	1.29E-08	109	3	NA	NA	NA	NA	NA	NA	NA			
1,2,3,7,8-PECDF	3/4	5.90E-06	1.29E-08	457	3	NA	NA	NA	NA	NA	NA	NA			
2,3,4,6,7,8-HXCDF	4/4	1.07E-05	1.29E-08	829	4	NA	NA	NA	NA	NA	NA	NA			
2,3,4,7,8-PECDF	4/4	9.30E-06	1.29E-08	721	4	NA	NA	NA	NA	NA	NA	NA			
2,3,7,8-TCDD	4/4	3.70E-06	3.30E-06	1.12	1	NA	NA	NA	NA	NA	NA	NA			
2,3,7,8-TCDF	4/4	7.00E-06	1.29E-08	543	4	NA	NA	NA	NA	NA	NA	NA			
TOTAL HPCDD	4/4	4.22E-04	3.30E-06	128	4	NA	NA	NA	NA	NA	NA	NA			
TOTAL HPCDF	1/4	1.07E-04	1.29E-08	8295	1	NA	NA	NA	NA	NA	NA	NA			
Volatile Organics															
CIS-1,2-DICHLOROETHENE	1/4	1	0.21	4.79	1	NA	NA	NA	NA	NA	0.65	NA	- Although the detected concentrations are greater than the ESLs, the location of the maximum detection is very poor aquatic habitat. - VOCs are generally not detected in sediment because they are volatile. - The samples were collected in winter, when volatilization is low. - Few receptors are present in the sediment in winter; VOCs are not expected to be detected in the sediment in the warmer months when aquatic receptors are present.	Acceptable	No
TRICHLOROETHENE	1/4	0.7	0.18	3.90	1	NA	NA	NA	NA	NA	0.11	NA			
Semivolatile Organics															
2-METHYLNAPHTHALENE	1/4	0.024	0.020	1.19	1	NA	NA	NA	NA	NA	NA	NA	- Total PAHs were evaluated instead of individually detected PAHs. - The maximum detection is less than the consensus-based TEC.	Acceptable	No
DIBENZO(A,H)ANTHRACENE	1/4	0.016	0.006	2.57	1	NA	NA	NA	NA	NA	NA	NA			
TOTAL PAHs	NA	0.104	NA	NA	NA	1.61	NA	NA	NA	NA	NA	NA			
PCBs															
AROCLOR-1260	1/4	0.17	0.034	4.99	1	0.0598	0.676	NA	NA	NA	NA	NA	- Only the single detected concentration is greater than the TEC. - The location of the single detection is very poor aquatic habitat. - Risks are not great enough to keep Aroclor-1260 as a COPC.	Acceptable	No
Inorganics															
ALUMINUM	4/4	7,660	NA	NA	NA	NA	NA	NA	NA	NA	NA	25500	-The maximum detection is less than the TEL.	Acceptable	No
ANTIMONY	3/4	5.8	NA	NA	NA	NA	NA	2	NA	NA	NA	NA	- Two detected concentrations were slightly greater than the ER-L. - The location of the maximum detection has little aquatic habitat; effects to sediment invertebrates are unlikely due to the marginal exceedance reported at other locations.	Acceptable	No
BARIUM	4/4	148	NA	NA	NA	NA	NA	NA	NA	48	NA	NA	- All detections are greater than the AET. - All concentrations are within the soil background data set for NSWC Crane indicating that barium concentrations are not significantly elevated in sediment.	Acceptable	No
CADMIUM	1/4	2.5	0.596	4.19	1	0.99	4.98	NA	NA	NA	NA	NA	- Only the maximum detected concentration is greater than the TEC; all detected concentrations were less than the PEC. - The location of the maximum detection has little aquatic habitat. - Effects to sediment invertebrates are unlikely.	Acceptable	No

TABLE 5-29

STEP 3A EVALUATION FOR RISKS TO BENTHIC ORGANISMS - SEDIMENT COPCs
SWMU 5 - OLD BURN PIT
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Screening Level (mg/kg)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation								Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						Alternate Benchmarks							Other Step 3a Factors Considered in Evaluation[3,4]		
						Consensus-based TEC	Consensus-based PEC	ER-L	Canadian LEL	AET	ESL	TEL			
COPPER	4/4	37.1	16	2.32	2	31.6	149	NA	NA	NA	NA	NA	- Only the maximum detected concentration is greater than the TEC; all detected concentrations were less than the PEC. - The location of the maximum detection has little aquatic habitat. - Effects to sediment invertebrates are unlikely	Acceptable	No
LEAD	4/4	130	31	4.19	1	35.8	128	NA	NA	NA	NA	NA	- Only the maximum detected concentration is greater than the TEC and slightly greater than the PEC. - The location of the maximum detection has little aquatic habitat. - Effects to sediment invertebrates are unlikely.	Acceptable	No
MANGANESE	4/4	812	NA	NA	NA	NA	NA	NA	460	NA	NA	NA	- Several detected concentrations are greater than the Canadian LEL; all detected concentrations were less than the SEL. - Manganese concentrations in the soil are within background concentrations; because the source of manganese in the sediment is surface soil runoff, it is unlikely that manganese in the sediment is related to site-activities.	Acceptable	No
VANADIUM	4/4	16.7	NA	NA	NA	NA	NA	NA	NA	57	NA	NA	- All detections are less than the AET. - The maximum detected concentration is slightly greater than the upgradient concentration. - Any risks would not be site-related.	Acceptable	No
ZINC	4/4	243	120	2.03	1	121	459	NA	NA	NA	NA	NA	- Only the maximum detected concentration is greater than the TEC and slightly greater than the PEC. - The location of the maximum detection has little aquatic habitat. - Effects to sediment invertebrates are unlikely.	Acceptable	No

Footnotes:
1 Maximum EEQ = Maximum detection divided by the screening level.
2 Number of samples with concentrations greater than the screening level.
3 See Section 5.7.6 for a more detailed Step 3a Evaluation.
4 Several chemicals that were detected at concentrations greater than conservative screening levels were not retained as COPCs because of the poor and/or lack of aquatic habitat at the SWMU.

Acronyms:
AET = Apparent Effects Threshold
COPC = Chemical of Potential Concern
EEQ = Ecological Effects Quotient
ER-L = Effects Range-Low
ESL = Ecological Screening Level
LEL = Lowest Effects Level
NA = Not Available or Not Applicable
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
PEC = Probable Effects Concentration
SEL = Severe Effects Level
TEC = Threshold Effects Concentration
TEL = Threshold Effects Level

TABLE 5-30

STEP 3A EVALUATION FOR RISKS TO AQUATIC ORGANISMS - SURFACE WATER COPCs
SWMU 5 - OLD BURN PIT
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (ug/L)	Screening Level (ug/L)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation					Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						AWQC		ORNL Aquatic				
						Chronic	ESL	SCV	LCV (daphnids)	Other Step 3a Factors Considered in Evaluation[3]		
Dioxins												
TOTAL PECDD	1/4	9.40E-06	2.78E-07	33.8	1	NA	NA[5]	NA	NA	- Although the detected concentration is greater than effects levels for fish, fish are not likely present in the streams and invertebrates are much less sensitive to dioxins than are fish.	Acceptable	No
Volatile Organics												
CIS-1,2-DICHLOROETHENE	3/4	290	NA	NA	NA	NA	970[4]	NA	NA	-The maximum detected concentration is less than the ESL.	Acceptable	No
TRICHLOROETHENE	2/4	120	75	1.6	1	NA	47	NA	7257	-The maximum detection is greater than the ESL. - VOCs are generally not detected in surface water because they are volatile but the samples were collected in winter, when volatilization is low. - Few receptors are present in the water in winter; VOCs are not expected to be detected in the surface water in the warmer months when aquatic receptors are present.	Acceptable	No
VINYL CHLORIDE	2/4	85	9.2	9.2	2	NA	930	NA	NA	-The maximum detected concentration is less than the ESL	Acceptable	No
Inorganics												
ALUMINUM	1/4	204	NA	NA	NA	NA	NA	NA	NA	- Not detected in filtered sample which represents the bioavalable portion.	Acceptable	No
IRON	4/4	1520	NA	NA	NA	1000	NA	NA	NA	- Maximum detected concentration in the filtered sample is less than the chronic WQC.	Acceptable	No
IRON (Filtered)	4/4	594	NA	NA	NA	1000	NA	NA	NA			
MANGANESE	3/4	315	NA	NA	NA	NA	NA	120	NA	- Maximum detected concentration is much less than tolerance value of 1500 ug/L (tolerance level from the U.S. EPA Gold Book).	Acceptable	No
MANGANESE (Filtered)	3/4	304	NA	NA	NA	NA	NA	120	NA			

Footnotes:
1 Maximum EEQ = Maximum detection divided by the screening level.
2 Number of samples with concentrations greater than the screening level.
3 See Section 5.7.6 for a more detailed Step 3a Evaluation.
4 Based on trans-1,2-dichloroethene.
5 The ESL for dioxins was not used in this Step 3a evaluation because it is based on risks to wildlife, not aquatic organisms.

AWQC = Ambient Water Quality Criteria
COPC = Chemical of Potential Concern
EEQ = Ecological Effects Quotient
ESL = Ecological Screening Level
LCV = Lowest Chronic Value
NA = Not Available or Not Applicable
ORNL = Oak Ridge National Laboratory
SCV = Secondary Chronic Value

TABLE 5-31

TERRESTRIAL WILDLIFE MODEL-MAXIMUM EEQS
SWMU 5 - OLD BURN PIT
INSECTIVOROUS/HERBIVOROUS RECEPTORS
NSWC CRANE, INDIANA

Parameter	Meadow Vole EEQ_{NOAEL}	Meadow Vole EEQ_{LOAEL}	Short-Tailed Shrew EEQ_{NOAEL}	Short-Tailed Shrew EEQ_{LOAEL}	American Robin EEQ_{NOAEL}	American Robin EEQ_{LOAEL}	N. Bobwhite Quail EEQ_{NOAEL}	N. Bobwhite Quail EEQ_{LOAEL}
Dioxins								
1,2,3,4,6,7,8,9-OCDD	5.3E-04	5.3E-05	1.1E-01	1.1E-02	2.1E-01	2.1E-02	3.0E-04	3.0E-05
1,2,3,4,6,7,8,9-OCDF	3.3E-05	3.3E-06	6.7E-03	6.7E-04	1.3E-02	1.3E-03	1.9E-05	1.9E-06
1,2,3,4,6,7,8-HPCDD	2.4E-04	2.4E-05	4.8E-02	4.8E-03	1.5E-01	1.5E-02	2.1E-04	2.1E-05
1,2,3,4,6,7,8-HPCDF	3.6E-04	3.6E-05	7.3E-02	7.3E-03	2.3E+00	2.3E-01	3.2E-03	3.2E-04
1,2,3,4,7,8,9-HPCDF	3.8E-05	3.8E-06	7.7E-03	7.7E-04	2.4E-01	2.4E-02	3.4E-04	3.4E-05
1,2,3,4,7,8-HXCDD	1.4E-04	1.4E-05	2.9E-02	2.9E-03	4.5E-01	4.5E-02	6.5E-04	6.5E-05
1,2,3,4,7,8-HXCDF	2.4E-03	2.4E-04	4.8E-01	4.8E-02	1.5E+01	1.5E+00	2.1E-02	2.1E-03
1,2,3,6,7,8-HXCDD	3.5E-04	3.5E-05	7.1E-02	7.1E-03	2.2E-01	2.2E-02	3.2E-04	3.2E-05
1,2,3,6,7,8-HXCDF	8.4E-04	8.4E-05	1.7E-01	1.7E-02	5.3E+00	5.3E-01	7.6E-03	7.6E-04
1,2,3,7,8,9-HXCDD	4.5E-04	4.5E-05	9.3E-02	9.3E-03	2.9E+00	2.9E-01	4.1E-03	4.1E-04
1,2,3,7,8-PECDD	2.4E-02	2.4E-03	4.8E+00	4.8E-01	9.2E+00	9.2E-01	1.3E-02	1.3E-03
1,2,3,7,8-PECDF	7.1E-04	7.1E-05	1.4E-01	1.4E-02	4.4E+00	4.4E-01	6.3E-03	6.3E-04
2,3,4,6,7,8-HXCDF	9.6E-04	9.6E-05	2.0E-01	2.0E-02	6.1E+00	6.1E-01	8.7E-03	8.7E-04
2,3,4,7,8-PECDF	9.6E-03	9.6E-04	1.9E+00	1.9E-01	6.0E+01	6.0E+00	8.6E-02	8.6E-03
2,3,7,8-TCDD	6.6E-03	6.6E-04	1.3E+00	1.3E-01	2.5E+00	2.5E-01	3.7E-03	3.7E-04
2,3,7,8-TCDF	3.8E-02	3.8E-03	7.0E+00	7.0E-01	1.4E+02	1.4E+01	2.0E-01	2.0E-02
TOTAL HPCDD	5.3E-04	5.3E-05	1.1E-01	1.1E-02	3.3E-01	3.3E-02	4.8E-04	4.8E-05
TOTAL HPCDF	5.2E-04	5.2E-05	1.1E-01	1.1E-02	3.3E+00	3.3E-01	4.7E-03	4.7E-04
TOTAL HXCDD	5.9E-03	5.9E-04	1.2E+00	1.2E-01	3.7E+01	3.7E+00	5.3E-02	5.3E-03
TOTAL HXCDF	1.7E-04	1.7E-05	3.4E-02	3.4E-03	1.1E+00	1.1E-01	1.5E-03	1.5E-04
TOTAL TCDD	4.4E-01	4.4E-02	8.7E+01	8.7E+00	1.7E+02	1.7E+01	2.4E-01	2.4E-02
TOTAL TCDF	6.2E-03	6.2E-04	1.1E+00	1.1E-01	2.2E+01	2.2E+00	3.2E-02	3.2E-03
Inorganics								
Cadmium	1.6E+00	1.6E-01	1.4E+01	1.4E+00	2.3E+02	1.6E+01	2.3E+00	1.7E-01
Chromium	7.3E-02	1.8E-02	1.3E+00	3.2E-01	1.1E+02	2.2E+01	1.2E+00	2.4E-01
Copper	4.2E-01	3.2E-01	9.9E-01	7.7E-01	1.8E+01	1.4E+01	8.8E-01	6.7E-01
Lead	1.5E+01	1.5E+00	4.6E+01	4.6E+00	8.3E+03	8.3E+02	3.4E+02	3.4E+01
Mercury	6.6E-01	4.0E-01	2.0E+00	1.2E+00	3.6E+02	3.6E+01	1.1E+01	1.1E+00
Silver	7.4E-02	7.4E-03	7.3E+00	7.3E-01				
Zinc	7.9E-01	4.0E-01	4.1E+00	2.0E+00	1.2E+03	1.3E+02	2.2E+01	2.5E+00

Notes:
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- Cells are shaded if the EEQ is greater than 1.0

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration

TABLE 5-32

TERRESTRIAL WILDLIFE MODEL-AVERAGE EEQS
SWMU 5 - OLD BURN PIT
NSWC CRANE, INDIANA

Parameter	Meadow Vole EEQ_{NOAEL}	Meadow Vole EEQ_{LOAEL}	Short-Tailed Shrew EEQ_{NOAEL}	Short-Tailed Shrew EEQ_{LOAEL}	American Robin EEQ_{NOAEL}	American Robin EEQ_{LOAEL}	N. Bobwhite Quail EEQ_{NOAEL}	N. Bobwhite Quail EEQ_{LOAEL}
Dioxins								
1,2,3,4,6,7,8,9-OCDD	1.2E-04	1.2E-05	8.3E-03	8.3E-04	2.4E-02	2.4E-03	7.1E-05	7.1E-06
1,2,3,4,6,7,8,9-OCDF	7.2E-06	7.2E-07	4.9E-04	4.9E-05	1.4E-03	1.4E-04	4.2E-06	4.2E-07
1,2,3,4,6,7,8-HPCDD	5.5E-05	5.5E-06	3.7E-03	3.7E-04	1.7E-02	1.7E-03	5.1E-05	5.1E-06
1,2,3,4,6,7,8-HPCDF	5.9E-05	5.9E-06	4.0E-03	4.0E-04	1.8E-01	1.8E-02	5.5E-04	5.5E-05
1,2,3,4,7,8,9-HPCDF	5.6E-06	5.6E-07	3.8E-04	3.8E-05	1.7E-02	1.7E-03	5.2E-05	5.2E-06
1,2,3,4,7,8-HXCDD	2.3E-05	2.3E-06	1.6E-03	1.6E-04	3.6E-02	3.6E-03	1.1E-04	1.1E-05
1,2,3,4,7,8-HXCDF	3.4E-04	3.4E-05	2.3E-02	2.3E-03	1.0E+00	1.0E-01	3.1E-03	3.1E-04
1,2,3,6,7,8-HXCDD	6.1E-05	6.1E-06	4.1E-03	4.1E-04	1.9E-02	1.9E-03	5.7E-05	5.7E-06
1,2,3,6,7,8-HXCDF	1.2E-04	1.2E-05	8.2E-03	8.2E-04	3.8E-01	3.8E-02	1.1E-03	1.1E-04
1,2,3,7,8,9-HXCDD	7.6E-05	7.6E-06	5.1E-03	5.1E-04	2.4E-01	2.4E-02	7.0E-04	7.0E-05
1,2,3,7,8-PECDD	4.0E-03	4.0E-04	2.6E-01	2.6E-02	7.5E-01	7.5E-02	2.2E-03	2.2E-04
1,2,3,7,8-PECDF	9.2E-04	9.2E-05	6.0E-02	6.0E-03	2.8E-01	2.8E-02	8.4E-04	8.4E-05
2,3,4,6,7,8-HXCDF	1.4E-04	1.4E-05	9.6E-03	9.6E-04	4.4E-01	4.4E-02	1.3E-03	1.3E-04
2,3,4,7,8-PECDF	1.4E-04	1.4E-05	9.6E-03	9.6E-04	4.4E+00	4.4E-01	1.3E-02	1.3E-03
2,3,7,8-TCDD	1.2E-03	1.2E-04	7.6E-02	7.6E-03	2.2E-01	2.2E-02	6.5E-04	6.5E-05
2,3,7,8-TCDF	5.0E-03	5.0E-04	3.0E-01	3.0E-02	8.7E+00	8.7E-01	2.7E-02	2.7E-03
TOTAL HPCDD	1.2E-04	1.2E-05	7.9E-03	7.9E-04	3.6E-02	3.6E-03	1.1E-04	1.1E-05
TOTAL HPCDF	9.1E-05	9.1E-06	6.1E-03	6.1E-04	2.8E-01	2.8E-02	8.4E-04	8.4E-05
TOTAL HXCDD	8.8E-04	8.8E-05	5.9E-02	5.9E-03	2.7E+00	2.7E-01	8.2E-03	8.2E-04
TOTAL HXCDF	7.1E-04	7.1E-05	4.8E-02	4.8E-03	2.2E+00	2.2E-01	6.6E-03	6.6E-04
TOTAL TCDD	6.4E-02	6.4E-03	4.2E+00	4.2E-01	1.2E+01	1.2E+00	3.6E-02	3.6E-03
TOTAL TCDF	2.0E-02	2.0E-03	1.2E+00	1.2E-01	3.5E+01	3.5E+00	1.1E-01	1.1E-02
Inorganics								
Cadmium	4.9E-02	4.9E-03	2.9E-01	2.9E-02	7.0E+00	5.0E-01	9.0E-02	6.6E-03
Chromium	1.3E-02	3.2E-03	5.5E-02	1.4E-02	6.3E+00	1.3E+00	2.6E-01	5.2E-02
Copper	1.7E-02	1.3E-02	5.0E-02	3.9E-02	1.3E+00	9.8E-01	5.6E-02	4.2E-02
Lead	3.5E-01	3.5E-02	1.4E+00	1.4E-01	3.6E+02	3.6E+01	1.5E+01	1.5E+00
Mercury	3.0E-02	1.8E-02	4.7E-02	2.8E-02	1.2E+01	1.2E+00	6.0E-01	6.0E-02
Silver	1.1E-02	1.1E-03	1.5E-01	1.5E-02				
Zinc	2.7E-02	1.4E-02	1.1E-01	5.7E-02	4.9E+01	5.4E+00	1.0E+00	1.1E-01

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration

TABLE 5-33

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-MAXIMUM CONCENTRATIONS
SWMU 5 - OLD BURN PIT
PISCIVOROUS RECEPTORS
NSWC CRANE, INDIANA

Parameter	Raccoon EEQ_{NOAEL}	Raccoon EEQ_{LOAEL}	Belted Kingfisher EEQ_{NOAEL}	Belted Kingfisher EEQ_{LOAEL}
Dioxins				
1,2,3,4,6,7,8,9-OCDD	1.2E+00	1.2E-01	4.4E-03	4.4E-04
1,2,3,4,6,7,8,9-OCDF	4.5E-02	4.5E-03	1.6E-04	1.6E-05
1,2,3,4,6,7,8-HPCDD	2.5E-01	2.5E-02	1.5E-03	1.5E-04
1,2,3,4,6,7,8-HPCDF	1.1E-01	1.1E-02	6.2E-03	6.2E-04
1,2,3,4,7,8,9-HPCDF	8.1E-03	8.1E-04	4.7E-04	4.7E-05
1,2,3,4,7,8-HXCDF	2.6E-01	2.6E-02	1.5E-02	1.5E-03
1,2,3,6,7,8-HXCDD	9.0E-02	9.0E-03	5.2E-04	5.2E-05
1,2,3,6,7,8-HXCDF	1.0E-01	1.0E-02	6.0E-03	6.0E-04
1,2,3,7,8,9-HXCDD	9.6E-02	9.6E-03	5.6E-03	5.6E-04
1,2,3,7,8,9-HXCDF	1.8E-02	1.8E-03	1.0E-03	1.0E-04
1,2,3,7,8-PECDF	7.4E-02	7.4E-03	4.3E-03	4.3E-04
2,3,4,6,7,8-HXCDF	1.3E-01	1.3E-02	7.7E-03	7.7E-04
2,3,4,7,8-PECDF	1.2E+00	1.2E-01	6.7E-02	6.7E-03
2,3,7,8-TCDD	7.4E+00	7.4E-01	2.7E-02	2.7E-03
2,3,7,8-TCDF	2.6E+00	2.6E-01	1.1E-01	1.1E-02
TOTAL PECDD	2.5E-02	2.5E-03	9.2E-05	9.2E-06
TOTAL HPCDD	5.3E-01	5.3E-02	3.1E-03	3.1E-04
TOTAL HPCDF	1.3E-01	1.3E-02	7.7E-03	7.7E-04
Semi-Volatiles				
DIBENZO(A,H)ANTHRACENE	2.9E+00	2.9E-01	8.5E-03	8.5E-04
PCBs				
AROCLOR-1260	5.9E+03	5.9E+02	6.3E+00	6.3E-01
Inorganics				
CADMIUM	2.5E+01	2.5E+00	5.3E-02	3.9E-03
COPPER	9.5E+00	7.3E+00	2.4E-02	1.9E-02
LEAD	1.4E+02	1.4E+01	3.6E+00	3.6E-01
ZINC	1.3E+01	6.5E+00	5.2E-01	5.8E-02

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

TABLE 5-34

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-AVERAGE CONCENTRATIONS
SWMU 5 - OLD BURN PIT
PISCIVOROUS RECEPTORS
NSWC CRANE, INDIANA

Parameter	Raccoon EEQ_{NOAEL}	Raccoon EEQ_{LOAEL}	Belted Kingfisher EEQ_{NOAEL}	Belted Kingfisher EEQ_{LOAEL}
Dioxins				
1,2,3,4,6,7,8,9-OCDD	2.7E-01	2.7E-02	1.6E-03	1.6E-04
2,3,4,7,8-PECDF	2.8E-02	2.8E-03	2.7E-02	2.7E-03
2,3,7,8-TCDD	1.3E+00	1.3E-01	7.9E-03	7.9E-04
2,3,7,8-TCDF	7.2E-01	7.2E-02	5.1E-02	5.1E-03
Semi-Volatiles				
DIBENZO(A,H)ANTHRACENE	7.3E-01	7.3E-02	3.5E-03	3.5E-04
PCBs				
AROCLOR-1260	1.1E+03	1.1E+02	1.9E+00	1.9E-01
Inorganics				
CADMIUM	5.3E+00	5.3E-01	1.9E-02	1.4E-03
COPPER	2.7E+00	2.1E+00	1.2E-02	8.8E-03
LEAD	2.5E+01	2.5E+00	1.1E+00	1.1E-01
ZINC	3.0E+00	1.5E+00	2.0E-01	2.2E-02

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

TABLE 5-35

STEP 3A EVALUATION FOR RISKS TO WILDLIFE
SWMU 05 - OLD BURN PIT
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection[1]	Maximum Detected Concentration (mg/kg)[1]	Average Concentration (mg/kg)[1]	EEQs Using Average Exposure Values				Basis of Wildlife Toxicity Reference Value	Other Step 3a Factors Considered in Evaluation[3]	Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
				NOAEL		LOAEL					
				EEQ > 1.0	Species	EEQ > 1.0	Species				
Insectivorous/Herbivorous Wildlife											
1,2,3,4,6,7,8,9-OCDD	8/8	5.05E-03	1.50E-03	None	NA	None	NA	- Significant reduction in egg production and hatchability - for birds - Significant reduction in fertility and neonatal survival - for mammals	- LOAEL EEQs calculated for several chemicals are greater than 1.0. - Most of the NOAELs and LOAELs are based on reproductive studies so some reproductive effects to mammals and birds are possible. - The risks are likely overestimated because some portion of the chemicals will not be bioavailable, especially for the metals present as metal fragments; dioxins may also be bound to the organic carbon portion the soil.	Unacceptable)	Yes
1,2,3,4,6,7,8,9-OCDF	7/8	3.13E-04	8.83E-05	None	NA	None	NA				
1,2,3,4,6,7,8-HPCDD	8/8	3.59E-04	1.07E-04	None	NA	None	NA				
1,2,3,4,6,7,8-HPCDF	7/8	5.41E-04	1.14E-04	None	NA	None	NA				
1,2,3,4,7,8,9-HPCDF	6/8	5.75E-05	1.08E-05	None	NA	None	NA				
1,2,3,4,7,8-HXCDD	5/8	2.17E-05	4.48E-06	None	NA	None	NA				
1,2,3,4,7,8-HXCDF	7/8	3.61E-04	6.52E-05	1.0	Robin	None	NA				
1,2,3,6,7,8-HXCDD	7/8	5.30E-05	1.19E-05	None	NA	None	NA				
1,2,3,6,7,8-HXCDF	8/8	1.28E-04	2.36E-05	None	NA	None	NA				
1,2,3,7,8,9-HXCDD	8/8	6.91E-05	1.47E-05	None	NA	None	NA				
1,2,3,7,8-PECDD	5/8	2.21E-05	4.64E-06	None	NA	None	NA				
1,2,3,7,8-PECDF	4/8	1.05E-04	1.74E-05	None	NA	None	NA				
2,3,4,6,7,8-HXCDF	7/8	1.46E-04	2.75E-05	None	NA	None	NA				
2,3,4,7,8-PECDF	7/8	1.43E-04	2.75E-05	4.4	Robin	None	NA				
2,3,7,8-TCDD	5/8	6.10E-06	1.36E-06	None	NA	None	NA				
2,3,7,8-TCDF	7/8	3.25E-04	5.41E-05	8.7	Robin	None	NA				
TOTAL HPCDD	8/8	8.03E-04	2.27E-04	None	NA	None	NA				
TOTAL HPCDF	6/8	7.92E-04	1.76E-04	None	NA	None	NA				
TOTAL HXCDD	5/8	8.90E-04	1.71E-04	2.7	Robin	None	NA				
TOTAL HXCDF	1/8	2.54E-05	1.38E-04	2.2	Robin	None	NA				
TOTAL TCDD	2/8	4.04E-04	7.57E-05	12	Robin	1.2	Robin				
TOTAL TCDF	1/8	5.24E-05	2.16E-04	35	Robin	3.5	Robin				
Cadmium	6/8	31.1	6.3	7.0	Robin	None	NA	Reproduction			
Chromium	8/8	112	34.0	6.3	Robin	1.3	Robin	Reproduction			
Copper	8/8	1520	269	1.3	Robin	None	NA	Mortality			
Lead	8/8	16900	2276	360	Robin	36	Robin	Reproduction			
Mercury	8/8	0.43	0.17	12	Robin	1.2	Robin	Reproduction			
Silver	3/8	7.5	1.8	None	NA	None	NA	NA			
Zinc	8/8	5110	957	49	Robin	5.4	Robin	Reproduction			

TABLE 5-35

STEP 3A EVALUATION FOR RISKS TO WILDLIFE
SWMU 05 - OLD BURN PIT
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection[1]	Maximum Detected Concentration (mg/kg)[1]	Average Concentration (mg/kg)[1]	EEQs Using Average Exposure Values				Basis of Wildlife Toxicity Reference Value	Other Step 3a Factors Considered in Evaluation[3]	Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
				NOAEL		LOAEL					
				EEQ > 1.0	Species	EEQ > 1.0	Species				
Piscivorous Wildlife											
1,2,3,4,6,7,8,9-OCDD	4/4	6.1E-03	2.8E-03	None	NA	None	NA	- Significant reduction in fertility and neonatal survival - for mammals	- PCBs and metals have LOAEL EEQs that are greater than 1; however, the waterbodies are only expected to account for a small portion of the raccoons diet because of its home range and the small size of the streams. - The NOAELs and LOAELs used in the FCM for the raccoon are conservative based of the methodology used to derive the benchmarks. - EEQs calculated for inorganics are high because there are no sediment to fish BAFs for inorganics. A default BAF of 1.0 was used which assumes that the chemical concentration in fish is equal to the chemical concentration in sediment. - The only PCB detection was in a drainage ditch sample that is dry most of the time. Therefore, raccoons or birds will not be consuming aquatic organisms from this area so impacts to piscivorous wildlife from PCBs in the sediment are not expected.	Acceptable	No
1,2,3,4,6,7,8,9-OCDF	4/4	2.2E-04	8.5E-05	None	NA	None	NA				
1,2,3,4,6,7,8-HPCDD	4/4	2.0E-04	1.0E-04	None	NA	None	NA				
1,2,3,4,6,7,8-HPCDF	4/4	8.6E-05	4.1E-05	None	NA	None	NA				
1,2,3,4,7,8,9-HPCDF	3/4	6.5E-06	2.9E-06	None	NA	None	NA				
1,2,3,4,7,8-HXCDF	4/4	2.1E-05	1.1E-05	None	NA	None	NA				
1,2,3,6,7,8-HXCDD	4/4	7.2E-06	3.9E-06	None	NA	None	NA				
1,2,3,6,7,8-HXCDF	4/4	8.3E-06	4.5E-06	None	NA	None	NA				
1,2,3,7,8,9-HXCDD	4/4	7.7E-06	4.4E-06	None	NA	None	NA				
1,2,3,7,8,9-HXCDF	3/4	1.4E-06	7.0E-07	None	NA	None	NA				
1,2,3,7,8-PECDF	3/4	5.9E-06	2.8E-06	None	NA	None	NA				
2,3,4,6,7,8-HXCDF	4/4	1.1E-05	5.5E-06	None	NA	None	NA				
2,3,4,7,8-PECDF	4/4	9.3E-06	4.6E-06	None	NA	None	NA				
2,3,7,8-TCDD	4/4	3.7E-06	1.3E-06	1.3	Raccoon	None	NA				
2,3,7,8-TCDF	4/4	7.0E-06	4.0E-06	None	NA	None	NA				
TOTAL PECDD[2]	1/4	9.4E-09	5.0E-09	None	NA	None	NA				
TOTAL HPCDD	4/4	4.2E-04	2.2E-04	None	NA	None	NA				
TOTAL HPCDF	1/4	1.1E-04	6.8E-05	None	NA	None	NA				
DIBENZO(A,H)ANTHRACENE	1/4	0.016	0.008	None	NA	None	NA	NA			
AROCLOR-1260	1/4	0.17	0.063	1100	Raccoon	110	Raccoon	Reproduction			
CADMIUM	1/4	2.5	1.1	5.3	Raccoon	None	NA	Reproduction			
COPPER	4/4	37.1	21.5	2.7	Raccoon	2.1	Raccoon	Reproduction			
LEAD	4/4	130	48.6	25	Raccoon	2.5	Raccoon	Reproduction			
ZINC	4/4	243	116	3.0	Raccoon	1.5	Raccoon	Reproduction			

Footnotes:
1 These columns present the FOD and concentrations for soil (for insectivorous/herbivorous wildlife) or sediment (for piscivorous wildlife), except as noted in footnote 3.
2 Total PECDD was detected in the surface water but not the sediment. Values given are surface water values in units of mg/L.
3 See section 5.7.6.3 for a more detailed Step 3a evaluation.

Acronyms:
COC = Chemical of Concern
EEQ = Ecological Effects Quotient
FOD = Frequency of Detection
LOAEL = Lowest Observable Adverse Effect Level
NA = Not available or not applicable
NOAEL = No Observable Adverse Effect Level
FCM = Food Chain Model

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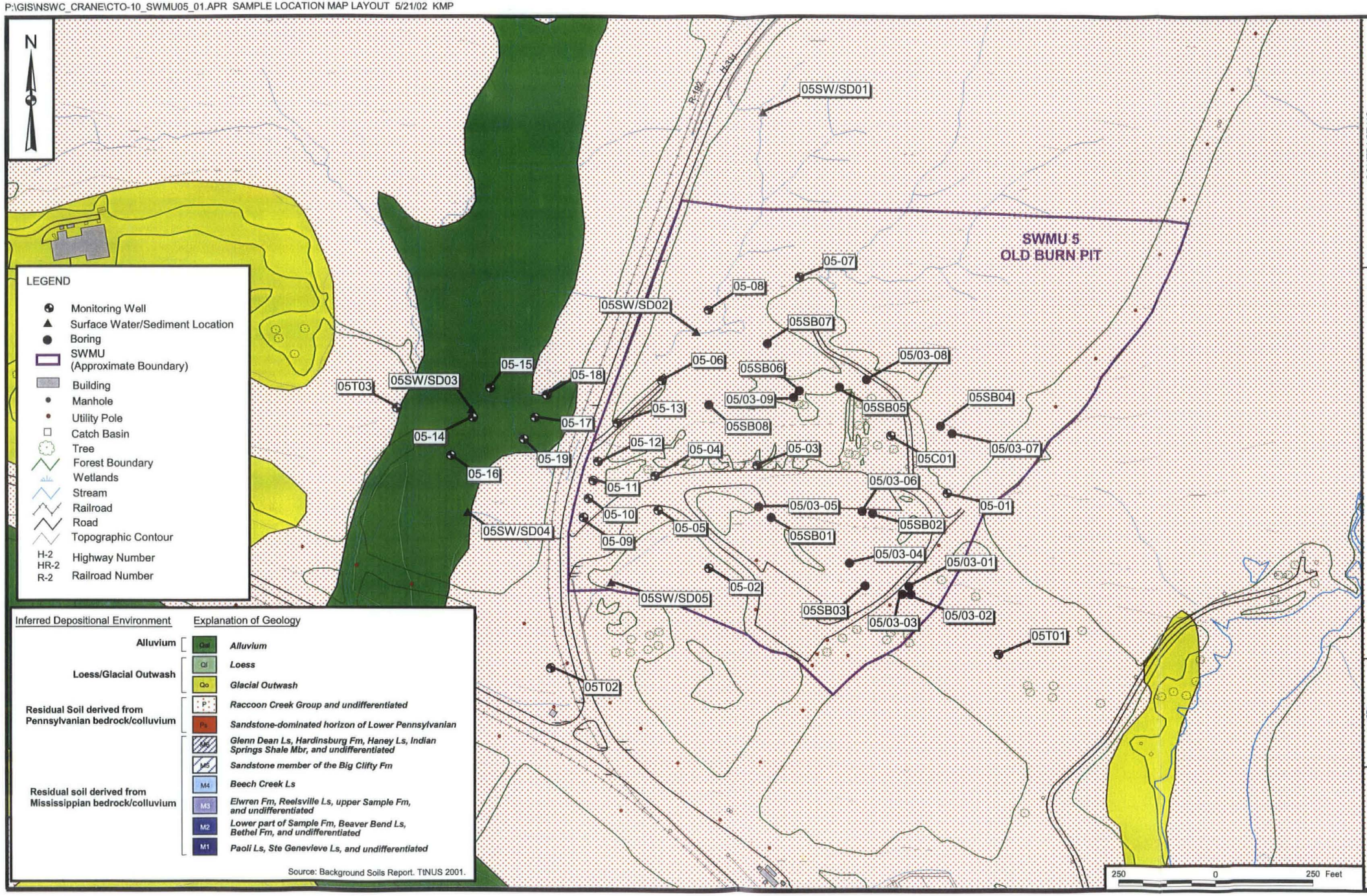

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DRAWING NO. FIGURE 5 - 1 REV -

SITE FEATURES AND SAMPLE LOCATION MAP
SWMU 5 - OLD BURN PIT
NSWC CRANE, INDIANA

DEPARTMENT OF THE NAVY * SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMD *

DRAWN BY K. PEILA DATE 5/21/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

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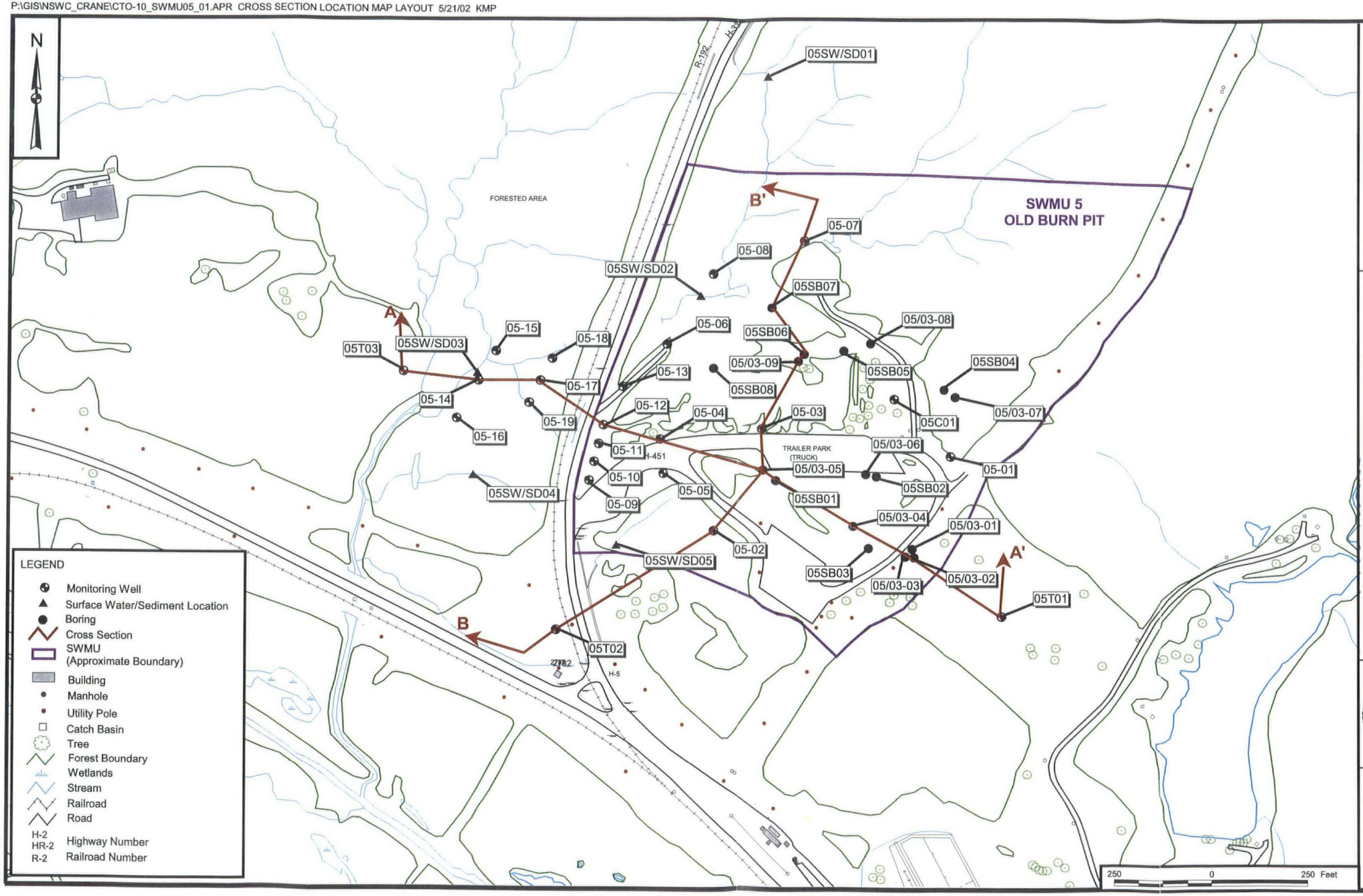

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7141

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DRAWING NO. FIGURE 5 - 2

REV _

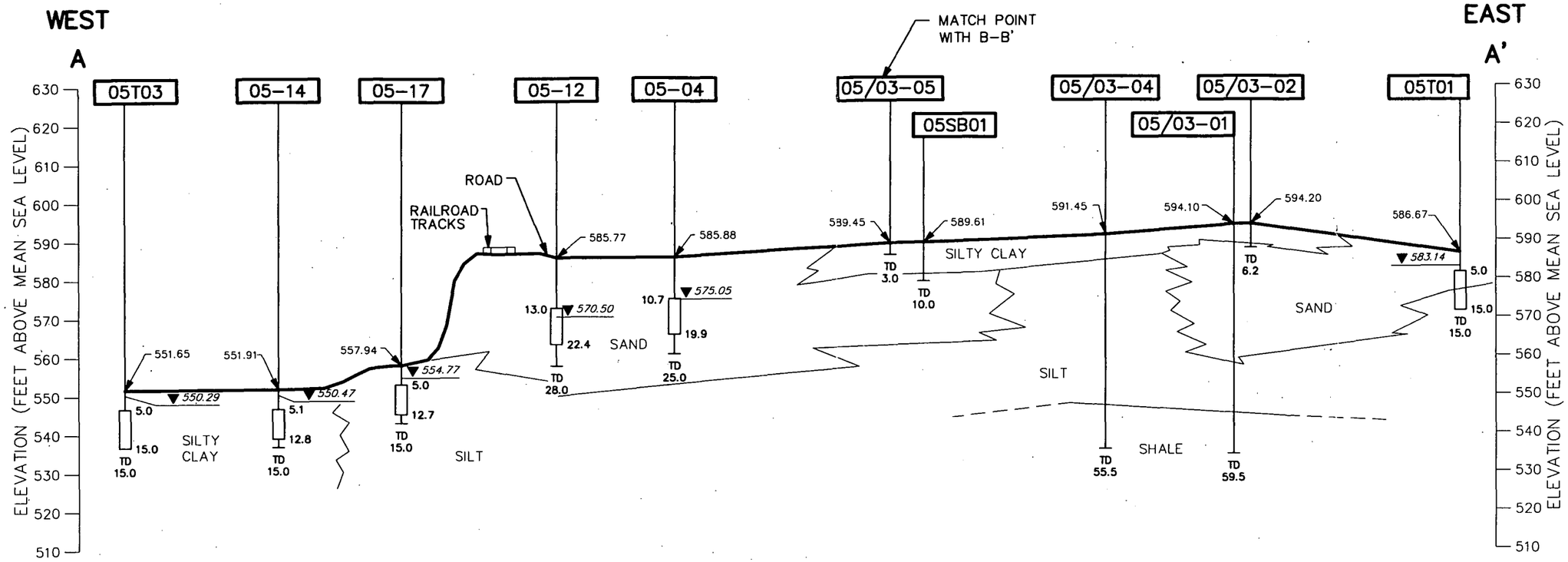
CROSS SECTION LOCATION MAP
SWMU 5 - OLD BURN PIT
NSWC CRANE, INDIANA

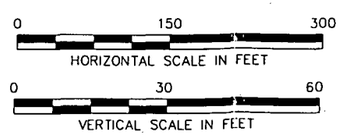
DRAWN BY K. PEILA DATE 5/21/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE: AS NOTED





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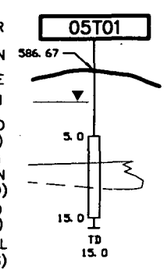

CONTRACT NO. 7141

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DRAWING NO. FIGURE 5-3

REV. 0

GEOLOGIC CROSS SECTION A-A'
SWMU 5 - OLD BURN PIT
NSWC CRANE, INDIANA

DEPARTMENT OF THE NAVY * SOUTHERN DIV. FACILITIES ENGINEERING COMD *

DRAWN BY HJB — DATE 5/7/02

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SCALE AS NOTED

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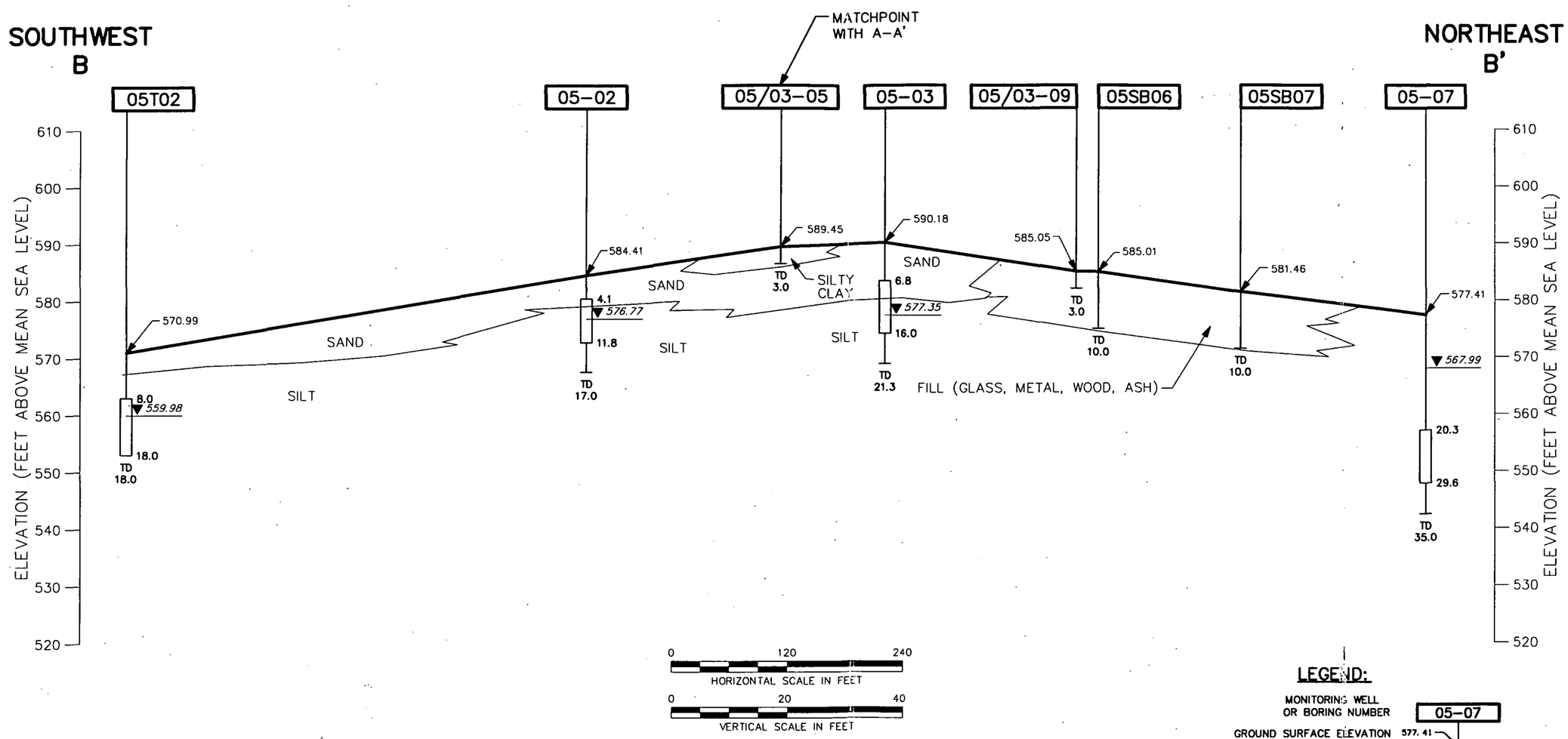

CONTRACT NO. 7141

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 5-4

REV. 0

GEOLOGIC CROSS SECTION B-B'
SWMU 5 - OLD BURN PIT
NSWC CRANE, INDIANA

DEPARTMENT OF THE NAVY * SOUTHERN DIV FACILITIES ENGINEERING COMD *

DRAWN BY HJB DATE 5/8/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

FORM CADD NO. SDIV_BV.DWG - REV 0 - 1/20/98

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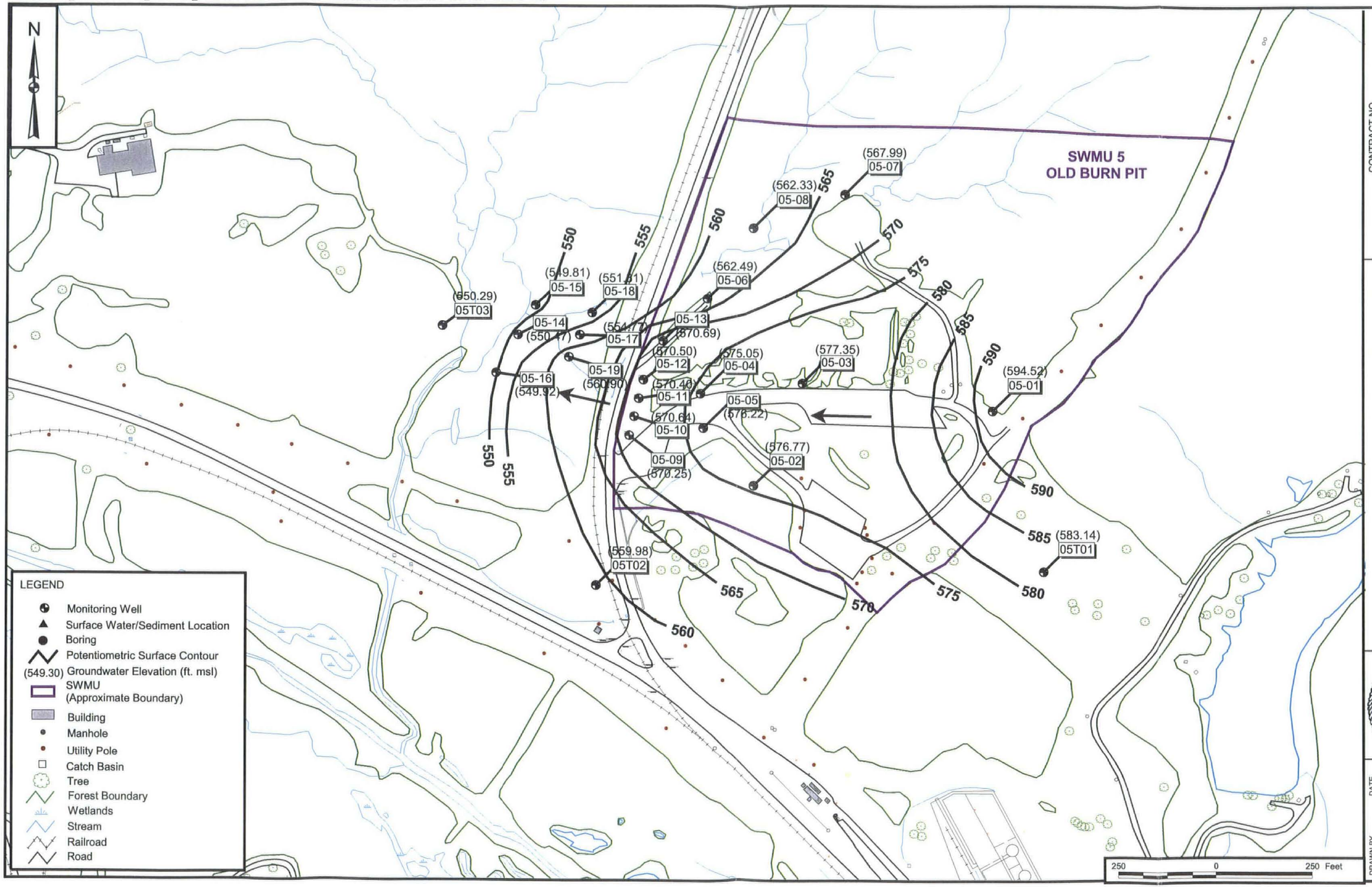

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DRAWING NO. FIGURE 5 - 5

REV ___

POTENTIOMETRIC SURFACE CONTOUR MAP (1-16-01)
SWMU 5 - OLD BURN PIT
NSWC CRANE, INDIANA

DEPARTMENT OF THE NAVY * SOUTHERN DIV FACILITIES ENGINEERING COMD *

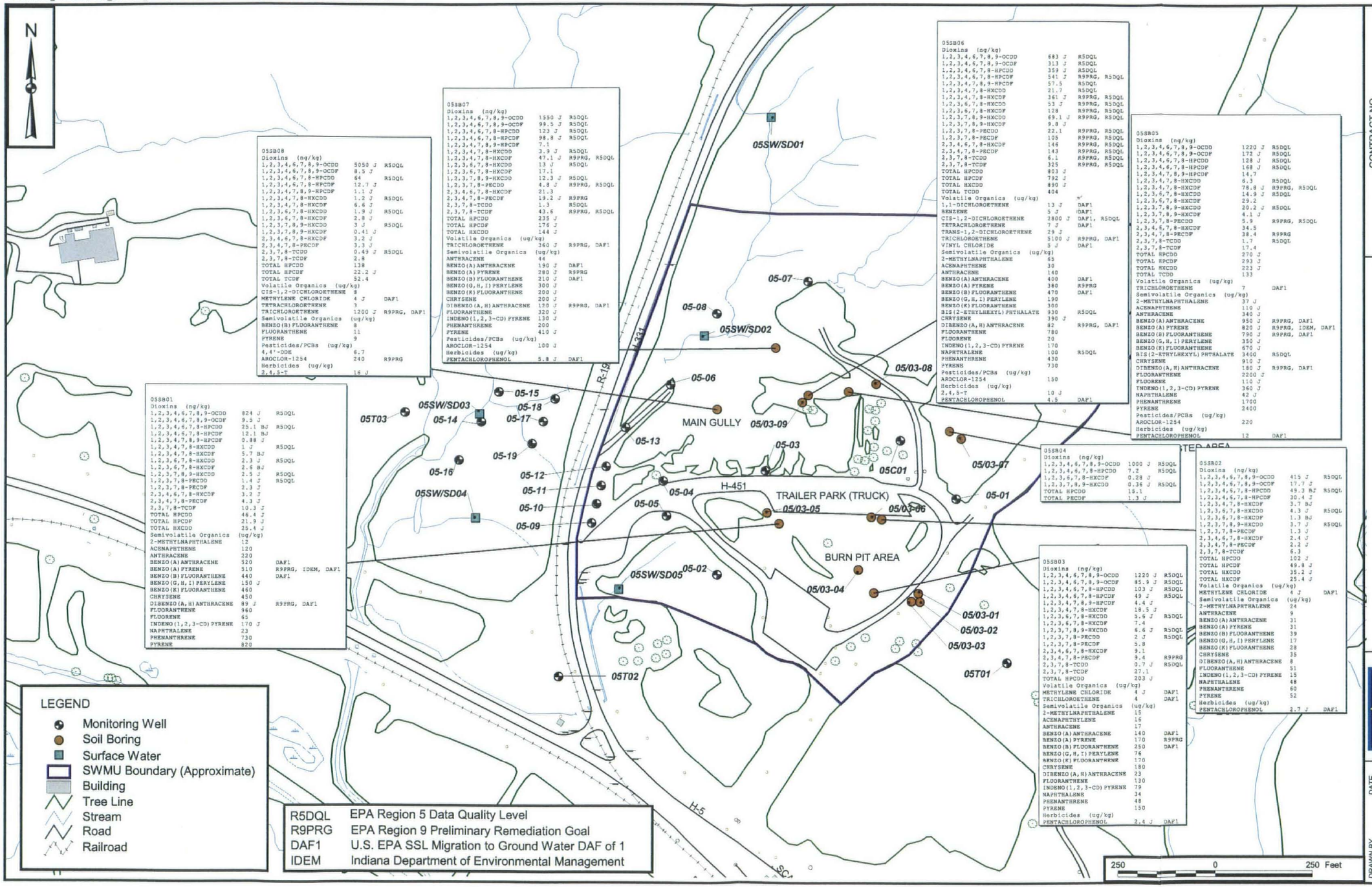
DRAWN BY K. PEILA — DATE 5/21/02

CHECKED BY — DATE

COST/SCHED-AREA

SCALE AS NOTED

P:\GIS\NSWC_CRANE\CTO-10_SWMU05_TAGS_R1.APR ORGANIC DETECTIONS IN SURFACE SOIL 7/07/05 AJ



05SB08
Dioxins (ng/kg)

1,2,3,4,6,7,8,9-OCDD	5050 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	8.5 J	
1,2,3,4,6,7,8-HPCDD	64	R5DQL
1,2,3,4,6,7,8-HPCDF	12.7 J	
1,2,3,4,7,8,9-HPCDF	1.1 J	
1,2,3,4,7,8-HXCDD	1.2 J	R5DQL
1,2,3,4,7,8-HXCDF	6.6 J	
1,2,3,6,7,8-HXCDD	1.9 J	R5DQL
1,2,3,6,7,8-HXCDF	2.8 J	
1,2,3,7,8,9-HXCDD	3 J	R5DQL
1,2,3,7,8,9-HXCDF	0.41 J	
2,3,4,6,7,8-HXCDF	3.2 J	
2,3,4,7,8-PECDF	3.3 J	
2,3,7,8-TCDD	0.49 J	R5DQL
2,3,7,8-TCDF	2.8	
TOTAL HPCDD	138	
TOTAL HPCDF	22.2 J	
TOTAL TCDF	52.4	
Volatile Organics (ug/kg)		
CIS-1,2-DICHLOROETHENE	8	
METHYLENE CHLORIDE	4 J	DAF1
TETRACHLOROETHENE	3	
TRICHLOROETHENE	1200 J	R9PRG, DAF1
Semivolatile Organics (ug/kg)		
BENZO(B)FLUORANTHENE	8	
FLUORANTHENE	11	
PYRENE	9	
Pesticides/PCBs (ug/kg)		
4,4'-DDE	6.7	
AROCLOR-1254	240	R9PRG
Herbicides (ug/kg)		
2,4,5-T	16 J	

05SB07
Dioxins (ng/kg)

1,2,3,4,6,7,8,9-OCDD	1350 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	99.5 J	R5DQL
1,2,3,4,6,7,8-HPCDD	123 J	R5DQL
1,2,3,4,6,7,8-HPCDF	98.8 J	R5DQL
1,2,3,4,7,8,9-HPCDF	7.1	
1,2,3,4,7,8-HXCDD	3.9 J	R5DQL
1,2,3,4,7,8-HXCDF	47.1 J	R9PRG, R5DQL
1,2,3,6,7,8-HXCDD	13 J	R5DQL
1,2,3,6,7,8-HXCDF	17.1	
1,2,3,7,8,9-HXCDD	12.3 J	R5DQL
1,2,3,7,8-PECDD	4.8 J	R9PRG, R5DQL
2,3,4,6,7,8-HXCDF	21.3	
2,3,4,7,8-PECDF	19.2 J	R9PRG
2,3,7,8-TCDD	1.3	R5DQL
2,3,7,8-TCDF	43.6	R9PRG, R5DQL
TOTAL HPCDD	235 J	
TOTAL HPCDF	176 J	
TOTAL HXCDD	144 J	
Volatile Organics (ug/kg)		
TRICHLOROETHENE	360 J	R9PRG, DAF1
Semivolatile Organics (ug/kg)		
ANTHRACENE	44	
BENZO(A)ANTHRACENE	190 J	DAF1
BENZO(A)PYRENE	280 J	R9PRG
BENZO(B)FLUORANTHENE	210 J	DAF1
BENZO(G,H,I)PERYLENE	300 J	
BENZO(K)FLUORANTHENE	200 J	
CHRYSENE	200 J	
DIBENZO(A,H)ANTHRACENE	120 J	R9PRG, DAF1
FLUORANTHENE	320 J	
INDENO(1,2,3-CD)PYRENE	130 J	
PHENANTHRENE	200	
PYRENE	410 J	
Pesticides/PCBs (ug/kg)		
AROCLOR-1254	100 J	
Herbicides (ug/kg)		
PENTACHLOROPHENOL	5.8 J	DAF1

05SB01
Dioxins (ng/kg)

1,2,3,4,6,7,8,9-OCDD	824 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	9.5 J	
1,2,3,4,6,7,8-HPCDD	25.1 BJ	R5DQL
1,2,3,4,6,7,8-HPCDF	12.1 BJ	
1,2,3,4,7,8,9-HPCDF	0.88 J	
1,2,3,4,7,8-HXCDD	1 J	R5DQL
1,2,3,4,7,8-HXCDF	5.7 BJ	
1,2,3,6,7,8-HXCDD	2.3 J	R5DQL
1,2,3,6,7,8-HXCDF	2.6 BJ	
1,2,3,7,8,9-HXCDD	2.5 J	R5DQL
1,2,3,7,8-PECDD	1.4 J	R5DQL
1,2,3,7,8-PECDF	2.3 J	
2,3,4,6,7,8-HXCDF	3.2 J	
2,3,4,7,8-PECDF	4.3 J	
2,3,7,8-TCDF	10.3 J	
TOTAL HPCDD	46.4 J	
TOTAL HPCDF	21.9 J	
TOTAL HXCDD	25.4 J	
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	12	
ACENAPHTHENE	120	
ANTHRACENE	220	
BENZO(A)ANTHRACENE	520	DAF1
BENZO(A)PYRENE	510	R9PRG, IDEM, DAF1
BENZO(B)FLUORANTHENE	440	DAF1
BENZO(G,H,I)PERYLENE	150 J	
BENZO(K)FLUORANTHENE	460	
CHRYSENE	450	
DIBENZO(A,H)ANTHRACENE	89 J	R9PRG, DAF1
FLUORANTHENE	960	
FLUORENE	65	
INDENO(1,2,3-CD)PYRENE	170 J	
NAPHTHALENE	23	
PHENANTHRENE	730	
PYRENE	820	

05SB06
Dioxins (ng/kg)

1,2,3,4,6,7,8,9-OCDD	683 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	313 J	R5DQL
1,2,3,4,6,7,8-HPCDD	359 J	R5DQL
1,2,3,4,6,7,8-HPCDF	541 J	R9PRG, R5DQL
1,2,3,4,7,8,9-HPCDF	57.5	R5DQL
1,2,3,4,7,8-HXCDD	21.7	R5DQL
1,2,3,4,7,8-HXCDF	361 J	R9PRG, R5DQL
1,2,3,6,7,8-HXCDD	53 J	R9PRG, R5DQL
1,2,3,6,7,8-HXCDF	128	R9PRG, R5DQL
1,2,3,7,8,9-HXCDD	69.1 J	R9PRG, R5DQL
1,2,3,7,8,9-HXCDF	9.8 J	
1,2,3,7,8-PECDD	22.1	R9PRG, R5DQL
1,2,3,7,8-PECDF	105	R9PRG, R5DQL
2,3,4,6,7,8-HXCDF	146	R9PRG, R5DQL
2,3,4,7,8-PECDF	143	R9PRG, R5DQL
2,3,7,8-TCDD	6.1	R9PRG, R5DQL
2,3,7,8-TCDF	325	R9PRG, R5DQL
TOTAL HPCDD	803 J	
TOTAL HPCDF	792 J	
TOTAL HXCDD	890 J	
TOTAL TCDD	404	
Volatile Organics (ug/kg)		
1,1-DICHLOROETHENE	13 J	DAF1
BENZENE	5 J	DAF1
CIS-1,2-DICHLOROETHENE	2800 J	DAF1, R5DQL
TETRACHLOROETHENE	7 J	DAF1
TRANS-1,2-DICHLOROETHENE	29 J	
TRICHLOROETHENE	5100 J	R9PRG, DAF1
VINYL CHLORIDE	5 J	DAF1
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	65	
ACENAPHTHENE	30	
ANTHRACENE	140	
BENZO(A)ANTHRACENE	400	DAF1
BENZO(A)PYRENE	380	R9PRG
BENZO(B)FLUORANTHENE	470	DAF1
BENZO(G,H,I)PERYLENE	190	
BENZO(K)FLUORANTHENE	300	
BIS(2-ETHYLHEXYL)PHTHALATE	930	R5DQL
CHRYSENE	390 J	
DIBENZO(A,H)ANTHRACENE	82	R9PRG, DAF1
FLUORANTHENE	780	
FLUORENE	20	
INDENO(1,2,3-CD)PYRENE	170	
NAPHTHALENE	100	R5DQL
PHENANTHRENE	430	
PYRENE	730	
Pesticides/PCBs (ug/kg)		
AROCLOR-1254	150	
Herbicides (ug/kg)		
2,4,5-T	10 J	
PENTACHLOROPHENOL	4.5	DAF1

05SB05
Dioxins (ng/kg)

1,2,3,4,6,7,8,9-OCDD	1220 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	172 J	R5DQL
1,2,3,4,6,7,8-HPCDD	128 J	R5DQL
1,2,3,4,6,7,8-HPCDF	168 J	R5DQL
1,2,3,4,7,8,9-HPCDF	14.7	
1,2,3,4,7,8-HXCDD	6.3	R5DQL
1,2,3,4,7,8-HXCDF	78.8 J	R9PRG, R5DQL
1,2,3,6,7,8-HXCDD	14.9 J	R5DQL
1,2,3,6,7,8-HXCDF	29.2	
1,2,3,7,8,9-HXCDD	20.2 J	R5DQL
1,2,3,7,8,9-HXCDF	4.1 J	
1,2,3,7,8-PECDD	5.9	R9PRG, R5DQL
2,3,4,6,7,8-HXCDF	34.5	
2,3,4,7,8-PECDF	38.4	R9PRG
2,3,7,8-TCDD	1.7	R5DQL
2,3,7,8-TCDF	17.4	
TOTAL HPCDD	270 J	
TOTAL HPCDF	293 J	
TOTAL HXCDD	223 J	
TOTAL TCDD	133	
Volatile Organics (ug/kg)		
TRICHLOROETHENE	7	DAF1
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	37 J	
ACENAPHTHENE	110 J	
ANTHRACENE	340 J	
BENZO(A)ANTHRACENE	950 J	R9PRG, DAF1
BENZO(A)PYRENE	820 J	R9PRG, IDEM, DAF1
BENZO(B)FLUORANTHENE	790 J	R9PRG, DAF1
BENZO(G,H,I)PERYLENE	350 J	
BENZO(K)FLUORANTHENE	670 J	
BIS(2-ETHYLHEXYL)PHTHALATE	3400	R5DQL
CHRYSENE	910 J	
DIBENZO(A,H)ANTHRACENE	180 J	R9PRG, DAF1
FLUORANTHENE	2200 J	
FLUORENE	110 J	
INDENO(1,2,3-CD)PYRENE	360 J	
NAPHTHALENE	42 J	
PHENANTHRENE	1700	
PYRENE	2400	
Pesticides/PCBs (ug/kg)		
AROCLOR-1254	220	
Herbicides (ug/kg)		
PENTACHLOROPHENOL	12	DAF1

05SB04
Dioxins (ng/kg)

1,2,3,4,6,7,8,9-OCDD	1000 J	R5DQL
1,2,3,4,6,7,8-HPCDD	7.2	R5DQL
1,2,3,6,7,8-HXCDF	0.28 J	
1,2,3,7,8,9-HXCDD	0.36 J	R5DQL
TOTAL HPCDD	15.1	
TOTAL PECDF	1.3 J	

05SB02
Dioxins (ng/kg)

1,2,3,4,6,7,8,9-OCDD	415 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	17.7 J	
1,2,3,4,6,7,8-HPCDD	49.3 BJ	R5DQL
1,2,3,4,6,7,8-HPCDF	30.4 J	
1,2,3,4,7,8-HXCDF	3.7 BJ	
1,2,3,6,7,8-HXCDD	4.3 J	R5DQL
1,2,3,6,7,8-HXCDF	1.3 BJ	
1,2,3,7,8,9-HXCDD	3.7 J	R5DQL
1,2,3,7,8-PECDF	1.3 J	
2,3,4,6,7,8-HXCDF	2.4 J	
2,3,4,7,8-PECDF	2.2 J	
2,3,7,8-TCDF	6.3	
TOTAL HPCDD	102 J	
TOTAL HPCDF	49.8 J	
TOTAL HXCDD	35.2 J	
TOTAL HXCDF	25.4 J	
Volatile Organics (ug/kg)		
METHYLENE CHLORIDE	4 J	DAF1
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	24	
ANTHRACENE	9	
BENZO(A)ANTHRACENE	31	
BENZO(A)PYRENE	31	
BENZO(B)FLUORANTHENE	39	
BENZO(G,H,I)PERYLENE	17	
BENZO(K)FLUORANTHENE	28	
CHRYSENE	35	
DIBENZO(A,H)ANTHRACENE	8	
FLUORANTHENE	51	
INDENO(1,2,3-CD)PYRENE	15	
NAPHTHALENE	48	
PHENANTHRENE	60	
PYRENE	52	
Herbicides (ug/kg)		
PENTACHLOROPHENOL	2.7 J	DAF1

05SB03
Dioxins (ng/kg)

1,2,3,4,6,7,8,9-OCDD	1220 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	85.9 J	R5DQL
1,2,3,4,6,7,8-HPCDD	103 J	R5DQL
1,2,3,4,6,7,8-HPCDF	49 J	R5DQL
1,2,3,4,7,8,9-HPCDF	4.4 J	
1,2,3,4,7,8-HXCDF	18.5 J	
1,2,3,6,7,8-HXCDD	5.6 J	R5DQL
1,2,3,6,7,8-HXCDF	7.4	
1,2,3,7,8,9-HXCDD	6.6 J	R5DQL
1,2,3,7,8-PECDD	2 J	R5DQL
1,2,3,7,8-PECDF	5.8	
2,3,4,6,7,8-HXCDF	9.1	
2,3,4,7,8-PECDF	9.4	R9PRG
2,3,7,8-TCDD	0.7 J	R5DQL
2,3,7,8-TCDF	27.1	
TOTAL HPCDD	203 J	
Volatile Organics (ug/kg)		
METHYLENE CHLORIDE	4 J	DAF1
TRICHLOROETHENE	4	DAF1
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	15	
ACENAPHTHYLENE	16	
ANTHRACENE	17	
BENZO(A)ANTHRACENE	140	DAF1
BENZO(A)PYRENE	170	R9PRG
BENZO(B)FLUORANTHENE	250	DAF1
BENZO(G,H,I)PERYLENE	76	
BENZO(K)FLUORANTHENE	170	
CHRYSENE	180	
DIBENZO(A,H)ANTHRACENE	23	
FLUORANTHENE	130	
INDENO(1,2,3-CD)PYRENE	79	
NAPHTHALENE	34	
PHENANTHRENE	48	
PYRENE	150	
Herbicides (ug/kg)		
PENTACHLOROPHENOL	2.4 J	DAF1

LEGEND
- Monitoring Well
- Soil Boring
- Surface Water
- SWMU Boundary (Approximate)
- Building
- Tree Line
- Stream
- Road
- Railroad

R5DQL	EPA Region 5 Data Quality Level
R9PRG	EPA Region 9 Preliminary Remediation Goal
DAF1	U.S. EPA SSL Migration to Ground Water DAF of 1
IDEM	Indiana Department of Environmental Management

CONTRACT NO. 7141

APPROVED BY ____ DATE ____

APPROVED BY ____ DATE ____

DRAWING NO. FIGURE 5 - 6 REV 1

ORGANIC DETECTIONS IN SURFACE SOIL
SWMU 5 - OLD BURN PIT
NAVAL SURFACE WARFARE CENTER CRANE, INDIANA

NAVFAC

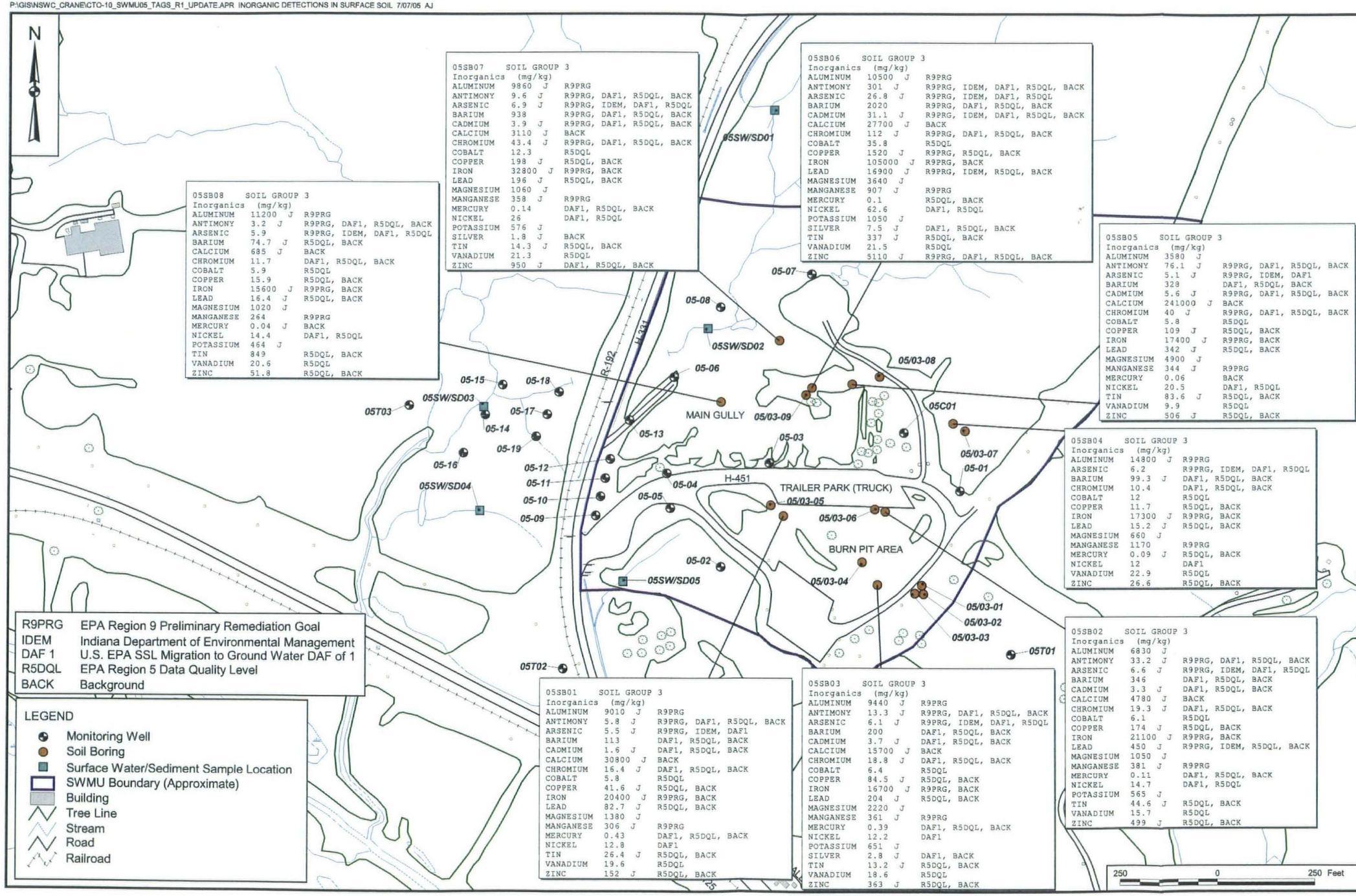
DRAWN BY J. LAMEY DATE 5/9/02

CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

P:\GIS\NSWC_CRANE\CTO-10_SWMU05_TAGS_R1_UPDATE.APR INORGANIC DETECTIONS IN SURFACE SOIL 7/07/05 AJ



05SB08 SOIL GROUP 3

Inorganics (mg/kg)		
ALUMINUM	11200 J	R9PRG
ANTIMONY	3.2 J	R9PRG, DAF1, R5DQL, BACK
ARSENIC	5.9	R9PRG, IDEM, DAF1, R5DQL
BARIUM	74.7 J	R5DQL, BACK
CALCIUM	685 J	BACK
CHROMIUM	11.7	DAF1, R5DQL, BACK
COBALT	5.9	R5DQL
COPPER	15.9	R5DQL, BACK
IRON	15600 J	R9PRG, BACK
LEAD	16.4 J	R5DQL, BACK
MAGNESIUM	1020 J	
MANGANESE	264	R9PRG
MERCURY	0.04 J	BACK
NICKEL	14.4	DAF1, R5DQL
POTASSIUM	464 J	
TIN	849	R5DQL, BACK
VANADIUM	20.6	R5DQL
ZINC	51.8	R5DQL, BACK

05SB07 SOIL GROUP 3

Inorganics (mg/kg)		
ALUMINUM	9860 J	R9PRG
ANTIMONY	9.6 J	R9PRG, DAF1, R5DQL, BACK
ARSENIC	6.9 J	R9PRG, IDEM, DAF1, R5DQL
BARIUM	938	R9PRG, DAF1, R5DQL, BACK
CADMIUM	3.9 J	R9PRG, DAF1, R5DQL, BACK
CALCIUM	3110 J	BACK
CHROMIUM	43.4 J	R9PRG, DAF1, R5DQL, BACK
COBALT	12.3	R5DQL
COPPER	198 J	R5DQL, BACK
IRON	32800 J	R9PRG, BACK
LEAD	196 J	R5DQL, BACK
MAGNESIUM	1060 J	
MANGANESE	358 J	R9PRG
MERCURY	0.14	DAF1, R5DQL, BACK
NICKEL	26	DAF1, R5DQL
POTASSIUM	576 J	
SILVER	1.8 J	BACK
TIN	14.3 J	R5DQL, BACK
VANADIUM	21.3	R5DQL
ZINC	950 J	DAF1, R5DQL, BACK

05SB06 SOIL GROUP 3

Inorganics (mg/kg)		
ALUMINUM	10500 J	R9PRG
ANTIMONY	301 J	R9PRG, IDEM, DAF1, R5DQL, BACK
ARSENIC	26.8 J	R9PRG, IDEM, DAF1, R5DQL
BARIUM	2020	R9PRG, DAF1, R5DQL, BACK
CADMIUM	31.1 J	R9PRG, IDEM, DAF1, R5DQL, BACK
CALCIUM	27700 J	BACK
CHROMIUM	112 J	R9PRG, DAF1, R5DQL, BACK
COBALT	35.8	R5DQL
COPPER	1520 J	R9PRG, R5DQL, BACK
IRON	105000 J	R9PRG, BACK
LEAD	16900 J	R9PRG, IDEM, R5DQL, BACK
MAGNESIUM	3640 J	
MANGANESE	907 J	R9PRG
MERCURY	0.1	R5DQL, BACK
NICKEL	62.6	DAF1, R5DQL
POTASSIUM	1050 J	
SILVER	7.5 J	DAF1, R5DQL, BACK
TIN	337 J	R5DQL, BACK
VANADIUM	21.5	R5DQL
ZINC	5110 J	R9PRG, DAF1, R5DQL, BACK

05SB05 SOIL GROUP 3

Inorganics (mg/kg)		
ALUMINUM	3580 J	
ANTIMONY	76.1 J	R9PRG, DAF1, R5DQL, BACK
ARSENIC	5.1 J	R9PRG, IDEM, DAF1
BARIUM	328	DAF1, R5DQL, BACK
CADMIUM	5.6 J	R9PRG, DAF1, R5DQL, BACK
CALCIUM	241000 J	BACK
CHROMIUM	40 J	R9PRG, DAF1, R5DQL, BACK
COBALT	5.8	R5DQL
COPPER	109 J	R5DQL, BACK
IRON	17400 J	R9PRG, BACK
LEAD	342 J	R5DQL, BACK
MAGNESIUM	4900 J	
MANGANESE	344 J	R9PRG
MERCURY	0.06	BACK
NICKEL	20.5	DAF1, R5DQL
TIN	83.6 J	R5DQL, BACK
VANADIUM	9.9	R5DQL
ZINC	506 J	R5DQL, BACK

05SB04 SOIL GROUP 3

Inorganics (mg/kg)		
ALUMINUM	14800 J	R9PRG
ARSENIC	6.2	R9PRG, IDEM, DAF1, R5DQL
BARIUM	99.3 J	DAF1, R5DQL, BACK
CHROMIUM	10.4	DAF1, R5DQL, BACK
COBALT	12	R5DQL
COPPER	11.7	R5DQL, BACK
IRON	17300 J	R9PRG, BACK
LEAD	15.2 J	R5DQL, BACK
MAGNESIUM	660 J	
MANGANESE	1170	R9PRG
MERCURY	0.09 J	R5DQL, BACK
NICKEL	12	DAF1
VANADIUM	22.9	R5DQL
ZINC	26.6	R5DQL, BACK

05SB02 SOIL GROUP 3

Inorganics (mg/kg)		
ALUMINUM	6830 J	
ANTIMONY	33.2 J	R9PRG, DAF1, R5DQL, BACK
ARSENIC	6.6 J	R9PRG, IDEM, DAF1, R5DQL
BARIUM	346	DAF1, R5DQL, BACK
CADMIUM	3.3 J	DAF1, R5DQL, BACK
CALCIUM	4780 J	BACK
CHROMIUM	19.3 J	DAF1, R5DQL, BACK
COBALT	6.1	R5DQL
COPPER	174 J	R5DQL, BACK
IRON	21100 J	R9PRG, BACK
LEAD	450 J	R9PRG, IDEM, R5DQL, BACK
MAGNESIUM	1050 J	
MANGANESE	381 J	R9PRG
MERCURY	0.11	DAF1, R5DQL, BACK
NICKEL	14.7	DAF1, R5DQL
POTASSIUM	565 J	
TIN	44.6 J	R5DQL, BACK
VANADIUM	15.7	R5DQL
ZINC	499 J	R5DQL, BACK

05SB01 SOIL GROUP 3

Inorganics (mg/kg)		
ALUMINUM	9010 J	R9PRG
ANTIMONY	5.8 J	R9PRG, DAF1, R5DQL, BACK
ARSENIC	5.5 J	R9PRG, IDEM, DAF1
BARIUM	113	DAF1, R5DQL, BACK
CADMIUM	1.6 J	DAF1, R5DQL, BACK
CALCIUM	30800 J	BACK
CHROMIUM	16.4 J	DAF1, R5DQL, BACK
COBALT	5.8	R5DQL
COPPER	41.6 J	R5DQL, BACK
IRON	20400 J	R9PRG, BACK
LEAD	82.7 J	R5DQL, BACK
MAGNESIUM	1380 J	
MANGANESE	306 J	R9PRG
MERCURY	0.43	DAF1, R5DQL, BACK
NICKEL	12.8	DAF1
TIN	26.4 J	R5DQL, BACK
VANADIUM	19.6	R5DQL
ZINC	152 J	R5DQL, BACK

05SB03 SOIL GROUP 3

Inorganics (mg/kg)		
ALUMINUM	9440 J	R9PRG
ANTIMONY	13.3 J	R9PRG, DAF1, R5DQL, BACK
ARSENIC	6.1 J	R9PRG, IDEM, DAF1, R5DQL
BARIUM	200	DAF1, R5DQL, BACK
CADMIUM	3.7 J	DAF1, R5DQL, BACK
CALCIUM	15700 J	BACK
CHROMIUM	18.8 J	DAF1, R5DQL, BACK
COBALT	6.4	R5DQL
COPPER	84.5 J	R5DQL, BACK
IRON	16700 J	R9PRG, BACK
LEAD	204 J	R5DQL, BACK
MAGNESIUM	2220 J	
MANGANESE	361 J	R9PRG
MERCURY	0.39	DAF1, R5DQL, BACK
NICKEL	12.2	DAF1
POTASSIUM	651 J	
SILVER	2.8 J	DAF1, BACK
TIN	13.2 J	R5DQL, BACK
VANADIUM	18.6	R5DQL
ZINC	363 J	R5DQL, BACK

R9PRG	EPA Region 9 Preliminary Remediation Goal
IDEM	Indiana Department of Environmental Management
DAF 1	U.S. EPA SSL Migration to Ground Water DAF of 1
R5DQL	EPA Region 5 Data Quality Level
BACK	Background

LEGEND

- Monitoring Well
- Soil Boring
- Surface Water/Sediment Sample Location
- SWMU Boundary (Approximate)
- Building
- Tree Line
- Stream
- Road
- Railroad

CONTRACT NO. 7141

APPROVED BY ___ DATE ___

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DRAWING NO. ___ FIGURE 5 - 7 REV 1

INORGANIC DETECTIONS IN SURFACE SOIL
SWMU 5 - OLD BURN PIT
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMEY DATE 5/9/02

CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

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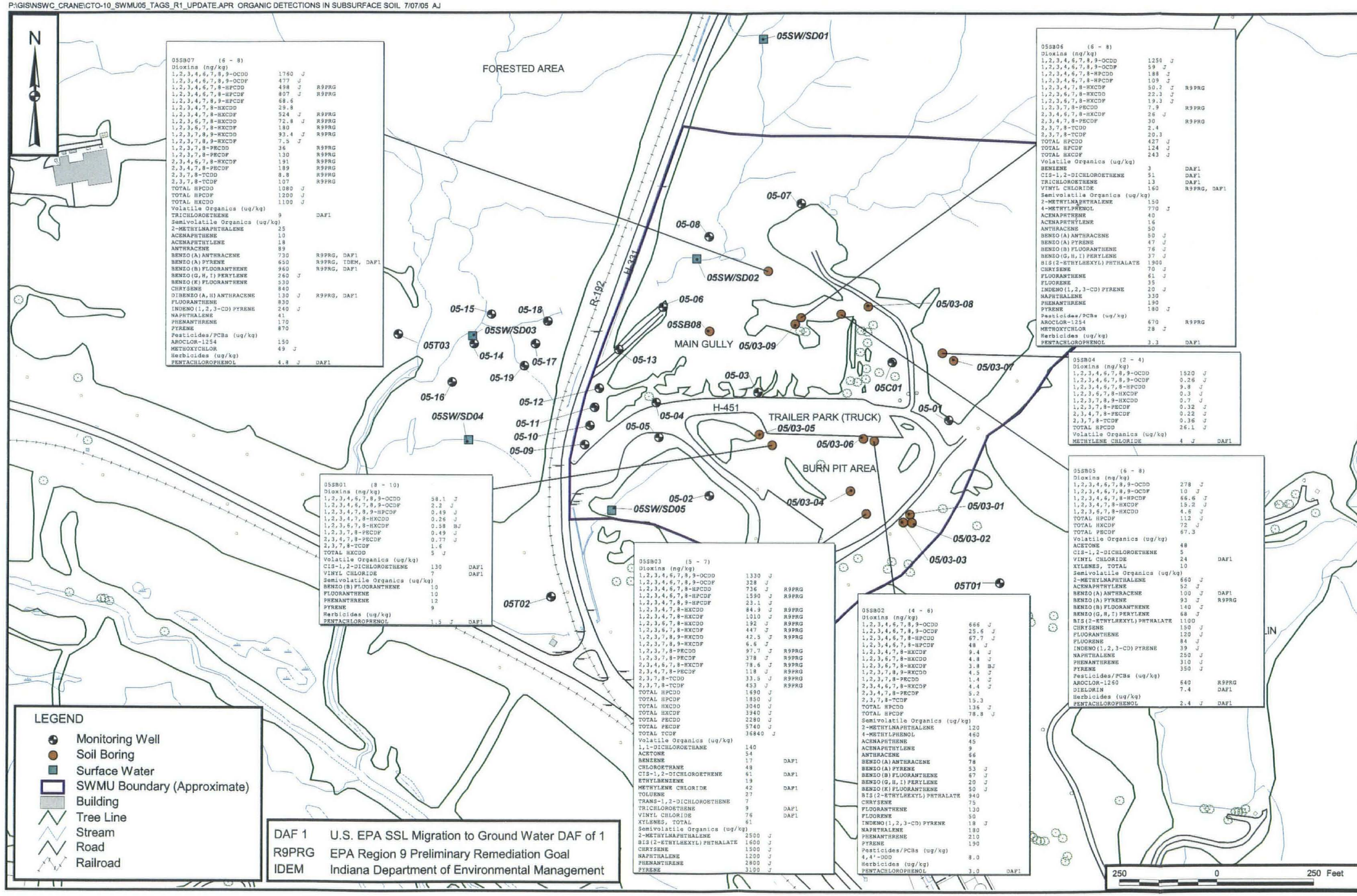

05SB07 (6 - 8)

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	1760 J	
1,2,3,4,6,7,8,9-OCDF	477 J	
1,2,3,4,6,7,8-HPCDD	498 J	R9PRG
1,2,3,4,6,7,8-HPCDF	807 J	R9PRG
1,2,3,4,7,8,9-HPCDF	68.6	
1,2,3,4,7,8-HXCDD	29.8	
1,2,3,4,7,8-HXCDF	524 J	R9PRG
1,2,3,6,7,8-HXCDD	72.8 J	R9PRG
1,2,3,6,7,8-HXCDF	180	R9PRG
1,2,3,7,8,9-HXCDD	93.4 J	R9PRG
1,2,3,7,8,9-HXCDF	7.5 J	
1,2,3,7,8-PECDD	36	R9PRG
1,2,3,7,8-PECDF	130	R9PRG
2,3,4,6,7,8-HXCDF	191	R9PRG
2,3,4,7,8-PECDF	189	R9PRG
2,3,7,8-TCDD	8.8	R9PRG
2,3,7,8-TCDF	107	R9PRG
TOTAL HPCDD	1080 J	
TOTAL HPCDF	1200 J	
TOTAL HXCDD	1100 J	
Volatile Organics (ug/kg)		
TRICHLOROETHENE	9	DAF1
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	25	
ACENAPHTHENE	10	
ACENAPHTHYLENE	18	
ANTHRACENE	89	
BENZO(A)ANTHRACENE	730	R9PRG, DAF1
BENZO(A)PYRENE	650	R9PRG, IDEM, DAF1
BENZO(B)FLUORANTHENE	960	R9PRG, DAF1
BENZO(G,H,I)PERYLENE	260 J	
BENZO(K)FLUORANTHENE	530	
CHRYSENE	840	
DIBENZO(A,H)ANTHRACENE	130 J	R9PRG, DAF1
FLUORANTHENE	830	
INDENO(1,2,3-CD)PYRENE	240 J	
NAPHTHALENE	41	
PHENANTHRENE	170	
PYRENE	870	
Pesticides/PCBs (ug/kg)		
AROCLOR-1254	150	
METHOXYCHLOR	49 J	
Herbicides (ug/kg)		
PENTACHLOROPHENOL	4.8 J	DAF1

05SB06 (6 - 8)

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	1250 J	
1,2,3,4,6,7,8,9-OCDF	59 J	
1,2,3,4,6,7,8-HPCDD	188 J	
1,2,3,4,6,7,8-HPCDF	109 J	
1,2,3,4,7,8-HXCDF	50.2 J	R9PRG
1,2,3,6,7,8-HXCDD	22.3 J	
1,2,3,6,7,8-HXCDF	19.3 J	
1,2,3,7,8-PECDD	7.9	R9PRG
2,3,4,6,7,8-HXCDF	26 J	
2,3,4,7,8-PECDF	30	R9PRG
2,3,7,8-TCDD	2.4	
2,3,7,8-TCDF	20.3	
TOTAL HPCDD	427 J	
TOTAL HPCDF	124 J	
TOTAL HXCDF	243 J	
Volatile Organics (ug/kg)		
BENZENE	3	DAF1
CIS-1,2-DICHLOROETHENE	51	DAF1
TRICHLOROETHENE	13	DAF1
VINYL CHLORIDE	160	R9PRG, DAF1
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	150	
4-METHYLPHENOL	770 J	
ACENAPHTHENE	40	
ACENAPHTHYLENE	16	
ANTHRACENE	50	
BENZO(A)ANTHRACENE	50 J	
BENZO(A)PYRENE	47 J	
BENZO(B)FLUORANTHENE	76 J	
BENZO(G,H,I)PERYLENE	37 J	
BIS(2-ETHYLHEXYL)PHTHALATE	1900	
CHRYSENE	70 J	
FLUORANTHENE	61 J	
FLUORENE	35	
INDENO(1,2,3-CD)PYRENE	20 J	
NAPHTHALENE	330	
PHENANTHRENE	190	
PYRENE	180 J	
Pesticides/PCBs (ug/kg)		
AROCLOR-1254	670	R9PRG
METHOXYCHLOR	28 J	
Herbicides (ug/kg)		
PENTACHLOROPHENOL	3.3	DAF1

05SB04 (2 - 4)

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	1520 J	
1,2,3,4,6,7,8,9-OCDF	0.26 J	
1,2,3,4,6,7,8-HPCDD	9.8 J	
1,2,3,6,7,8-HXCDF	0.3 J	
1,2,3,7,8,9-HXCDD	0.7 J	
1,2,3,7,8-PECDF	0.32 J	
2,3,4,7,8-PECDF	0.22 J	
2,3,7,8-TCDF	0.36 J	
TOTAL HPCDD	26.1 J	
Volatile Organics (ug/kg)		
METHYLENE CHLORIDE	4 J	DAF1

05SB05 (6 - 8)

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	278 J	
1,2,3,4,6,7,8,9-OCDF	10 J	
1,2,3,4,6,7,8-HPCDF	66.6 J	
1,2,3,4,7,8-HXCDF	15.2 J	
1,2,3,6,7,8-HXCDD	4.8 J	
TOTAL HPCDF	112 J	
TOTAL HXCDF	72 J	
TOTAL PECDF	67.3	
Volatile Organics (ug/kg)		
ACETONE	48	
CIS-1,2-DICHLOROETHENE	5	
VINYL CHLORIDE	24	DAF1
XYLENES, TOTAL	10	
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	660 J	
ACENAPHTHYLENE	52 J	
BENZO(A)ANTHRACENE	100 J	DAF1
BENZO(A)PYRENE	93 J	R9PRG
BENZO(B)FLUORANTHENE	140 J	
BENZO(G,H,I)PERYLENE	68 J	
BIS(2-ETHYLHEXYL)PHTHALATE	1100	
CHRYSENE	150 J	
FLUORANTHENE	120 J	
FLUORENE	84 J	
INDENO(1,2,3-CD)PYRENE	39 J	
NAPHTHALENE	250 J	
PHENANTHRENE	310 J	
PYRENE	350 J	
Pesticides/PCBs (ug/kg)		
AROCLOR-1260	640	R9PRG
DIELDRIN	7.4	DAF1
Herbicides (ug/kg)		
PENTACHLOROPHENOL	2.4 J	DAF1

05SB01 (8 - 10)

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	58.1 J	
1,2,3,4,6,7,8,9-OCDF	2.2 J	
1,2,3,4,7,8,9-HPCDF	0.49 J	
1,2,3,4,7,8-HXCDD	0.26 J	
1,2,3,6,7,8-HXCDF	0.58 BJ	
1,2,3,7,8-PECDF	0.49 J	
2,3,4,7,8-PECDF	0.77 J	
2,3,7,8-TCDF	1.6	
TOTAL HXCDD	5 J	
Volatile Organics (ug/kg)		
CIS-1,2-DICHLOROETHENE	130	DAF1
VINYL CHLORIDE	7	DAF1
Semivolatile Organics (ug/kg)		
BENZO(B)FLUORANTHENE	10	
FLUORANTHENE	10	
PHENANTHRENE	12	
PYRENE	9	
Herbicides (ug/kg)		
PENTACHLOROPHENOL	1.5 J	DAF1

05SB03 (5 - 7)

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	1330 J	
1,2,3,4,6,7,8,9-OCDF	328 J	
1,2,3,4,6,7,8-HPCDD	736 J	R9PRG
1,2,3,4,6,7,8-HPCDF	1590 J	R9PRG
1,2,3,4,7,8,9-HPCDF	23.1 J	
1,2,3,4,7,8-HXCDD	84.9 J	R9PRG
1,2,3,4,7,8-HXCDF	1010 J	R9PRG
1,2,3,6,7,8-HXCDD	192 J	R9PRG
1,2,3,6,7,8-HXCDF	447 J	R9PRG
1,2,3,7,8,9-HXCDD	42.5 J	R9PRG
1,2,3,7,8,9-HXCDF	6.6 J	
1,2,3,7,8-PECDD	97.7 J	R9PRG
1,2,3,7,8-PECDF	378 J	R9PRG
2,3,4,6,7,8-HXCDF	78.6 J	R9PRG
2,3,4,7,8-PECDF	118 J	R9PRG
2,3,7,8-TCDD	33.5 J	R9PRG
2,3,7,8-TCDF	453 J	R9PRG
TOTAL HPCDD	1690 J	
TOTAL HPCDF	1850 J	
TOTAL HXCDD	3040 J	
TOTAL HXCDF	3940 J	
TOTAL PECDD	2280 J	
TOTAL PECDF	5740 J	
TOTAL TCDF	36840 J	
Volatile Organics (ug/kg)		
1,1-DICHLOROETHANE	140	
ACETONE	54	
BENZENE	17	DAF1
CHLOROETHANE	48	
CIS-1,2-DICHLOROETHENE	61	DAF1
ETHYLBENZENE	19	
METHYLENE CHLORIDE	42	DAF1
TOLUENE	27	
TRANS-1,2-DICHLOROETHENE	7	
TRICHLOROETHENE	9	DAF1
VINYL CHLORIDE	76	DAF1
XYLENES, TOTAL	61	
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	2500 J	
BIS(2-ETHYLHEXYL)PHTHALATE	1600 J	
CHRYSENE	1500 J	
NAPHTHALENE	1200 J	
PHENANTHRENE	2800 J	
PYRENE	3100 J	

05SB02 (4 - 6)

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	666 J	
1,2,3,4,6,7,8,9-OCDF	25.6 J	
1,2,3,4,6,7,8-HPCDD	67.7 J	
1,2,3,4,6,7,8-HPCDF	48 J	
1,2,3,4,7,8-HXCDF	9.4 J	
1,2,3,6,7,8-HXCDD	4.8 J	
1,2,3,6,7,8-HXCDF	3.8 BJ	
1,2,3,7,8,9-HXCDD	4.5 J	
1,2,3,7,8-PECDD	1.4 J	
2,3,4,6,7,8-HXCDF	4.4 J	
2,3,4,7,8-PECDF	5.2	
2,3,7,8-TCDF	15.3	
TOTAL HPCDD	136 J	
TOTAL HPCDF	78.8 J	
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	120	
4-METHYLPHENOL	460	
ACENAPHTHENE	45	
ACENAPHTHYLENE	9	
ANTHRACENE	66	
BENZO(A)ANTHRACENE	78	
BENZO(A)PYRENE	53 J	
BENZO(B)FLUORANTHENE	67 J	
BENZO(G,H,I)PERYLENE	20 J	
BENZO(K)FLUORANTHENE	50 J	
BIS(2-ETHYLHEXYL)PHTHALATE	940	
CHRYSENE	75	
FLUORANTHENE	130	
FLUORENE	50	
INDENO(1,2,3-CD)PYRENE	18 J	
NAPHTHALENE	180	
PHENANTHRENE	210	
PYRENE	190	
Pesticides/PCBs (ug/kg)		
4,4'-DDD	8.0	
Herbicides (ug/kg)		
PENTACHLOROPHENOL	3.0	DAF1

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DRAWING NO. FIGURE 5 - 8

REV 1

ORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 5 - OLD BURN PIT
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMEY DATE 5/9/02

CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

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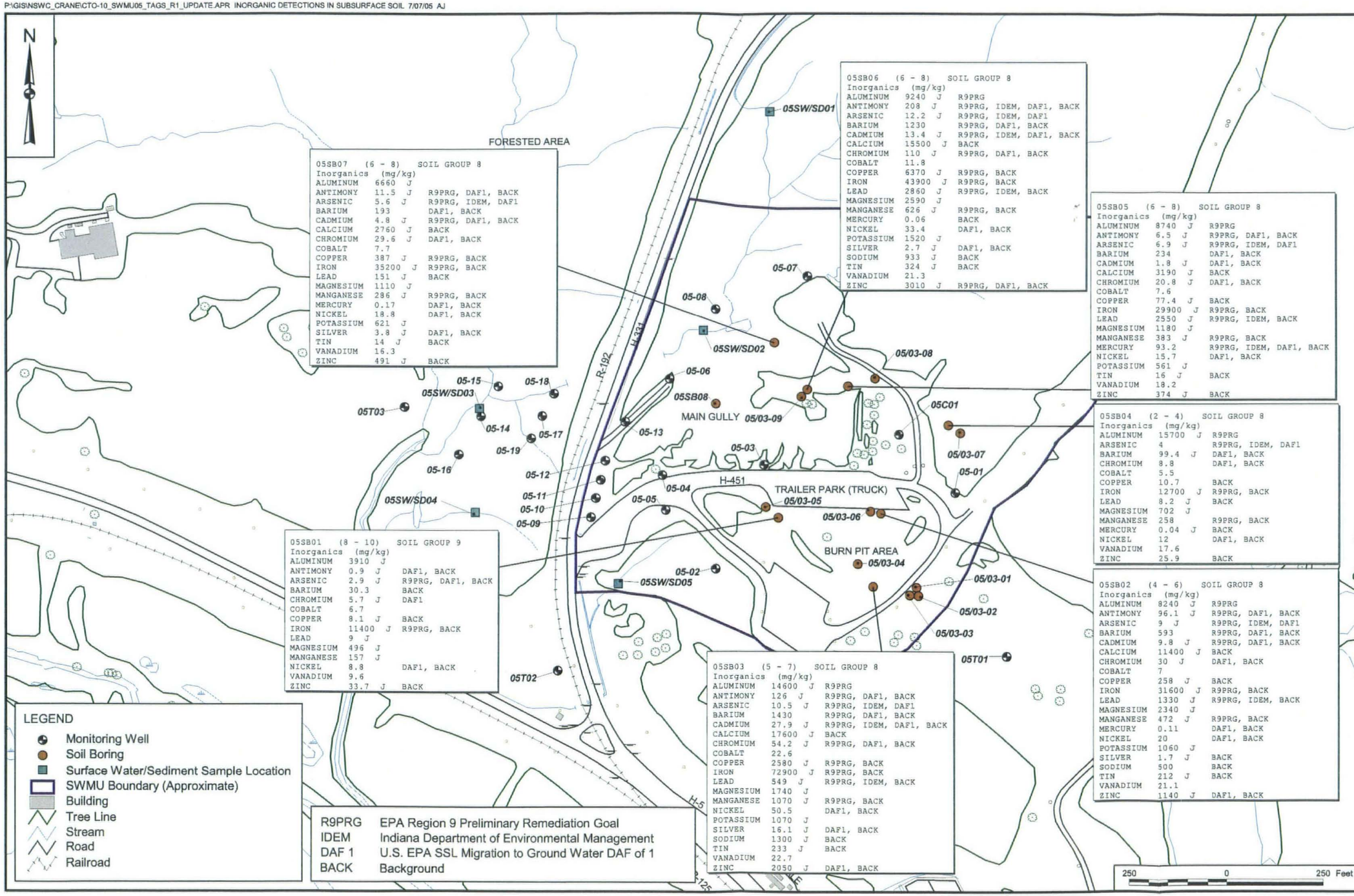

05SB07 (6 - 8) SOIL GROUP 8

Inorganics (mg/kg)			
ALUMINUM	6660	J	
ANTIMONY	11.5	J	R9PRG, DAF1, BACK
ARSENIC	5.6	J	R9PRG, IDEM, DAF1
BARIUM	193		DAF1, BACK
CADMIUM	4.8	J	R9PRG, DAF1, BACK
CALCIUM	2760	J	BACK
CHROMIUM	29.6	J	DAF1, BACK
COBALT	7.7		
COPPER	387	J	R9PRG, BACK
IRON	35200	J	R9PRG, BACK
LEAD	151	J	BACK
MAGNESIUM	1110	J	
MANGANESE	286	J	R9PRG, BACK
MERCURY	0.17		DAF1, BACK
NICKEL	18.8		DAF1, BACK
POTASSIUM	621	J	
SILVER	3.8	J	DAF1, BACK
TIN	14	J	BACK
VANADIUM	16.3		
ZINC	491	J	BACK

05SB06 (6 - 8) SOIL GROUP 8

Inorganics (mg/kg)			
ALUMINUM	9240	J	R9PRG
ANTIMONY	208	J	R9PRG, IDEM, DAF1, BACK
ARSENIC	12.2	J	R9PRG, IDEM, DAF1
BARIUM	1230		R9PRG, DAF1, BACK
CADMIUM	13.4	J	R9PRG, IDEM, DAF1, BACK
CALCIUM	15500	J	BACK
CHROMIUM	110	J	R9PRG, DAF1, BACK
COBALT	11.8		
COPPER	6370	J	R9PRG, BACK
IRON	43900	J	R9PRG, BACK
LEAD	2860	J	R9PRG, IDEM, BACK
MAGNESIUM	2590	J	
MANGANESE	626	J	R9PRG, BACK
MERCURY	0.06		BACK
NICKEL	33.4		DAF1, BACK
POTASSIUM	1520	J	
SILVER	2.7	J	DAF1, BACK
SODIUM	933	J	BACK
TIN	324	J	BACK
VANADIUM	21.3		
ZINC	3010	J	R9PRG, DAF1, BACK

05SB05 (6 - 8) SOIL GROUP 8

Inorganics (mg/kg)			
ALUMINUM	8740	J	R9PRG
ANTIMONY	6.5	J	R9PRG, DAF1, BACK
ARSENIC	6.9	J	R9PRG, IDEM, DAF1
BARIUM	234		DAF1, BACK
CADMIUM	1.8	J	DAF1, BACK
CALCIUM	3190	J	BACK
CHROMIUM	20.8	J	DAF1, BACK
COBALT	7.6		
COPPER	77.4	J	BACK
IRON	29900	J	R9PRG, BACK
LEAD	2550	J	R9PRG, IDEM, BACK
MAGNESIUM	1180	J	
MANGANESE	383	J	R9PRG, BACK
MERCURY	93.2		R9PRG, IDEM, DAF1, BACK
NICKEL	15.7		DAF1, BACK
POTASSIUM	561	J	
TIN	16	J	BACK
VANADIUM	18.2		
ZINC	374	J	BACK

05SB04 (2 - 4) SOIL GROUP 8

Inorganics (mg/kg)			
ALUMINUM	15700	J	R9PRG
ARSENIC	4		R9PRG, IDEM, DAF1
BARIUM	99.4	J	DAF1, BACK
CHROMIUM	8.8		DAF1, BACK
COBALT	5.5		
COPPER	10.7		BACK
IRON	12700	J	R9PRG, BACK
LEAD	8.2	J	BACK
MAGNESIUM	702	J	
MANGANESE	258		R9PRG, BACK
MERCURY	0.04	J	BACK
NICKEL	12		DAF1, BACK
VANADIUM	17.6		
ZINC	25.9		BACK

05SB01 (8 - 10) SOIL GROUP 9

Inorganics (mg/kg)			
ALUMINUM	3910	J	
ANTIMONY	0.9	J	DAF1, BACK
ARSENIC	2.9	J	R9PRG, DAF1, BACK
BARIUM	30.3		BACK
CHROMIUM	5.7	J	DAF1
COBALT	6.7		
COPPER	8.1	J	BACK
IRON	11400	J	R9PRG, BACK
LEAD	9	J	
MAGNESIUM	496	J	
MANGANESE	157	J	
NICKEL	8.8		DAF1, BACK
VANADIUM	9.6		
ZINC	33.7	J	BACK

05SB03 (5 - 7) SOIL GROUP 8

Inorganics (mg/kg)			
ALUMINUM	14600	J	R9PRG
ANTIMONY	126	J	R9PRG, DAF1, BACK
ARSENIC	10.5	J	R9PRG, IDEM, DAF1
BARIUM	1430		R9PRG, DAF1, BACK
CADMIUM	27.9	J	R9PRG, IDEM, DAF1, BACK
CALCIUM	17600	J	BACK
CHROMIUM	54.2	J	R9PRG, DAF1, BACK
COBALT	22.6		
COPPER	2580	J	R9PRG, BACK
IRON	72900	J	R9PRG, BACK
LEAD	549	J	R9PRG, IDEM, BACK
MAGNESIUM	1740	J	
MANGANESE	1070	J	R9PRG, BACK
NICKEL	50.5		DAF1, BACK
POTASSIUM	1070	J	
SILVER	16.1	J	DAF1, BACK
SODIUM	1300	J	BACK
TIN	233	J	BACK
VANADIUM	22.7		
ZINC	2050	J	DAF1, BACK

05SB02 (4 - 6) SOIL GROUP 8

Inorganics (mg/kg)			
ALUMINUM	8240	J	R9PRG
ANTIMONY	96.1	J	R9PRG, DAF1, BACK
ARSENIC	9	J	R9PRG, IDEM, DAF1
BARIUM	593		R9PRG, DAF1, BACK
CADMIUM	9.8	J	R9PRG, DAF1, BACK
CALCIUM	11400	J	BACK
CHROMIUM	30	J	DAF1, BACK
COBALT	7		
COPPER	258	J	BACK
IRON	31600	J	R9PRG, BACK
LEAD	1330	J	R9PRG, IDEM, BACK
MAGNESIUM	2340	J	
MANGANESE	472	J	R9PRG, BACK
MERCURY	0.11		DAF1, BACK
NICKEL	20		DAF1, BACK
POTASSIUM	1060	J	
SILVER	1.7	J	BACK
SODIUM	500		BACK
TIN	212	J	BACK
VANADIUM	21.1		
ZINC	1140	J	DAF1, BACK

LEGEND

- Monitoring Well
- Soil Boring
- Surface Water/Sediment Sample Location
- SWMU Boundary (Approximate)
- Building
- Tree Line
- Stream
- Road
- Railroad

R9PRG	EPA Region 9 Preliminary Remediation Goal
IDEM	Indiana Department of Environmental Management
DAF 1	U.S. EPA SSL Migration to Ground Water DAF of 1
BACK	Background

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DRAWING NO. FIGURE 5 - 9

REV 1

INORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 5 - OLD BURN PIT
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

NAVFAC

	DATE
DRAWN BY J. LAMEY	5/9/02
CHECKED BY T. JOHNSTON	7/15/05
COST/SCHED-AREA	
SCALE	AS NOTED

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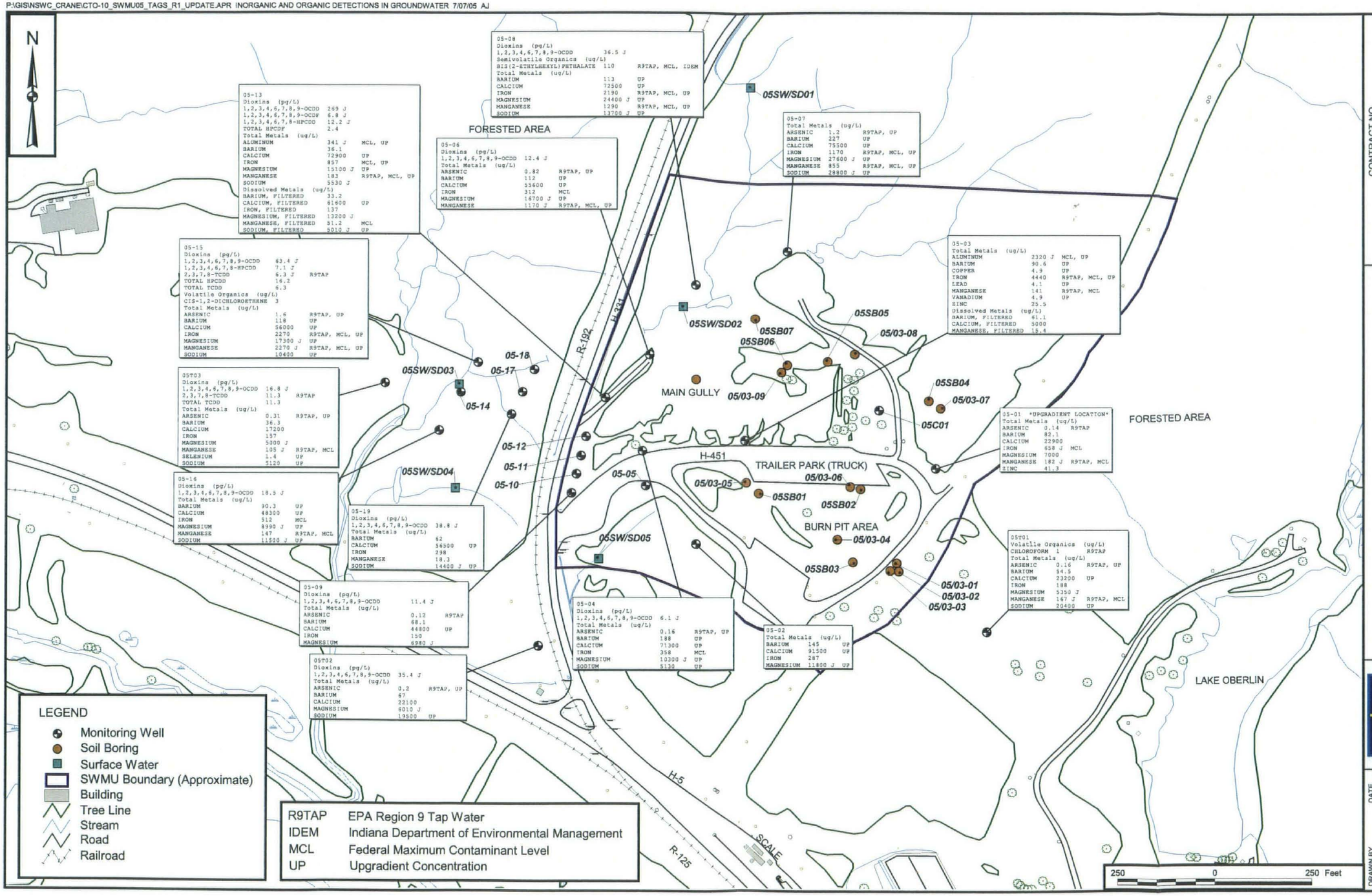

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DRAWING NO. FIGURE 5 - 10

REV 1

INORGANIC AND ORGANIC DETECTIONS IN GROUND WATER
SWMU 5 - OLD BURN PIT
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMEY DATE 5/9/02

CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

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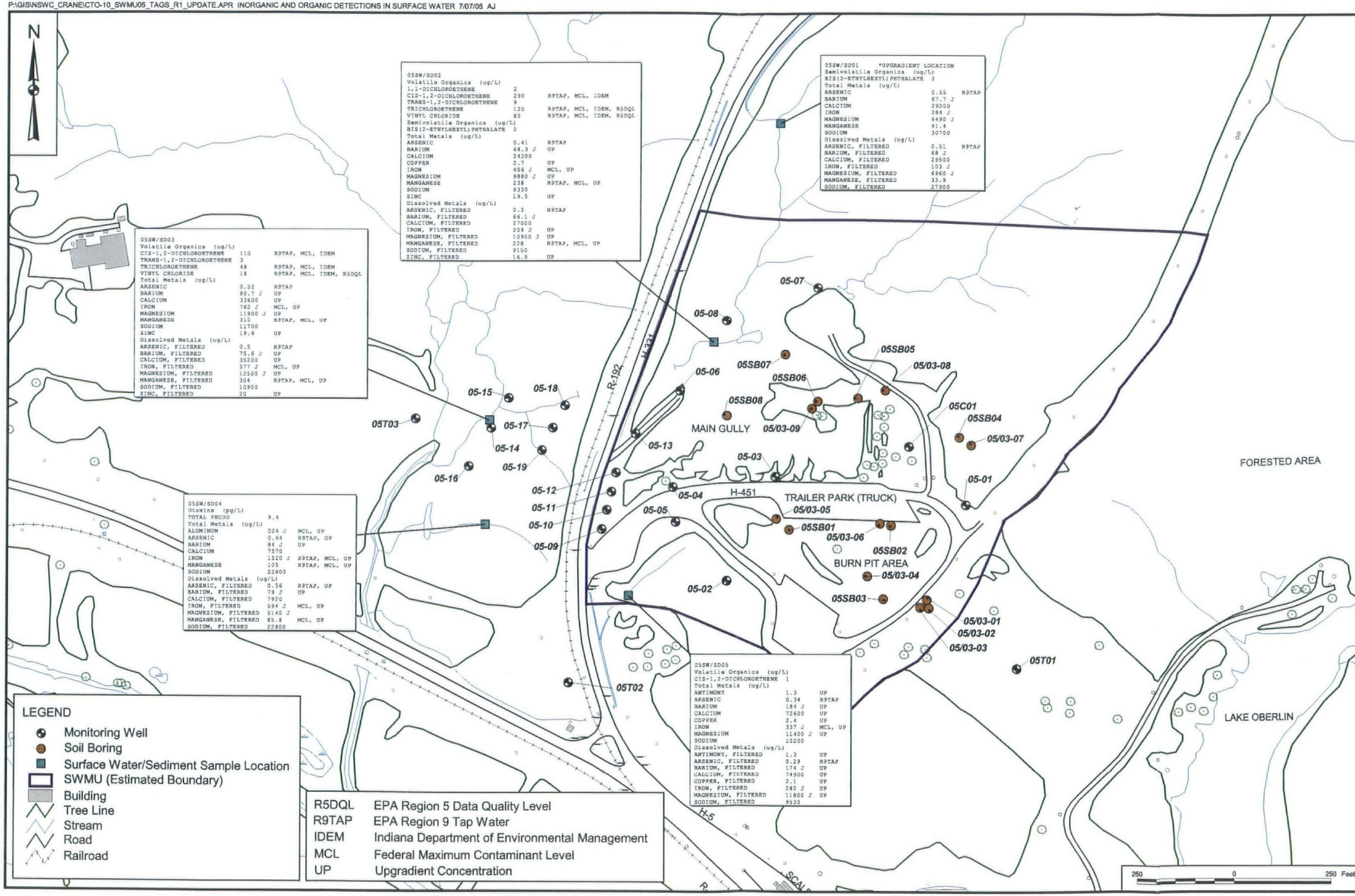

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DRAWING NO. FIGURE 5 - 11

REV 1

INORGANIC AND ORGANIC DETECTIONS IN SURFACE WATER SWMU 5 - OLD BURN PIT NAVAL SURFACE WARFARE CENTER CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMEY DATE 5/09/02

CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

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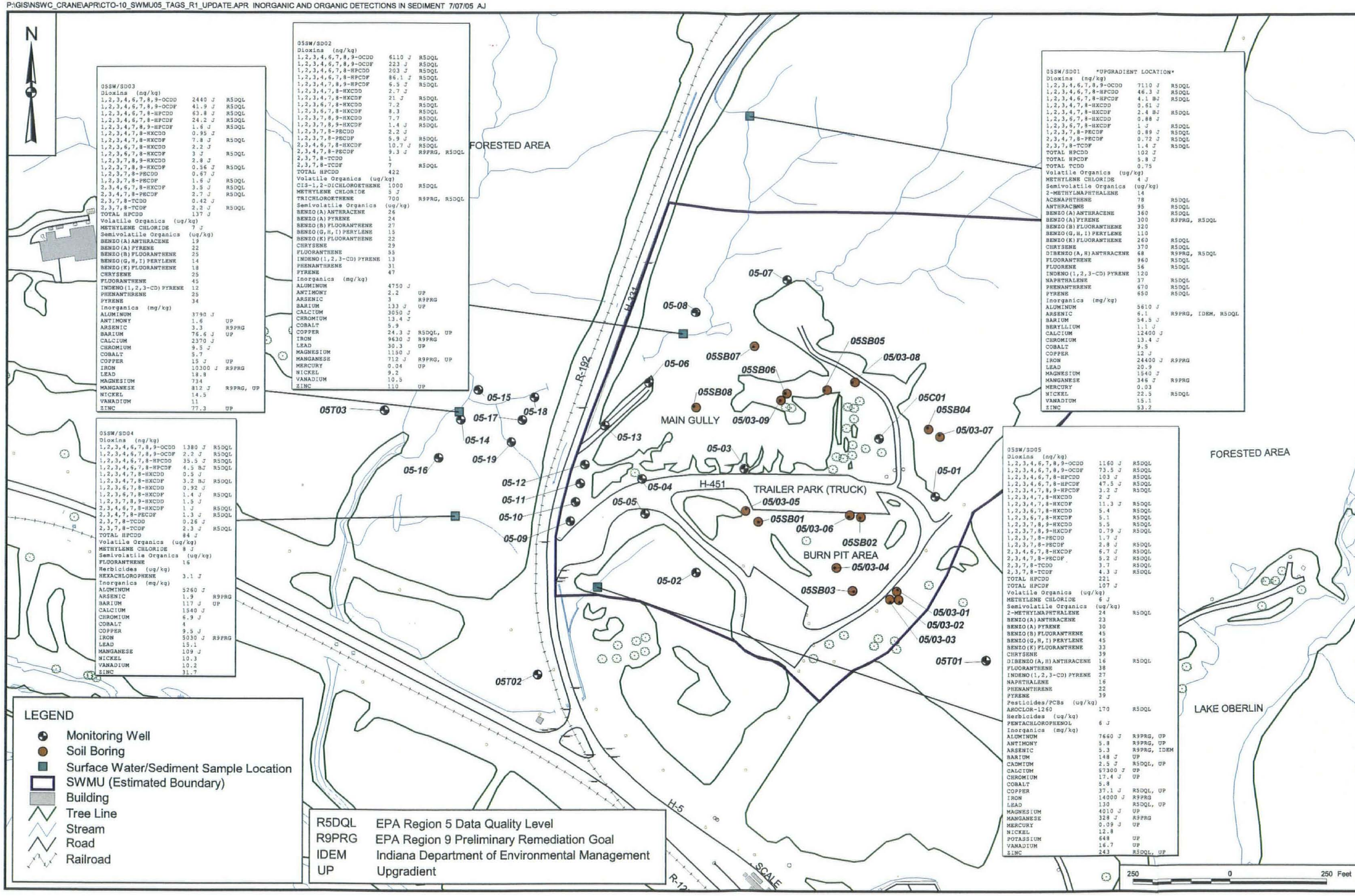


05SW/SD03

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	2440 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	41.9 J	R5DQL
1,2,3,4,6,7,8-HPCDD	63.8 J	R5DQL
1,2,3,4,6,7,8-HPCDF	24.2 J	R5DQL
1,2,3,4,7,8,9-HPCDF	1.6 J	R5DQL
1,2,3,4,7,8-HXCDD	0.95 J	
1,2,3,4,7,8-HXCDF	7.8 J	R5DQL
1,2,3,6,7,8-HXCDD	2.2 J	
1,2,3,6,7,8-HXCDF	3 J	R5DQL
1,2,3,7,8,9-HXCDD	2.8 J	
1,2,3,7,8,9-HXCDF	0.56 J	R5DQL
1,2,3,7,8-PECDD	0.67 J	
1,2,3,7,8-PECDF	1.6 J	R5DQL
2,3,4,6,7,8-HXCDF	3.5 J	R5DQL
2,3,4,7,8-PECDF	2.7 J	R5DQL
2,3,7,8-TCDD	0.42 J	
2,3,7,8-TCDF	2.2 J	R5DQL
TOTAL HPCDD	137 J	
Volatile Organics (ug/kg)		
METHYLENE CHLORIDE	7 J	
Semivolatile Organics (ug/kg)		
BENZO(A)ANTHRACENE	19	
BENZO(A)PYRENE	22	
BENZO(B)FLUORANTHENE	25	
BENZO(G,H,I)PERYLENE	14	
BENZO(K)FLUORANTHENE	18	
CHRYSENE	25	
FLUORANTHENE	45	
INDENO(1,2,3-CD)PYRENE	12	
PHENANTHRENE	25	
PYRENE	34	
Inorganics (mg/kg)		
ALUMINUM	3790 J	
ANTIMONY	1.6	UP
ARSENIC	3.3	R9PRG
BARIUM	76.6 J	UP
CALCIUM	2370 J	
CHROMIUM	9.5 J	
COBALT	5.7	
COPPER	15 J	UP
IRON	10300 J	R9PRG
LEAD	18.8	
MAGNESIUM	734	
MANGANESE	812 J	R9PRG, UP
NICKEL	14.5	
VANADIUM	11	
ZINC	77.3	UP

05SW/SD02

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	6110 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	223 J	R5DQL
1,2,3,4,6,7,8-HPCDD	203 J	R5DQL
1,2,3,4,6,7,8-HPCDF	86.1 J	R5DQL
1,2,3,4,7,8,9-HPCDF	6.5 J	R5DQL
1,2,3,4,7,8-HXCDD	2.7 J	
1,2,3,4,7,8-HXCDF	21 J	R5DQL
1,2,3,6,7,8-HXCDD	7.2	R5DQL
1,2,3,6,7,8-HXCDF	8.3	R5DQL
1,2,3,7,8,9-HXCDD	7.7	R5DQL
1,2,3,7,8,9-HXCDF	1.4 J	R5DQL
1,2,3,7,8-PECDD	2.2 J	
1,2,3,7,8-PECDF	5.9 J	R5DQL
2,3,4,6,7,8-HXCDF	10.7 J	R5DQL
2,3,4,7,8-PECDF	9.3 J	R9PRG, R5DQL
2,3,7,8-TCDD	1	
2,3,7,8-TCDF	7	R5DQL
TOTAL HPCDD	422	
Volatile Organics (ug/kg)		
CIS-1,2-DICHLOROETHENE	1000	R5DQL
METHYLENE CHLORIDE	5 J	
TRICHLOROETHENE	700	R9PRG, R5DQL
Semivolatile Organics (ug/kg)		
BENZO(A)ANTHRACENE	26	
BENZO(A)PYRENE	24	
BENZO(B)FLUORANTHENE	27	
BENZO(G,H,I)PERYLENE	15	
BENZO(K)FLUORANTHENE	22	
CHRYSENE	29	
FLUORANTHENE	55	
INDENO(1,2,3-CD)PYRENE	13	
PHENANTHRENE	31	
PYRENE	47	
Inorganics (mg/kg)		
ALUMINUM	4750 J	
ANTIMONY	2.2	UP
ARSENIC	3	R9PRG
BARIUM	133 J	UP
CALCIUM	3050 J	
CHROMIUM	13.4 J	
COBALT	5.9	
COPPER	24.3 J	R5DQL, UP
IRON	9630 J	R9PRG
LEAD	30.3	UP
MAGNESIUM	1150 J	
MANGANESE	712 J	R9PRG, UP
MERCURY	0.04	UP
NICKEL	9.2	
VANADIUM	10.5	
ZINC	110	UP

05SW/SD01 *UPGRADIENT LOCATION*

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	7110 J	R5DQL
1,2,3,4,6,7,8-HPCDD	46.3 J	R5DQL
1,2,3,4,6,7,8-HPCDF	4.1 BJ	R5DQL
1,2,3,4,7,8-HXCDD	0.61 J	
1,2,3,4,7,8-HXCDF	2.4 BJ	R5DQL
1,2,3,6,7,8-HXCDD	0.88 J	
1,2,3,6,7,8-HXCDF	1 J	R5DQL
1,2,3,7,8-PECDF	0.89 J	R5DQL
2,3,4,7,8-PECDF	0.72 J	R5DQL
2,3,7,8-TCDF	1.4 J	R5DQL
TOTAL HPCDD	102 J	
TOTAL HPCDF	5.8 J	
TOTAL TCDD	0.75	
Volatile Organics (ug/kg)		
METHYLENE CHLORIDE	4 J	
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	14	
ACENAPHTHENE	78	R5DQL
ANTHRACENE	95	R5DQL
BENZO(A)ANTHRACENE	360	R5DQL
BENZO(A)PYRENE	300	R9PRG, R5DQL
BENZO(B)FLUORANTHENE	320	
BENZO(G,H,I)PERYLENE	110	
BENZO(K)FLUORANTHENE	260	R5DQL
CHRYSENE	370	R5DQL
DIBENZO(A,H)ANTHRACENE	68	R9PRG, R5DQL
FLUORANTHENE	960	R5DQL
FLUORENE	56	R5DQL
INDENO(1,2,3-CD)PYRENE	120	
NAPHTHALENE	37	R5DQL
PHENANTHRENE	670	R5DQL
PYRENE	650	R5DQL
Inorganics (mg/kg)		
ALUMINUM	5610 J	
ARSENIC	6.1	R9PRG, IDEM, R5DQL
BARIUM	54.5 J	
BERYLLIUM	1.1 J	
CALCIUM	12400 J	
CHROMIUM	13.4 J	
COBALT	9.5	
COPPER	12 J	
IRON	24400 J	R9PRG
LEAD	20.9	
MAGNESIUM	1540 J	
MANGANESE	346 J	R9PRG
MERCURY	0.03	
NICKEL	22.5	R5DQL
VANADIUM	15.1	
ZINC	53.2	

05SW/SD04

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	1380 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	2.2 J	R5DQL
1,2,3,4,6,7,8-HPCDD	35.5 J	R5DQL
1,2,3,4,6,7,8-HPCDF	4.5 BJ	R5DQL
1,2,3,4,7,8-HXCDD	0.5 J	
1,2,3,4,7,8-HXCDF	3.2 BJ	R5DQL
1,2,3,6,7,8-HXCDD	0.92 J	
1,2,3,6,7,8-HXCDF	1.4 J	R5DQL
1,2,3,7,8,9-HXCDD	1.5 J	
2,3,4,6,7,8-HXCDF	1 J	R5DQL
2,3,4,7,8-PECDF	1.3 J	R5DQL
2,3,7,8-TCDD	0.26 J	
2,3,7,8-TCDF	2.3 J	R5DQL
TOTAL HPCDD	84 J	
Volatile Organics (ug/kg)		
METHYLENE CHLORIDE	8 J	
Semivolatile Organics (ug/kg)		
FLUORANTHENE	16	
Herbicides (ug/kg)		
HEXACHLOROPHENE	3.1 J	
Inorganics (mg/kg)		
ALUMINUM	5260 J	
ARSENIC	1.9	R9PRG
BARIUM	117 J	UP
CALCIUM	1540 J	
CHROMIUM	6.9 J	
COBALT	4	
COPPER	9.5 J	
IRON	5030 J	R9PRG
LEAD	15.1	
MANGANESE	109 J	
NICKEL	10.3	
VANADIUM	10.2	
ZINC	31.7	

05SW/SD05

Dioxins (ng/kg)		
1,2,3,4,6,7,8,9-OCDD	1160 J	R5DQL
1,2,3,4,6,7,8,9-OCDF	73.5 J	R5DQL
1,2,3,4,6,7,8-HPCDD	103 J	R5DQL
1,2,3,4,6,7,8-HPCDF	47.5 J	R5DQL
1,2,3,4,7,8,9-HPCDF	3.2 J	R5DQL
1,2,3,4,7,8-HXCDD	2 J	
1,2,3,4,7,8-HXCDF	11.3 J	R5DQL
1,2,3,6,7,8-HXCDD	5.4	R5DQL
1,2,3,6,7,8-HXCDF	5.1	R5DQL
1,2,3,7,8,9-HXCDD	5.5	R5DQL
1,2,3,7,8,9-HXCDF	0.79 J	R5DQL
1,2,3,7,8-PECDD	1.7 J	
1,2,3,7,8-PECDF	2.8 J	R5DQL
2,3,4,6,7,8-HXCDF	6.7 J	R5DQL
2,3,4,7,8-PECDF	5.2 J	R5DQL
2,3,7,8-TCDD	3.7	R5DQL
2,3,7,8-TCDF	4.3 J	R5DQL
TOTAL HPCDD	221	
TOTAL HPCDF	107 J	
Volatile Organics (ug/kg)		
METHYLENE CHLORIDE	6 J	
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	24	R5DQL
BENZO(A)ANTHRACENE	23	
BENZO(A)PYRENE	30	
BENZO(B)FLUORANTHENE	45	
BENZO(G,H,I)PERYLENE	45	
BENZO(K)FLUORANTHENE	33	
CHRYSENE	39	
DIBENZO(A,H)ANTHRACENE	16	R5DQL
FLUORANTHENE	38	
INDENO(1,2,3-CD)PYRENE	27	
NAPHTHALENE	16	
PHENANTHRENE	22	
PYRENE	39	
Pesticides/PCBs (ug/kg)		
AROCLOR-1260	170	R5DQL
Herbicides (ug/kg)		
PENTACHLOROPHENOL	6 J	
Inorganics (mg/kg)		
ALUMINUM	7660 J	R9PRG, UP
ANTIMONY	5.8	R9PRG, UP
ARSENIC	5.3	R9PRG, IDEM
BARIUM	148 J	UP
CADMIUM	2.5 J	R5DQL, UP
CALCIUM	57300 J	UP
CHROMIUM	17.4 J	UP
COBALT	5.8	
COPPER	37.1 J	R5DQL, UP
IRON	14000 J	R9PRG
LEAD	130	R5DQL, UP
MAGNESIUM	4010 J	UP
MANGANESE	328 J	R9PRG
MERCURY	0.09 J	UP
NICKEL	12.8	
POTASSIUM	648	UP
VANADIUM	16.7	UP
ZINC	243	R5DQL, UP

CONTRACT NO. 7141

APPROVED BY ____ DATE ____

APPROVED BY ____ DATE ____

DRAWING NO. FIGURE 5 - 12

REV 1

INORGANIC AND ORGANIC DETECTIONS IN SEDIMENT
SWMU 5 - OLD BURN PIT
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMEY DATE 5/09/02

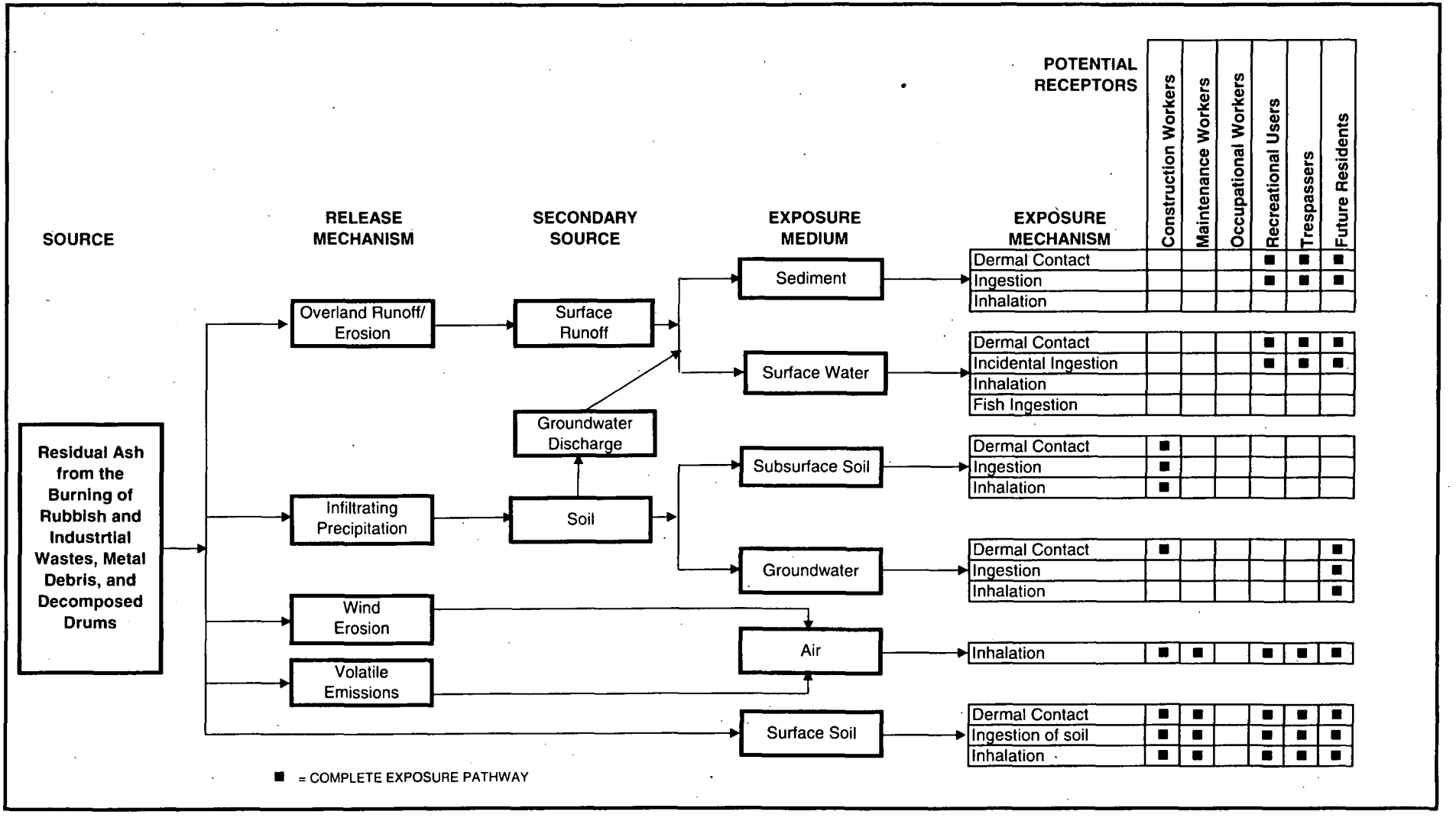
CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

FIGURE 5-13

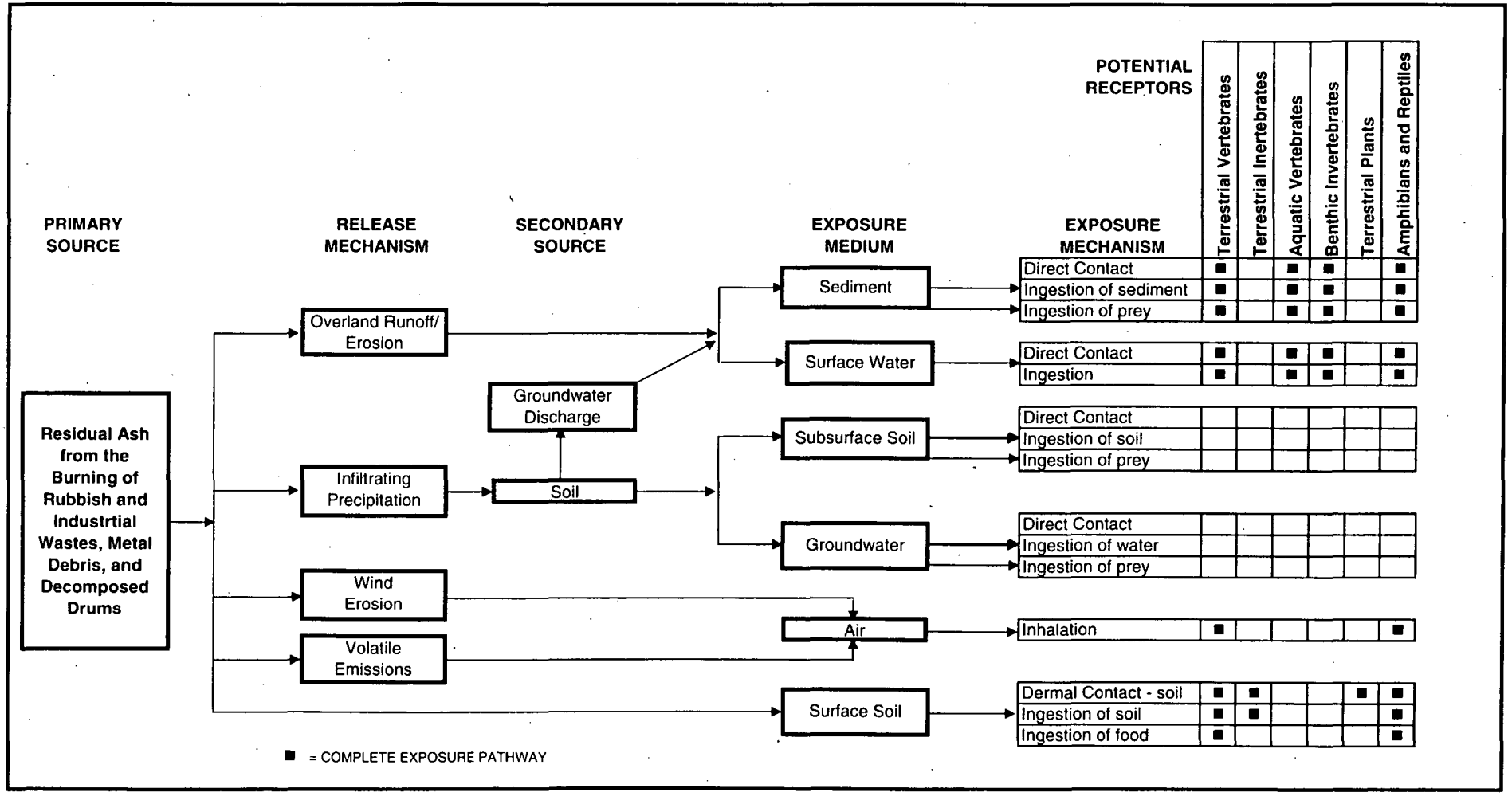
HUMAN HEALTH CONCEPTUAL SITE MODEL
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA



Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

FIGURE 5-14

ECOLOGICAL CONCEPTUAL SITE MODEL
SWMU 5 - OLD BURN PIT
NSWC CRANE, CRANE, INDIANA



Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

6.0 SWMU 9

This section describes the SWMU 9 (Pesticide Control/R-150 Tank Area) site investigations, physical characterization, nature and extent of contamination, human and ecological risk assessment and conclusions. References are provided to other sections of this RFI report for relevant background information and general data evaluation procedures.

6.1 BACKGROUND

Section 1.4.3 contains a description of the Pesticide Control/R-150 Tank Area. Section 1.5.3 contains a description of historical data collection activities. Section 1.6.3 summarizes information on constituents found in environmental media that may be attributable to historical operations at SWMU 9. These constituents of concern were used as the basis for the SWMU 9 site investigation described in this section.

6.2 SITE INVESTIGATION

The primary objective of the field investigation was to collect field and laboratory data to evaluate the potential risks for human and ecological receptors. Figure 6-1 includes the sample locations. Table 6-1 summarizes the sampling and analysis program for SWMU 9, the Pesticide Control/R-150 Tank Area.

As depicted on Table 6-1, environmental samples collected from the site were analyzed for a comprehensive field and laboratory analytical program. Field parameters were collected for ground water and surface water samples. Typical water-quality indicator parameters, such as turbidity, were collected in the field. Soil samples were screened for VOCs using monitoring equipment (PID).

The analytical program for the Pesticide Control/R-150 Tank Area was developed based on the chemical categories represented by the list of detected chemicals of interest identified for the site in Section 7.6 of the Risk Assessment Work Plan (TtNUS, August 2000a). Soil, sediment, surface water, and ground water samples were collected and analyzed for the full list of Appendix IX constituents (VOCs, SVOCs, pesticides, PCBs, inorganics), as well as other miscellaneous inorganics. Surface water samples were also analyzed for total and dissolved inorganics, hardness, and TSS, and sediment samples were analyzed for TOC to assist in assessing potential risks for ecological receptors. Additionally, soil characteristic parameters (CEC, pH, and TOC) were collected to determine the likelihood of the potential fate and transport of contaminants at the site (and the potential for risks outside the site boundaries).

Ground water samples were not analyzed for dissolved inorganics since low-flow sampling procedures were used to minimize turbidity in ground water samples.

As noted previously, Figure 6-1 illustrates the sampling locations for the field investigation at the Pesticide Control/R-150 Tank Area. Sample locations are in three distinct areas of the site: Building 55, Building 2189, and the R-150 Tank Area. The rationale for the collection of these samples is as follows:

- Surface/subsurface soil (borings) (22 samples) - To assess the potential risks associated with residual soil contamination at SWMU 9, soil borings were installed at the site. Three borings were placed around the former location of Building 2189; one additional boring was placed west of the building at a location where the ground surface slopes toward an unnamed tributary. Four borings were installed at locations dispersed throughout the R-150 Tank Area. Two borings were placed around the former location of Building 55; one additional boring was placed west of the former building at a location where the ground surface slopes toward an unnamed tributary. A sample was collected from the surface (0 to 2 feet bgs) and at a subsurface depth (not greater than 10 feet bgs) determined in the field using screening techniques (i.e., from a depth correlated with the highest PID readings).

- Ground water (13 samples) - Eight existing monitoring wells (09-02, 09-03, 09-04, 09-07, 09-10, 09-12, 09-WTP5, and 09-WTP6) were sampled to assess the potential risks associated with the migration of soil constituents to ground water. A total of five new monitoring wells were installed at the site and sampled during this field effort. One well, 09T01, was located east of the former location of Building 2189 to assess upgradient water quality conditions. Well 09T02 was placed immediately downgradient of the R-150 Tank Area (i.e., west-northwest of the excavated tank). Three other wells, 09T03 through 09T05, were placed near the former location of Building 55 to evaluate upgradient and downgradient conditions at the building. Borings 09T01A and 09T02B were drilled for explanation purposes to evaluate subsurface lithology and hydrogeology. The borings were grouted in place and 090T01 and 09T02 monitoring wells were installed adjacent to borings 09T01A and 09T02A once the conditions were known.

- Surface water (5 samples) and sediment (5 samples) - To assess the potential risks associated with migration (ground water discharge and surface runoff) of ground water and soil chemicals to surface water and sediment, collocated surface water and sediment samples were collected from five locations. Four sampling points were located in the unnamed tributary west of the former location of Building 2189 and the R-150 Tank. Locations in the tributary were sampled to evaluate upstream and downstream locations and to monitor the stream at locations potentially affected by surface water

runoff and/or ground water discharge. Surface water and sediment samples were also collected from a location potentially affected by surface water runoff and/or ground water discharge from Building 55.

Section 2.0 contains details on field sampling procedures and field documentation.

The data collected during the proposed field investigation were used to assess potential risks for human and ecological receptors exposed to site media under current and/or future land use. A description of how the data obtained during the field investigation were managed prior to use in the risk assessment is presented in Section 3.0. General methodologies and techniques used to calculate potential risks for the site are also provided in Section 3.0.

6.3 PHYSICAL CHARACTERISTICS

The Pesticide Control/R-150 Tank Area is located in the central portion of NSWC Crane, approximately 5 miles northeast of the Burns City Gate No. 2. The site (including space between the three distinct areas) occupies approximately 11 acres. Site operations were centered around the three areas (Building 55, Building 2189, and the R-150 Tank Area) previously identified. The site is bounded on the east by Highway 45. Figure 6-1 shows these details for the Pesticide Control/R-150 Tank Area.

6.3.1 Topography/Hydrology

The topography at the site consists of undulating terrain dissected by many small drainageways. The SWMU lies along a northwestward slope. A road and railroad form a topographic high ridge that runs north-south along the eastern border of the SWMU. Surface water east of this ridge flows to the east through several drainage ditches that join to form a stream that flows south. Surface water runoff west of this ridge in the northern portion of the SWMU flows northwest into a stream. This stream conveys water in a southwest direction away from the northern SWMU area. A drainage ditch that originates from the former tank area flows west and discharges into this stream. Surface water runoff in the southern portion of the SWMU is also toward the west into a stream that flows south and southwest away from the SWMU area. This stream ultimately joins with the stream that conveys surface water from the northern portion of the SWMU, further to the southwest. Both of these streams flow intermittent in their upstream reaches. These streams ultimately discharge into Boggs Creek.

6.3.2 Geology

The Pesticide Control/R-150 Tank Area is underlain by up to 10 feet of unconsolidated natural material overlying Pennsylvanian age sedimentary rocks of the Raccoon Creek Group Mansfield Formation. Soils mapped at the unit are representative of residual soils derived from the Pennsylvanian bedrock.

Three hydrogeologic cross-sections have been developed for the Pesticide Control / R-150 Tank Area at locations shown on Figure 6-2, and are included on Figures 6-3, 6-4, and 6-5. Borings shown on these figures consist of those installed by TtNUS and seven historical borings installed by the U.S. Army Corp of Engineers (US ACE) which includes borings 09/05-02, 09/05-04, 09/05-05, 09/05-06, 09/05-07, 09/05-10, and 09/05-11. The encountered subsurface materials included natural unconsolidated materials and bedrock. The natural unconsolidated materials are extensive across the SWMU area and consist primarily of silt and clay. Bedrock was encountered at depths as shallow as 5 feet bgs and consists primarily of sandstone with lenses of siltstone, shale, and coal.

6.3.3 Hydrogeology

Ground water is present beneath the Pesticide Control/R-150 Tank Area in both the natural unconsolidated materials and the bedrock. The depth to ground water ranges from less than 5 feet bgs in topographic low areas near surface water bodies to approaching 25 feet bgs at the higher elevations. The majority of the monitoring wells at the site were completed within the first ground water yielding unit encountered during drilling, which existed in either the natural unconsolidated material or the shallow bedrock. The ground water moves through the unconsolidated material or in fractures in the shallow bedrock and appears to be hydraulically connected. This shallow ground water system flows generally west and southwest as shown on Figure 6-6 toward the stream valleys which serve as ground water discharge points. The shallow ground water flows at an approximate gradient of 0.08. One of the previously installed wells (0914A, see Figure 6-4) was installed deeper in the bedrock in an interbedded shale and sandstone. This well was found to contain no ground water during the synoptic water level measurement activity performed by TtNUS. A shale unit was also encountered less than 10 feet beneath the ground in this boring. It may be possible that shallow ground water becomes perched on the shale and other lower permeable units that act as localized aquitards within the bedrock; therefore, limiting the vertical hydraulic connection in the bedrock.

6.4 NATURE AND EXTENT OF CONTAMINATION

Soil (surface and subsurface), ground water, surface water, and sediment samples were collected from SWMU 9 and analyzed for the presence of site-related contamination during the investigation phase of

this RFI. Based on analytical data obtained during this investigation, the nature and extent of contamination in the soil, ground water, surface water, and sediment at SWMU 9 are discussed on a matrix-specific basis in the following subsections.

Soil samples at each SWMU were classified according to the soil types defined in the NSWC Crane Basewide Soil Background Study (TtNUS, 2001). Each soil type is defined by the characteristics of soil parent material (depositional environment), depth (surface or subsurface), and grain size (sand, silt, or clay). The soil types were gathered into soil groups that reflect different classifications of soil throughout NSWC Crane. SWMU 9 surface soils are classified as Group 3 and subsurface soils are classified as Groups 8 and 9. The following are descriptions of these soil types:

- Group 3 - Alluvial, Mississippian, and Pennsylvanian Surface Soil
- Group 8 - Pennsylvanian Subsurface Clay and Silt
- Group 9 - Pennsylvanian Subsurface Sand

Metal concentrations in each soil group from a given SWMU were compared to metal concentrations from the corresponding background soil group. These comparisons used the entire data set from the background study for a given soil group and all SWMU samples of the corresponding soil group. The outcome of each comparison was a classification of each metal at a given SWMU as being statistically determined to be either elevated or not elevated relative to background concentrations, unless the data indicates that the contaminants (e.g., laboratory related) are from non-site related sources.

No background samples were collected for ground water, surface water, and sediment; however, at least one upgradient sample per medium was collected. These upgradient samples are treated as background, and direct comparisons to these upgradient values are discussed in the ground water, surface water, and sediment sections.

The Risk Assessment work plan (TtNUS, August 2000) provides a tabular summary and text discussing historical analytical results for SWMU 9 media. Some discussion from the work plan as relevant is referenced in this nature and extent discussion for SWMU 9.

6.4.1 Surface Soil

As detailed in Table 6-1 and Section 6.2, 11 surface soil samples were collected to evaluate the nature and extent of contamination. All 11 surface soil samples were analyzed for Appendix IX VOCs, Appendix

IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, TAL metals (plus tin), and cyanide. Additionally, three surface soil samples were analyzed for CEC, pH, and TOC.

Table 6-2 presents a summary of the reported results for compounds detected in the surface soil samples collected from SWMU 9. Table 6-3 presents a summary of descriptive statistics for surface soil detections including range of detections, frequency of detection, location of maximum, and comparison to background concentrations. Appendix E.1.3 contains a copy of the entire analytical database for SWMU 9 surface soil. Figures 6-7 and 6-8 present a geographical depiction of organic and inorganic detections in surface soil, respectively. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R5DQL) on the tag at the affected sampling location shows this on Figure 6-8. If an inorganic chemical was detected at a particular location and the site data set for that chemical was elevated as compared to the corresponding background data set (Soil Group 3), the result was flagged with "BACK" at all locations where samples from Soil Group 3 were collected. If "BACK" does not appear next to the result for an inorganic chemical, it means that the chemical was detected at that location but the chemical concentrations for that soil group are not elevated relative to background concentrations.

Volatile Organic Compounds

Methylene chloride was detected in five of the 11 surface soil samples analyzed. Methylene chloride concentrations ranged from 4 µg/kg to 6 µg/kg. This compound was detected in samples 09SB010102 and 09SB030102 in the vicinity of former Building 2189, in sample 09SB080102 in the vicinity of former R-150 Tank Area, and in samples 09SB090102 and 09SB100102 in the vicinity of former Building 55. This compound is considered a common laboratory contaminant, and the low concentrations (i.e., near the detection limit of 5 µg/L) found in these SWMU 9 soils are similar to those concentrations commonly found in laboratory method blanks and are therefore not likely site-related. See Section 3.1.4.2 for a detailed discussion regarding methylene chloride concentrations detected in laboratory blanks.

Semivolatile Organic Compounds

Seventeen PAHs and di-n-butyl phthalate were detected in surface soil samples; no other semivolatiles were detected. Di-n-butyl phthalate was detected in sample 09SB020002 at a concentration of 1,200 µg/kg. Maximum detected concentrations of the PAHs ranged from 18 µg/kg (acenaphthylene) to 1,800 µg/kg (2-methylnaphthalene). PAHs were detected in from one to five of 11 samples collected. All 17 PAHs were detected in sample 09SB030002; the maximum detected concentrations of 14 of these 17 PAHs were also found in this sample. Sample 09SB030002 was collected just south of former Building

2189. Maximum concentrations of the remaining three PAHs (2-methylnaphthalene, naphthalene, and phenanthrene) were found in sample 09SB090002, which is located in the vicinity of former Building 55. Benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, and pyrene were the most frequently detected PAHs (detected in five of 11 samples).

In general, there was no distinguishable pattern of PAH contamination. As shown in Figure 6-7, samples 09SB090002 and 09SB030002 were collected in the eastern portions of the site. The eastern border of the site is Highway 45. The PAHs may be attributable to asphalt, road traffic, or waste oil. The presence of di-n-butyl phthalate in sample 09SB020002 (located on the western side of Building 2189) may be resultant of site activities because di-n-butyl phthalate is used in pesticide formulation. Pesticide spray tanks and containers were reportedly rinsed on the western side of Building 2189.

Pesticides/PCBs

4,4'-DDT and methoxychlor were the only pesticides detected in the surface soil samples. These pesticides were detected in sample 09SB090002 at concentrations of 4.7 µg/kg and 25 µg/kg, respectively. This sample is located in the southern portion of the site near the location of Former Building 55. It is likely that the presence of these pesticides is attributable to past site activities such as spraying and possibly release through disposal.

No PCBs were detected at SWMU 9 in surface soils.

Herbicides

The herbicides 2,4-D, dinoseb, and pentachlorophenol were detected at SWMU 9. 2,4-D was detected in sample 09SB040002 (20 µg/kg). Dinoseb was detected in sample 09SB080002 at a concentration of 14 µg/kg. Pentachlorophenol was detected in samples 09SB020002 (3.5 µg/kg), 09SB040002 (2.0 µg/kg), and 05SB070002 (1.2 µg/kg). Samples 09SB020002 and 09SB040002 were collected west of former Building 2189. Sample 09SB080002 was located west of the former R-150 Tank, and sample 09SB070002 was collected north of the former R-150 Tank. It is likely that the presence of these pesticides is attributable to past site activities such as spraying and possibly release through disposal.

Metals

As displayed in Table 6-3, 18 metals were detected in the surface soil samples. Beryllium, selenium, silver, sodium, thallium, and tin were not detected in any of these surface soil samples. Of the 18 detected metals, aluminum, arsenic, barium, chromium, cobalt, iron, manganese, nickel, and vanadium

were detected in all 11 samples at concentrations statistically determined to be similar to background concentrations. Cadmium and mercury, were detected in one and five of 11 samples, respectively, but at concentrations statistically determined to be similar to background concentrations. Additionally, three of the detected metals (calcium, magnesium, and potassium) are considered to be essential nutrients and will not be discussed any further.

Antimony, copper, lead, and zinc concentrations were statistically determined to exceed the background concentrations. Antimony was detected in two of 11 samples at concentrations ranging from 0.97 mg/kg to 3.1 mg/kg; the maximum was in 09SB060002. Copper was detected in all 11 samples at concentrations ranging from 7.6 mg/kg to 20.1 mg/kg; the maximum was in sample 09SB100002. Lead was also detected in all 11 samples at concentrations ranging from 8.6 mg/kg to 34.9 mg/kg; the maximum was in sample 09SB100002. Zinc was detected in all 11 samples at concentrations ranging from 30.3 mg/kg to 120 mg/kg; the maximum was in sample 09SB060002. Sample 09SB060002 is located just north of the former R-150 Tank, and sample 09SB100002 was collected in the vicinity of former Building 55 (Figure 6-8).

As shown in Figure 6-8, metals were frequently detected but were not detected in any apparent pattern. It is unlikely that these metals concentrations are related to site activities, as evidenced by the few metals detected above background concentrations and the low concentrations of these metals.

Miscellaneous Parameters

Cyanide was not detected in SWMU 9 surface soil. Only samples 09SB040002, 09SB050002, and 09SB070002 were analyzed for miscellaneous parameters. The TOC ranged from 5,700 mg/kg to 8,500 mg/kg. The CEC ranged from 8.4 MEQ/100 g to 11 MEQ/100 g. The pH ranged from 6.9 to 8.0, which is relatively neutral.

6.4.2 Subsurface Soil

As detailed in Table 6-1 and Section 6.2, 11 subsurface soil samples were collected to evaluate the nature and extent of contamination. All 11 subsurface soil samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, TAL metals (plus tin), and cyanide. Additionally, five subsurface soil samples were analyzed for CEC, pH, and TOC.

Table 6-4 presents a summary of the positive results reported for compounds detected in the subsurface soil samples collected from SWMU 9. Table 6-5 presents a summary of descriptive statistics for positive

subsurface soil detections including range of detections, frequency of detection, location of maximum, and comparison to background. Because two different soil groups comprise subsurface soil at this SWMU, the table displays an exceedance of background concentrations if either soil group exceeded its respective background values. Figures described below indicate background exceedances for soil group-specific background comparisons. Appendix E.1.3 contains a copy of the entire analytical database for SWMU 9 subsurface soil. Figures 6-9 and 6-10 present a geographical depiction of organic and inorganic detections in subsurface soil, respectively. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R5DQL) on the tag map at the affected sampling location is shown on the figure. If an inorganic chemical was detected at a particular location and the site data set for that chemical was elevated as compared to the corresponding background data set (Soil Group 8 or 9), the result was flagged with "BACK" at all locations where samples from that soil group were collected. If "BACK" does not appear next to the result for an inorganic chemical, it means that the chemical was detected at that location but the chemical concentrations for that soil group are not elevated relative to background concentrations.

Volatile Organic Compounds

Three VOCs (methylene chloride, tetrachloroethene, and trichloroethene) were detected in one to six of the 11 subsurface soil samples. The detected VOCs are common solvents. Methylene chloride was detected in six of the 11 subsurface soil samples analyzed. Methylene chloride concentrations ranged from 3 µg/kg to 6 µg/kg. These concentrations of methylene chloride are similar to those found in laboratory blanks. See Section 3.1.4.2 for a detailed explanation of methylene chloride found in laboratory blanks. Additionally, methylene chloride was detected at similar concentrations in surface soil samples and in some of the same sample locations. The available evidence suggests that the methylene chloride concentrations are a laboratory contamination artifact rather than an indication of a methylene chloride release at this SMWU. Tetrachloroethene and trichloroethene were detected in sample 09SB070709 at concentrations of 4 µg/kg and 18 µg/kg, respectively. Sample 09SB070709 is located in the vicinity of former R-150 Tank. The tank is known to have contained chlorinated hydrocarbons. Tetrachloroethene and trichloroethene were not detected in surface soil. These two chemicals are likely to be related to site activities.

Semivolatile Organic Compounds

Bis(2-ethylhexyl) phthalate was the only semivolatile compound detected in subsurface soil samples. Bis(2-ethylhexyl) phthalate was detected in sample 09SB070709 at a concentration of 660 µg/kg. There is

no known source of this compound at SWMU 9; however, bis(2-ethylhexyl) phthalate is a common component of plastics and is commonly detected in environmental media.

Pesticides/PCBs

No pesticide compounds were detected in subsurface soil samples.

Aroclor 1254 was detected in sample 09SB070709 at a concentration of 460 µg/kg. PCBs were not detected in any of the surface soil samples. Sample 09SB070709 is located in the vicinity of the former R-150 Tank, which was known to contain chlorinated hydrocarbons. The presence of Aroclor 1254 is probably related to past disposal activities at this site because the observed concentration is relatively high (i.e., greater than 250 µg/kg). This level of detection in a single sample may indicate an isolated contamination hotspot. However, the PCB concentration (460 µg/kg) is below the TSCA remediation level of 1,000 µg/kg contained in TSCA regulations [40 CFR §761.61(a)(4)(i)(A)] for high occupancy areas.

Herbicides

The herbicide pentachlorophenol was detected at SWMU 9. Pentachlorophenol was detected in sample 09SB0110406 at a concentration of 1.4 µg/kg. Pentachlorophenol was detected more frequently in surface soil samples but at approximately the same concentration. However, pentachlorophenol was not detected in the surface soil sample collected from location 09SB11.

Metals

As displayed in Table 6-5, 18 metals were detected in the subsurface soil samples. Cadmium, selenium, silver, sodium, thallium, and tin were not detected in any of these subsurface soil samples. Of the 18 detected metals, arsenic and vanadium were detected in all 11 samples at concentrations statistically determined to be similar to background concentrations. Antimony and mercury were detected at low frequencies (in two of 11 samples) but at concentrations statistically determined to be similar to background concentrations. Additionally, three of the detected metals (calcium, magnesium, and potassium) are considered to be essential nutrients and will not be discussed any further.

Aluminum, arsenic, barium, chromium, copper, iron, lead, nickel, vanadium, and zinc concentrations were statistically determined to exceed background concentrations for Soil Group 9. These metals were detected in all 11 samples. The maximum detected concentrations of these metals were divided among several sample locations but the concentrations are generally comparable to Soil Group 8 concentrations. This is discussed further in Section 6.4.6.

As shown in Figure 6-10, metals are frequently detected but are not detected in any apparent pattern. The same metals detected in surface soil were detected in these subsurface soil samples; however, concentrations of the majority of these metals exceed background concentrations in subsurface soil.

Miscellaneous Parameters

Cyanide was not detected in subsurface soil samples.

Only samples 09SB010810, 09SB030406, 09SB080406, 09SB090810, and 09SB100204 were analyzed for miscellaneous parameters. TOC ranged from 1,200 mg/kg to 6,500 mg/kg. CEC ranged from 7.4 MEQ/100 g to 13 MEQ/100 g. The pH ranged from 4.3 to 6.9, respectively, which ranges from slightly acidic to neutral.

6.4.3 Ground Water

As detailed in Table 6-1 and Section 6.2, 12 ground water samples and one upgradient ground water sample (09GWTP0601) were collected to evaluate the nature and extent of contamination. All ground water samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, total TAL metals (plus tin), and cyanide. None of the samples were analyzed for dissolved TAL metals.

Table 6-6 presents a summary of the positive results reported for compounds detected in the ground water samples collected from SWMU 9. Table 6-7 presents a summary of descriptive statistics for positive ground water detections including range of detections, frequency of detection, location of maximum, and comparison to upgradient concentration. Appendix E.1.3 contains a copy of the entire analytical database for SWMU 9 ground water. Figure 6-11 presents a geographical depiction of organic and inorganic detection in ground water. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R9TAP) on the tag map at the affected sampling location is shown on the figure. If a detected organic or inorganic chemical concentration at a particular location exceeded the upgradient concentration, this was indicated with a "UP" flag at the affected location. If "UP" does not appear on the tag map it means the chemical was detected at that location, but the concentration was less than the upgradient concentration.

Volatile Organic Compounds

The VOCs 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, and trichloroethene were detected in SWMU 9 ground water samples. 1,1,1-Trichloroethane, 1,1-dichloroethane, and 1,1-dichloroethene were detected in sample 09GW0301 at concentrations of 26 µg/L, 14 µg/L, and 6.4 µg/L, respectively. Cis-1,2-Dichloroethene was detected in 09GW0301 (69 µg/L), 09GW0401 (130 µg/L), and 09GWT0201 (1.7 µg/L). Methylene chloride was detected in sample 09GW0401 at a concentration of 58 µg/L. Trichloroethene was detected in samples 09GW0301 (55 µg/L) and 09GW01001 (1 µg/L).

According to the Work Plan for Risk Assessment at SWMUs 4, 5, 9, and 10 (TtNUS August 2000a), during a previous investigation in July 1983 (NEESA, 1983), four soil borings (09WTP-1 through 09WTP-4) were drilled on each side of the R-150 Tank. Ground water and soil samples were collected from the borehole wells. The analytical results for these samples indicated that the tank had leaked and that hazardous constituents (VOCs) had been released to the surrounding environment. The tank was subsequently excavated and removed from the site in September 1983. The locations of 09WTP-1 through 09WTP-4 are shown on Figure 6-11.

Well 09-03 is located southwest of the former tank, and the ground water sample from this well contains five of the six detected VOCs. Well 09-10, which is southeast of the historic locations, contains trichlorethene at 1 µg/L. Well 09-04, which is west of wells 09WTP-1 through 09WTP-4, contains cis-1,2-dichloroethene at 130 µg/L and methylene chloride at 58 µg/L. Well 09T02, which is northwest of the historic wells, contained cis-1,2-dichloroethene at 1.7 µg/L. Wells located farther north (northwest and northeast) and farther south (southwest and southeast) do not contain VOCs.

Some of these VOCs were also detected in subsurface soil sample 09SB070102 at SWMU 9, which is located just south of historic well location 09-WTP03. The presence of these VOCs in ground water is likely a result of leakage from the former R-150 Tank.

Semivolatile Organic Compounds

No SVOCs were detected in SWMU 9 ground water.

Pesticides/PCBs

Dieldrin was detected in sample 09GWT0101 at a concentration of 0.03 µg/L. This sample is located on the eastern side of former Building 2189. No other pesticides were detected in SWMU 9 ground water

samples. It is possible that the presence of this pesticide is resultant of pesticide handling activities conducted at SWMU 9. However, the low frequency of detection indicates contamination is very limited. Dieldrin was not detected in surface or subsurface soil at SWMU 9.

No PCBs were detected in SWMU 9 ground water.

Herbicides

2,4,5-T and 2,4,5-TP (Silvex) were each detected in a single ground water sample. 2,4,5-T was detected in sample 09GWT0101 at a concentration of 0.13 µg/L, and 2,4,5-TP was detected in sample 09GW1201 at a concentration of 0.17 µg/L. Sample 09GWT0101 was collected along the eastern side of former Building 2189. Sample 09GW1201 was collected from the westernmost sample location at SWMU 9 (west of the former R-150 Tank Area). It is possible that the presence of these herbicides is the result of SWMU 9 activities. However, the low frequency of detection indicates contamination is very limited. These herbicides were not detected in surface or subsurface soil samples collected at SWMU 9.

Metals

As displayed in Table 6-7, 16 metals were detected in these ground water samples. The maximum detected concentrations of these 16 metals were in excess of respective upgradient concentrations. Antimony, cadmium, chromium, silver, thallium, mercury, potassium, and tin were not detected in these ground water samples. Three of the detected metals (calcium, magnesium, and sodium) are considered to be essential nutrients and will not be discussed any further.

As displayed in Table 6-7, arsenic, barium, and manganese were detected in all 12 ground water samples at maximum concentrations of 4.3 µg/L, 323 µg/L, and 7,920 µg/L, respectively; these all occurred in sample 09GW0201. Aluminum and beryllium were both detected in two of 12 samples. The maximum detected concentrations of aluminum (1,290 µg/L) and beryllium (4.4 µg/L) were found in sample 09GWT0201. Lead was detected in sample 09GW0401 at a concentration of 1.1 µg/L. Vanadium was detected in sample 09GWT0101 at a concentration of 2.1 µg/L. Zinc and nickel were both detected in six of 12 samples. The maximum detected concentrations of zinc (166 µg/L) and nickel (279 µg/L) were found in sample 09GWT0201. Copper was detected in four of 12 samples at concentrations ranging from 2 µg/L to 8.4 µg/L; the maximum detection occurred in sample 09GWT0201. Cobalt was detected in seven of 12 samples at concentrations ranging from 11.6 µg/L to 109 µg/L; the maximum occurred in sample 0909GWT0201. Iron was detected in 11 of 12 samples at concentrations ranging from 136 µg/L to 37,300 µg/L; the maximum was in sample 09GW0201. Selenium was detected in three of 12 samples

at concentrations ranging from 1.2 µg/L to 1.7 µg/L. The maximum detected concentration of selenium occurred in sample 09GWT0201.

Barium, iron, manganese, selenium, and zinc were detected in the upgradient sample (09GWTP0601). The concentrations of these metals in sample 09GWTP0601 were less than those detected in downgradient samples.

The maximum detected concentrations were divided among five of the 12 sample locations. As shown in Figure 6-11, there does not appear to be a pattern of metals contamination in the ground water. These metals were also detected in surface and subsurface soil samples at SWMU 9. These metals do not coincide with significant VOC, pesticide, or herbicide detections. Maximum detections occurred most frequently in samples 09GW0201 and 09GWT0201. Well 09-02 is located west of former Building 2189 and Well 09T02 is northwest of the former R-150 Tank.

Miscellaneous Parameters

Cyanide was not detected in these ground water samples.

6.4.4 Surface water

As detailed in Table 6-1 and Section 6.2, four surface water samples and one upgradient surface water sample (09SW0101) were collected to evaluate the nature and extent of contamination. The surface water samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, total and dissolved TAL metals (plus tin), cyanide, hardness, and total suspended solids. The upgradient sample was 09SW0101.

Table 6-8 presents a summary of the positive results reported for compounds detected in the surface water samples collected from SWMU 9. Table 6-9 presents a summary of descriptive statistics for positive surface water detections including range of detections, frequency of detection, location of maximum, and comparison to upgradient concentration. Appendix E.1.3 contains a copy of the entire analytical database for SWMU 9 surface water. Figure 6-12 presents a geographical depiction of organic and inorganic detections in surface water. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion , a flag (e.g., R9TAP) on the tag map at the affected sampling location is shown on the figure. If a detected organic or inorganic chemical concentration at a particular location exceeded the upgradient concentration, this was indicated with a

"UP" flag at the affected location. If "UP" does not appear on the tag map it means the chemical was detected at that location, but the concentration was less than the upgradient concentration.

Volatile Organic Compounds

No VOCs were detected in SWMU 9 surface water samples.

Semivolatile Organic Compounds

No SVOCs were detected in SWMU 9 surface water samples.

Pesticides/PCBs

No pesticide/PCBs were detected in SWMU 9 surface water samples.

Herbicides

2,4-D was detected in sample 09SW0201 at a concentration of 0.18 µg/L, which is just two times the detection limit. This sample is located about 400 feet west of former Building 2189 and the concentration does not exceed any risk based criteria.

Metals

As displayed in Table 6-9, 15 metals were detected in the downgradient surface water samples. Beryllium, cadmium, chromium, silver, selenium, thallium, mercury, and tin were not detected in these surface water samples. Four of the detected metals (calcium, magnesium, potassium, and sodium) are considered to be essential nutrients and will not be discussed any further.

Arsenic, barium, iron, and manganese were detected in all four surface water samples. The maximum detected concentrations of arsenic, barium, and iron were found in sample 09SW0501. The maximum detected concentration of manganese was found in sample 09SW0201. The remaining detected metals were present in from one to two of the four samples collected. Maximum detected concentrations of the majority of the metals detected in surface water were found in sample 09SW0501.

Of the 15 metals, the maximum detected concentration of antimony was in excess of upgradient concentrations. Antimony was detected in sample 09SW0501 at a concentration of 1.6 µg/L. This sample was collected in the southernmost location at SWMU 9 (southwest of former Building 55).

The surface water samples were also analyzed for dissolved metals. All the metals detected in the total (unfiltered samples), except aluminum, were detected in the dissolved (filtered) metals samples. The concentrations and frequencies of detection of these metals were similar to those found in the total (unfiltered) samples; however, the majority of the dissolved metals concentrations were in excess of upgradient concentrations. Dissolved concentrations of barium was the only metal not in excess of dissolved upgradient concentrations. The maximum detected concentrations of all metals except manganese were detected in sample 09SW0501, which, as noted above, was collected in the southernmost location at SWMU 9 (southwest of former Building 55).

As shown in Figure 6-12, there does not appear to be a pattern of metals contamination in the surface water. Also of note, the upgradient (background) sample 09SW0101 contained metals concentrations in excess of those found in the other surface water samples at SWMU 6. However, the dissolved (filtered) results for this sample were very similar to metals results for all other samples collected within SWMU 9. Additionally the TSS results for sample 09SW0101 were one order of magnitude greater than in the other samples substantiating that the elevated metals in the unfiltered (total) sample were due to suspended solids. These metals were also detected in surface soil, subsurface soil, and ground water samples at SWMU 9. These metals do not coincide with significant VOC, pesticide, or herbicide detections.

Miscellaneous Parameters

Cyanide was not detected. The hardness of these samples ranged from 70 mg/L to 180 mg/L, and the total suspended solids ranged from 3 mg/L to 10 mg/L. Sample 09SW0501 possessed the maximum hardness value, and sample 09SW0401 possessed the maximum total suspended solids value.

6.4.5 Sediment

As detailed in Table 6-1 and Section 6.2, four sediment samples and one upgradient sediment sample 09SD010006 were collected to evaluate the nature and extent of contamination. All sediment samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, TAL metals (plus tin), cyanide, and total organic carbon.

Table 6-10 presents a summary of the positive results reported for compounds detected in the sediment samples collected from SWMU 9. Table 6-11 presents a summary of descriptive statistics for positive sediment detections including range of detections, frequency of detection, location of maximum, and comparison to upgradient concentrations. Appendix E1.3 contains a copy of the entire analytical database

for SWMU 9 sediment. Figure 6-13 presents a geographical depiction of organic and inorganic detections in sediment. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R5DQL) on the tag map at the affected sampling location is shown on the figure. If a detected inorganic chemical concentration at a particular location exceeded the upgradient concentration, this was indicated with a "UP" flag at the affected location. If "UP" does not appear on the tag map it means the chemical was detected at that location, but the concentration was less than the upgradient concentration.

Volatile Organic Compounds

Methylene chloride was the only VOC detected in these sediment samples. Methylene chloride was detected in samples 09SD030006 and 09SD040006, both at a concentration of 4 µg/kg. Methylene chloride was also detected at a concentration of 8 µg/kg in sample 04SD010006, which was collected upgradient of SWMU 9. This compound is considered a common laboratory contaminant, and the low concentrations (i.e., near the detection limit 4 µg/kg) found in these SWMU 9 sediments are similar to those concentrations commonly found in laboratory method blanks. Methylene chloride was also detected in surface and subsurface soil samples from SWMU 9 at concentrations that were also near the detection limit of 4 µg/kg.

Semivolatile Organic Compounds

Fluoranthene was the only semivolatile compound detected in site-related sediment samples. Fluoranthene was detected at a concentration of 10 µg/kg in sample 09SD030006, which was collected west of the former R-150 Tank Area. This PAH was also detected in one surface soil sample in the vicinity of the former R-150 Tank. However, PAHs were not detected in subsurface soil, ground water, or surface water samples from this area.

The upgradient sediment location (09SD010006) for SWMU 9 contained benzo(b)fluoranthene (14 µg/kg), chrysene (11 µg/kg), and pyrene (14 µg/kg) indicating that these PAHs may not be site related but may be the resultant of roadway runoff as PAHs are components of vehicular exhaust and asphalt.

Pesticides/PCBs

No pesticides were detected in SWMU 9 sediment samples.

Aroclor 1248 was detected in sample 09SD030006 at a concentration of 380 µg/kg, which was collected west of the former R-150 Tank Area. The only other detection of PCBs in any media was in subsurface

soil sample 09SB070709. This soil sample was collected in the vicinity of the former R-150 Tank, which was known to contain chlorinated hydrocarbons. The presence of Aroclor 1248 is probably related to past disposal activities at this site because the observed concentration is relatively high (i.e., greater than 350 µg/kg). These sample locations are about 400 feet from each other and suggest that the area of contamination is associated with the former R-150 Tank.

Herbicides

Herbicides were not detected in any sediment samples collected for SWMU 9. However, the upgradient sediment location for SWMU 9 contained dinoseb (8.2 µg/kg) and pentachlorophenol (2.7 µg/kg), indicating that these herbicides may not be site related but are resultant of basewide applications. This would be consistent with the spotty detections of herbicides at SWMU 9.

Metals

As displayed in Table 6-11, 16 metals were detected in these sediment samples. Of these 16 metals, the maximum detected concentrations of aluminum, antimony, arsenic, barium, copper, chromium, cobalt, iron, lead, magnesium, manganese, potassium, vanadium, and zinc were in excess of respective upgradient concentrations. Three of the detected metals (calcium, potassium, and magnesium) are considered to be essential nutrients and will not be discussed any further. Of the metals detected above upgradient concentrations, antimony was the only metal that was detected in less than all four samples. Antimony was detected only in sample 09SD020006 at a concentration of 1.3 mg/kg.

The remaining metals were detected in all four samples. Maximum detected concentrations for aluminum, copper, and chromium were found in sample 09SD050006. Maximum detection concentrations of arsenic, barium, iron, lead, manganese, vanadium, and zinc were found in sample 09SD030006. The maximum detected concentration of cobalt was found in sample 09SD040006.

Aluminum concentrations ranged from 5,470 mg/kg to 10,800 mg/kg. Chromium concentrations ranged from 11.1 mg/kg to 13 mg/kg. Arsenic concentrations ranged from 0.77 mg/kg to 6.1 mg/kg. Iron concentrations ranged from 15,700 mg/kg to 18,600 mg/kg. Manganese concentrations ranged from 86.8 mg/kg to 1,300 mg/kg. Vanadium detections ranged from 12.2 mg/kg to 21.2 mg/kg. Zinc concentrations ranged from 27.7 mg/kg to 95.3 mg/kg. Cobalt concentrations ranged from 4.8 mg/kg to 14.5 mg/kg. Barium concentrations ranged from 39.3 mg/kg to 103 mg/kg. Copper concentrations ranged from 9 mg/kg to 27.7 mg/kg. Lead concentrations ranged from 6.6 mg/kg to 27.7 mg/kg.

As shown in Figure 6-13, the concentrations of metals detected across SWMU 9 sediment are similar. The concentrations of metals detected in sediment samples collected within SWMU 9 (including the upgradient location 09SD010006) are generally within one order of magnitude of each other. These metals were also detected in surface soil, subsurface soil, ground water, and surface water samples at SWMU 9.

Miscellaneous Parameters

Cyanide was not detected in these sediment samples. The TOC ranged from 1,600 mg/kg (09SD050006) to 14,000 mg/kg (09SD040006) in these sediment samples.

6.4.6 Summary

Methylene chloride was the only VOC detected in surface soil samples at SWMU 9. Methylene chloride was also detected in subsurface soil samples. In addition, tetrachloroethene and trichloroethene were also detected in subsurface soil samples. In general, the concentrations of the VOCs detected in both surface and subsurface soil were low (i.e., less than 20 µg/kg). Methylene chloride and chlorinated hydrocarbons (1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichlorethene, and trichloroethene) were detected in ground water at SWMU 9; most notably in two wells (09-03 and 09-04) located near the former R-150 Tank. No VOCs were detected in surface water samples. Methylene chloride was detected in sediment samples.

Even though methylene chloride was detected in most media, it was detected infrequently and at low concentrations (near the detection limit) except in ground water. In ground water, it was detected in a single sample (09GW0401) at a concentration of 58 µg/L. Based on these results in which no contamination pattern exists, the lack of association with operational history (i.e., pesticide use), and low concentrations consistent with laboratory contamination, methylene chloride does not appear to be a site-related contaminant. Nevertheless, methylene chloride is a common industrial solvent and COPC screening criteria are also low so this chemical was conservatively retained as a COPC in soils. The chlorinated hydrocarbon contamination is most closely associated with the former R-150 Tank Area and contamination does not extend much beyond that immediate area; however, it has migrated to ground water. Of the chlorinated hydrocarbons detected in ground water, only cis-1,2–dichloroethene in well 09-04, and 1,1–dichloroethene, cis-1,2–dichloroethene, and trichloroethene in well 09-03 are in exceedance of risk-based screening levels. The contamination is bounded sufficiently by lower or nondetectable concentrations in surrounding wells and supports the planned risk assessments.

PAHs and di-n-butyl phthalate were detected in SMWU 9 surface soil. Bis(2-ethylhexyl) phthalate was the only SVOC detected in subsurface soil samples. No SVOCs were detected in ground water or surface water. One PAH was detected in a single sediment sample (09SD030006) at a concentration of 10 µg/kg. However, several PAHs were detected in the SWMU 9 background sediment sample, indicating that PAHs may not be fully attributable to activities within SWMU 9. No other SVOCs were detected in sediment samples. The soil samples displaying the greatest concentrations of PAHs were collected in the eastern portions of the site, and the eastern border of the site is Highway 45. The PAHs may be attributable to asphalt, road traffic, or waste oil. The presence of di-n-butyl phthalate in sample 09SB020002 (located on the west side of Building 2189) may be resultant of site activities because di-n-butyl phthalate is used in pesticide formulation and pesticide spray tanks and containers were reportedly rinsed on the western side of Building 2189. Di-n-butyl phalate is well bounded at the site evident by no other concentrations detected in surrounding samples and supports the planned risk assessments.

Pesticides were not detected in any subsurface soil, sediment, or surface water samples. The pesticides 4,4-DDT and methoxychlor were only detected in a single surface soil sample (09SB090002). Dieldrin was also detected in a single ground water sample (09GWT0101). The concentrations of these pesticides were low (i.e., less than 25 µg/kg and 0.05 µg/L). Historical data discussed in the SWMUs 4, 5, 9, and 10 work plan also contained detectable concentrations of pesticides. These pesticides are considered site-related contaminants; however, the frequency of detection is very low, indicating no widespread contamination as a result of site activities. The HHRA presented in Section 6.6.1 and the ERA presented in Section 6.6.3 discusses the pesticides selected as COPCs for SWMU 9.

PCBs were not detected in surface soil, surface water, or ground water at SWMU 9 during this investigation. Aroclor 1254 was detected in subsurface soil sample 09SB070709 at a concentration of 460 µg/kg. This Aroclor was not detected in any other subsurface soil samples and is well bounded by surrounding downgradient samples exhibiting no detectable PCBs. Except for Aroclor 1016 (detected in one subsurface soil sample) and Aroclor 1254 (detected in one of 45 subsurface soil samples and in 2 of 13 surface soil samples) the historical data reveal that Aroclors were generally not detected (TtNUS 2000a) in soils. When they were detected the concentrations were less than 100 µg/kg. Aroclor 1248 was detected in a single sediment sample (09SD0300006) at a concentration of 380 µg/kg, and is well bounded by downgradient samples exhibiting no detectable PCBs. The locations of the two Aroclor detections found during this Phase III RFI are within 400 feet of each other and are in the vicinity of the former R-150 Tank. This tank is historically known to have held chlorinated hydrocarbons and is known to have leaked. The PCB contamination is viewed to be well bounded in the horizontal and vertical directions in soil with the only subsurface soil detection of PCBs being relatively minor. The Aroclor contamination

does not extend beyond the former R-150 Tank Area and sufficient information concerning the extent of PCB contamination is available to support the planned risk assessments. The HHRA presented in Section 6.6.1 and the ERA presented in Section 6.6.3 discusses PCBs selected as COPCs for SWMU 9.

The herbicides 2,4-D and dinoseb, and pentachlorophenol were detected in several SWMU 9 surface soil samples. Pentachlorophenol was detected in a single SWMU 9 subsurface soil sample (09SB110406). These three compounds were detected infrequently and at generally low concentrations (i.e., equal to or less than 20 µg/kg). 2,4,5-T and 2,4,5-TP were each detected in one ground water sample (09GWT0101 and 09GW1201, respectively) at concentrations less than 0.2 µg/L. 2,4-D was detected in surface water sample 09SW0201 at a concentration of 0.18 µg/L. Herbicides were not detected in any sediment samples collected for SWMU 9. However, the upgradient sediment location (09SD010006) for SWMU 9 contained dinoseb (8.2 µg/kg) and pentachlorophenol (2.7 µg/kg), indicating that these herbicides may not be site related.

2,4-D was detected in surface soil sample 09SB040002, at 20 µg/kg, but the downgradient sediment location did not show a detectable 2,4-D concentration. There are no other surface soil samples west of this location in the vicinity of former Building 2189. Dinoseb was detected in surface soil samples and the background sediment sample; these locations are 1,600 feet apart. These results are not clearly related to each other. Pentachlorophenol was detected in surface soil, subsurface soil, and the background sediment location. These pentachlorophenol concentrations were all less than 10 µg/kg and were primarily located in the vicinity of former Building 2189 (the exception is sample 09SB070002 at 1.2 µg/kg). The presence of some of these compounds in background samples suggests the herbicides may not be site related. Historical data discussed in the SWMUs 4, 5, 9, and 10 work plan did not display any herbicide detections at SWMU 9. The evidence does not suggest a release of herbicides at SWMU 9. Instead a more plausible explanation for the observed detectable concentrations of the two herbicides and pentachlorophenol is topical applications, as those chemicals are intended to be used. Thus, site-related herbicide contamination is not clearly present but, if present, is viewed to be well bounded in all directions. The HHRA presented in Section 6.6.1 and the ERA presented in Section 6.6.3 provide discussions regarding herbicides selected as COPCs for SWMU 9.

Numerous metals were detected in both surface (Figure 6-8) and subsurface soil samples (Figure 6-10). Of the metals detected in surface soil, concentrations of antimony, calcium, copper, lead, magnesium, and zinc were present in SWMU 9 surface soils at concentrations in excess of background concentrations. Calcium and magnesium are essential nutrients in surface and subsurface soils and therefore are not discussed further. Surface soil copper concentrations fall consistently within the range of 9.3 to 20.1 mg/kg with one exception as compared to a range of 5.4 to 17.1 mg/kg for background, thus copper

concentrations are barely elevated relative to background concentrations. A similar situation applies to lead (8.6 to 34.9 mg/kg at SWMU 5 versus 9.4 to 21.5 mg/kg in background surface soil) and, to a slightly lesser degree, zinc (30.3 to 120 mg/kg at SWMU 5 versus 24.4 to 60.2 mg/kg). Because the samples at the perimeter of the sampling pattern exhibit metal concentrations within background concentration ranges, the metals are well bounded in surface soils. The majority of the metals detected in subsurface soil samples were present at concentrations comparable to background concentrations. The exceptions are the Soil Group 9 samples (09SB040406 and 09SB090810). Just two of the 11 SWMU 9 subsoil samples belong to Soil Group 9 (rather than Soil Group 8). When compared to Soil Group 8 background data, the SWMU 5 subsurface metals concentrations fall within the range of background concentrations at virtually every location for all metals, except for cobalt in samples 05SB030406 (Soil Group 8) and 05SB070709 (Soil Group 9). The apparent exceedance of Soil Group 9 background concentrations is viewed to derive from the fact that the Soil Group 9 background data set contains only one value. This is discussed in more detail for a similar situation at SWMU 4 in the Summary of Section 4.4. In addition to generally not exceeding Soil Group 8 background concentrations, the SWMU 9 subsurface soil metals concentrations generally do not exceed risk-based criteria as evident by a dearth of criteria exceedance flags on Figure 6-10 (subsurface soil). Thus, subsurface metals contaminants are well bounded in all directions with the exception of cobalt in the vertical direction at these latter locations. Nevertheless, this is viewed to be a minor exception and the data are viewed to be sufficient to support the planned risk assessments.

Compared with metals detections in soil, fewer metals were detected in ground water samples (Figure 6-11). All metals detected in ground water, except calcium and selenium, were in excess of upgradient concentrations. The greatest barium concentration was detected west of the SWMU (well 09-02) and does not appear to be site-related, given the increasing trend from the SWMU toward the west. Furthermore, the barium concentrations did not exceed risk-based concentrations as evident by no risk-based concentration flags on Figure 6-11, therefore, this metal is not discussed further. Aluminum, cobalt, iron, manganese, nickel, selenium, and zinc display a concentration pattern similar to that of barium with concentrations increasing from SWMU 9 toward the west. The ground water manganese contamination appears to originate to the west of SWMU 9 between the line of western-most wells and the western SWMU 9 boundary. Historical time data indicate that all three wells outside the northern end of the SWMU (wells 09-02, 09-07, and 09-09) exhibit decreasing manganese concentrations from the early 1980s to 2002. For example, well 09-02 dissolved manganese concentrations (only filtered sample data are available) decreased from about 35,000 µg/L to about 5,000 µg/L and well 09-07 dissolved manganese concentrations decreased from about 63,000 µg/L to about 200 µg/L. Overall, concentrations of manganese, which is the only metal of significant interest, are greater outside the SWMU than within the SWMU. The available metals concentrations are sufficiently representative of site conditions to

support the planned risk assessments and further delineation of manganese contamination would be unwarranted. Because the manganese concentrations increase in the downgradient direction outside the SMWU, local geological effects should be suspected of causing the elevated manganese concentrations in the downgradient wells.

Few total metals (antimony, calcium, potassium, and sodium) were detected in unfiltered surface water samples at concentrations in excess of upgradient concentrations (Figure 6-12). Calcium, potassium, and sodium are essential nutrients and are not discussed further. The unfiltered antimony concentrations did not exceed risk-based concentration limits so the failure to completely bound this chemical relative to upgradient concentrations is of little consequence. Given that only one of the unfiltered surface water samples exhibited detectable antimony concentrations, there is some question as to whether the observed concentration is an artifact of laboratory contamination. Filtered samples also yielded few detectable metal concentrations in excess of upgradient concentrations. When upgradient exceedances of filtered samples did occur, the metal concentration was not in excess of a risk-based or regulatory criterion, except for arsenic, cobalt, copper, iron, lead, and manganese (essential nutrients excluded). Of these, metals, the concentrations are generally low or they are greater than the upgradient concentration only because a single upgradient filtered sample was collected. Because of this, no further delineation of metals in surface water is warranted based on the observed concentrations.

Aluminum, antimony, arsenic, chromium, cobalt, iron, manganese, vanadium, and zinc were present in sediment in excess of upgradient concentrations, however only copper and arsenic exceeded a risk-based concentration limit (Figure 6-13). The copper and arsenic exceedances were at a single location (09SW/SD05 and 09SW/SD03, respectively), and the exceedances were within two times the upgradient concentration. Given the lack of significant risk-based concentration exceedances, the fact that a single upgradient sample was used in the background comparisons and the limited exceedance for copper and arsenic, each at one sampling location, there is no need to further delineate metals contamination in SWMU 9 sediments.

As stated in earlier subsections, metals were detected in all sampled media and there does not appear to be any pattern associated with the metals contamination at SWMU 9. Metals detections generally do not coincide with significant VOC, pesticide, or herbicide detections. Metals contamination would not have been expected at this SWMU based on operational history. The observed high manganese concentrations appear to be steady or decreasing at individual wells and may even be due to local geology rather than site operations. The greatest manganese concentrations likely to be encountered by a receptor appear to have been established and there is no need to further delineate metals contamination. Organic chemicals appear to be sufficiently bounded to support the planned risk assessments. The

HHRA presented in Section 6.6.1 and the ERA presented in Section 6.6.3 discuss metals selected as COPCs for SWMU 9.

6.5 CONTAMINANT FATE AND TRANSPORT

This section presents a brief overview of contaminant fate and transport issues at SWMU 9. This discussion focuses on some of the major types of contaminants found at the site.

SWMU 9 is an inactive site composed of three distinct areas: Building 55, Building 2189, and the R-150 Tank area. Pesticide control activities occurred at Buildings 55 and 2189, which are no longer present at the site. Waste solvents were stored at the R-150 Tank area; the tank has been removed from the site. The three areas are located near each other in a triangular configuration. Building 2189 is 1,150 feet north of Building 55. The R-150 Tank area is approximately 800 feet southwest of Building 2189 and 700 feet northwest of Building 55.

Based on a review of the existing data for the site, a release of hazardous constituents to the surrounding soil has occurred as a result of historical site operations (i.e., pesticide management operations and waste solvents storage). The historical data also indicate that residual contaminants in the soil have migrated to ground water via infiltration and percolation. Additional release mechanisms, which are also expected to contribute to the contaminant transport, include discharge of ground water to surface water and sediment (unnamed tributaries), deposition via surface water runoff, and generation of fugitive dust and volatile emissions from soil.

The following classes of chemicals were detected in the media of concern at SWMU 9.

Soil - VOCs, PAHs, pesticides, PCBs, herbicides, and metals
Ground water - VOCs, pesticides, herbicides, and metals
Surface Water - Herbicides (2,4-D) and metals
Sediment - PAHs (Fluoranthene), PCBs, herbicides (pentachlorophenol), and metals

Fate and transport characteristics of these chemicals are briefly discussed in the following sections.

6.5.1 Volatile Organics

VOCs are typically considered to be fairly soluble and to have a low capacity for retention by soil organic carbon; therefore, these compounds are most frequently detected in ground water. These types of

chemicals may migrate through the soil column after they are released by a spill event or by subsurface waste burial as infiltrating precipitation solubilizes them. Some portion of these chemicals is retained by the soil, but most will continue migrating downward until they reach the water table. At that time, migration is primarily lateral with the hydraulic gradient. They may have migrated to surface water and sediment, but attenuation and dilution factors, such as volatilization, have resulted in their disappearance.

Three chlorinated VOCs were detected infrequently in soil samples at SWMU 9 (in one of 22 surface/subsurface soil samples) and seven chlorinated VOCs were detected in three of 12 ground water samples. The VOCs in ground water include the degradation products of PCE and TCE and are indicative of the natural attenuation of this class of chemicals. The soil and ground water data indicate that some impact of VOCs in soil on ground water may have occurred at the site.

6.5.2 Polycyclic Aromatic Hydrocarbons

PAHs are generally considered to be fairly immobile chemicals in the environment. They are large molecules with high organic carbon partition coefficients and low solubilities when compared to the volatile organics. These compounds, when found in the soil, generally do not migrate vertically to a great extent. Instead, they are more likely to adhere to soil particles and be removed from the site via surface runoff and erosional processes. Their absence in ground water is evidence of their immobility. Their presence in sediment may stem from surface erosion, but their absence in surface water is consistent with their low water solubilities and their ability to bind to soil and sediment.

6.5.3 Pesticides/Herbicides

Pesticides were widely used at NSWC Crane. Many of the detected compounds are no longer licensed for general sale and use in the United States. Therefore, it is assumed that much of what was detected at SWMU 9 is representative of past application for insect control.

Like PAHs, pesticides as a class of compounds are not considered to be very mobile in the environment. These chemicals, upon application or disposal, tend to remain affixed to soil particles. Migration of pesticides occurs primarily by erosion via the action of wind or water. Erosion accounts for their presence in sediment. Their absence in ground water and surface water is consistent with their ability to bind to soil and sediment and their low solubility in water.

6.5.4 Polychlorinated Biphenyls (PCBs)

PCBs are considered to be very persistent organic chemicals. Biodegradation is the only process known to transform PCBs under environmental conditions, and only the lighter compounds are measurably biodegraded. As with PAHs and pesticides, their absence in ground water and surface water is consistent with their ability to bind to soil and sediment and of their low solubility in water.

6.5.5 Inorganics

Because inorganics are frequently incorporated into the soil matrix and remain bound to particulate matter, they also migrate from the source areas via bulk movement processes (erosion). The larger particles (greater than 0.45 microns, which are removed via the filtration step prior to water analysis) are not generally considered to be mobile in ground water. The metals detected in unfiltered ground water samples are likely to be representative of suspended soil material in the samples.

There are some instances, however, where these metals are found at such concentrations or in such form as to be able to migrate in solution. It is possible that industrial activities could saturate all available exchange sites in soil and result in a metal being mobilized. Metals are also more mobile under acidic conditions, which may exist in areas where plating-type activities have occurred. Finally, a metal solution may be utilized in some industrial applications. In these cases, it is possible for metals to migrate vertically through the soil column and reach the ground water.

6.6 HUMAN HEALTH RISK ASSESSMENT

This section presents the results of the human health risk assessment for SWMU 9. The risk evaluation was performed using the general methodologies presented in Section 3.3. Site-specific information regarding data evaluation (i.e., the selection of COPCs), exposure assessment, characterization of estimated potential human health risks, and specific uncertainties for the risk screening process for the site are contained in the following sections.

6.6.1 Selection of Chemicals of Potential Concern

A medium-specific discussion of the chemicals selected as COPCs for SWMU 9 is provided in this section.

6.6.1.1 Soil

This section presents the results of the COPC selection process for surface and subsurface soil. The COPC screening process and the results of the screening are presented in Tables 6-12 and 6-13 for surface soil and in Tables 6-14 and 6-15 for subsurface soil.

COPC Selection for Surface Soil

Eleven surface soil samples were collected at SWMU 9 from a depth of 0 to 2 foot bgs. Three borings were placed around the former location of Building 2189; one boring was placed west of the building at a location where the ground surface slopes toward an unnamed tributary. Four borings were installed at locations dispersed throughout the R-150 Tank area. Two borings were placed around the former location of Building 55; one additional boring was placed west of the former building at a location where the ground surface slopes toward an unnamed tributary. The following chemicals were retained as COPCs for surface soil:

- Methylene chloride
- PAHs - benzo(a)anthracene, benzo(a)pyrene, naphthalene, 2-methylnaphthalene
- Pentachlorophenol
- Antimony

COPC Selection for Surface/Subsurface Soil

Twenty-two surface/subsurface soil samples were collected at SWMU 9 from depths of 2 to 10 feet bgs. Eleven subsurface soil samples were collocated with the surface soil samples discussed above. The following chemicals were retained as COPCs for surface/subsurface soil:

- Volatiles - methylene chloride, tetrachloroethene, and trichloroethene
- PAHs - benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, and naphthalene
- Pentachlorophenol
- Aroclor 1254
- Inorganics - aluminum, antimony, barium, chromium (total), and iron

These constituents were identified as COPCs in surface and subsurface soil because maximum concentrations exceeded one or more of the human health risk screening levels for residential land use

(i.e., U.S. EPA Region 9 risk-based screening levels for residential soil, U.S. EPA generic SSLs for migration to ground water, IDEM default closure levels for direct contact and migration to ground water, and representative basewide background concentrations). The maximum concentrations were also compared to U.S. EPA SSLs for migration from soil to air (inhalation). As shown in Tables 6-13 and 6-15, the maximum concentrations of all constituents were less than the inhalation SSLs. Therefore, potential risks from inhalation of chemicals detected in soil are expected to be minimal and this pathway was not evaluated further in the risk assessment. Chemicals present at concentrations greater than screening concentrations but within representative basewide background levels [aluminum, arsenic, barium, cadmium, chromium (total), iron, manganese, and nickel in surface soil and arsenic, cadmium, manganese, and nickel in surface/subsurface soil] are not considered to be site-related contaminants, were eliminated as COPCs, and were not carried through the quantitative risk assessment.

Migration from Soil to Ground water

As indicated in Tables 6-12, 6-13, 6-14, and 6-15, some constituents in soil were selected as COPCs because the maximum concentrations exceeded risk-based screening levels for residential soil exposure; some were selected as COPCs because the maximum concentration exceeded risk-based screening levels for residential soil and SSLs for migration to ground water; and some chemicals (methylene chloride, tetrachloroethene, trichloroethene, 2-methylnaphthalene, naphthalene, pentachlorophenol, antimony, barium, and chromium) were selected because the maximum concentrations of these chemicals exceeded SSLs for migration to ground water only. Because the reported concentrations of these chemicals were less than the screening levels for direct contact with soil and U.S. EPA generic SSLs for inhalation, potential risks from direct exposure to these COPCs in soil are expected to be minimal. However, exceedances of U.S. EPA and IDEM migration to ground water SSLs may indicate the potential for chemicals to leach to ground water and impact water quality. Of the organic chemicals detected in soil at SWMU 9 that exceeded SSLs for migration from soil to ground water, methylene chloride and trichloroethene were detected in ground water samples collected at the site, but in only two of 12 samples. In addition, several degradation products of tetrachloroethene and trichloroethene were detected in ground water at concentrations that exceeded risk-based screening levels and MCLs. The soil/ground water data, therefore, indicate that some contaminants (i.e., chlorinated volatile organics) in soil may have impacted ground water at the site. The ground water data for SWMU 9 is discussed in Section 6.6.1.2.

6.6.1.2 Ground water

Table 6-16 presents details of the COPC selection process for ground water. The COPC selection for ground water at SWMU 9 is based on analytical data from 12 unfiltered ground water samples collected from monitoring wells installed at the site. One well, 09TP0601, was used as the upgradient well for COPC selection. The following chemicals were retained as COPCs in ground water:

- Volatiles - 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, and trichloroethene
- Dieldrin
- Inorganics - aluminum, arsenic, barium, beryllium, iron, manganese, and nickel

These constituents were identified as COPCs in ground water because the maximum concentrations exceeded one or more of the human health screening levels (i.e., U.S. EPA Region 9 risk-based screening concentrations, federal MCLs or SMCLs, and IDEM residential default closure levels for ground water). No chemicals were eliminated from the quantitative risk assessment on the basis of background because maximum concentrations in the site ground water samples were greater than concentrations in the upgradient well.

6.6.1.3 Surface Water

Table 6-17 summarizes the COPC selection process for surface water at SWMU 9. Four unfiltered surface water samples were collected to assess potential risks associated with ground water discharge and surface runoff. The samples were collected in the unnamed tributary west of the former location of Building 2189, the R-150 Tank area, and a location potentially affected by surface water runoff and/or ground water discharge from Building 55. Four filtered samples were also collected from the surface water locations. There is no significant difference between the filtered and unfiltered results, indicating that turbidity did not greatly impact the unfiltered sample results. One sample, B09SW0101, upstream of the site was used as background for COPC selection.

The following chemical was retained as COPCs in surface water:

- Antimony

Antimony was selected as a COPC in surface water because the maximum concentration exceeded the U.S.EPA Region 9 risk-based screening concentration but was less than the federal MCL and the IDEM residential default closure level. Note that the use of these criteria for surface water assumes that the

surface water is used as a drinking source (i.e., potential receptors ingest 2 liters of water per day/ 350 days per year). Drinking water criteria are used because surface water criteria for human health are currently not available. The use of these criteria for screening and risk assessment is conservative because it is unlikely that the water in the creek, drainageways, or marshy areas would ever be used as a source of drinking water. Aluminum, arsenic, iron, and manganese were eliminated as COPCs on the basis of the comparison with concentrations in the upgradient sample.

6.6.1.4 Sediment

Table 6-18 summarizes the COPC selection process for sediment at SWMU 9. Four sediment samples collocated with the surface water samples were collected during the investigation, and sample B09SD0101 was used as the upgradient surface water location for COPC selection. The following chemicals were retained as COPCs in sediment:

- Aroclor 1248
- Inorganics - aluminum, antimony, iron, and manganese

These constituents were identified as COPCs in sediment because maximum concentrations exceeded U.S. EPA Region 9 risk-based screening levels for residential soil, IDEM default closure levels for direct contact, and concentrations in the upgradient sample. The use of the U.S. EPA Region 9 and IDEM risk-based concentrations for soil to evaluate COPC concentrations in sediment is conservative because these criteria were established assuming residential land use scenarios (e.g., routine daily contact with soils). However, it is anticipated that a human receptor would be exposed to the sediments in the streams and marshy areas of the site on a less frequent basis than is assumed for a typical residential exposure to soil. Consequently, the use of soil criteria for screening and risk estimation is likely to overestimate potential risks from exposure to sediment. No chemicals in sediment were eliminated from the quantitative risk assessment on the basis of background because concentrations in the maximum site sediment samples were greater than concentrations in the upgradient sample.

6.6.2 Exposure Assessment

This section presents the exposure assessment for SWMU 9. The general exposure assessment approach and the exposure factors, which serve as the basis of the risk assessment, are provided in Section 3.3.3.

6.6.2.1 Conceptual Site Model - SWMU 9

The CSM for the Pesticide Control/R-150 Tank Area, which defines the contaminant source, transport mechanisms, exposure routes, and potential receptors for the site, is presented as Figure 6-14. Based on a review of the existing data for the site, a release of hazardous constituents to the surrounding soil has occurred as a result of historical site operations (i.e., pesticide management operations and waste solvents storage). The historical data also indicate that residual contaminants in the soil have migrated to ground water via infiltration and percolation. Additional release mechanisms, which are also expected to contribute to the contaminant transport, include discharge of ground water to surface water and sediment (unnamed tributaries), deposition via surface water runoff, and generation of fugitive dust and volatile emissions from soil.

Likely future land use at the Pesticide Control/R-150 Tank Area is expected to be similar to current land use. Pesticide management activities no longer occur at the site, and the R-150 Tank has been removed from the site. As mentioned previously, the site is currently inactive.

Based on the general scenarios and receptor classes identified in Section 4.0 of the work plan, the following potential receptors may be exposed to contaminated media at the site:

- Trespassers (ages 6 to 17 years) - Likely receptor under current and 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 (i.e., the site is not patrolled or enclosed by a fence). This receptor may be exposed to potentially contaminated surface soil, air and surface water and sediment in the unnamed tributaries located near the site.

- Maintenance Workers - Likely receptor under current and future land use. Under current land use, some portions of the site, near the access road, are maintained. This receptor may be exposed to potentially contaminated surface soil and air. Exposure to ground water at the site and surface water and sediment in the unnamed tributary that leads to Boggs Creek is not expected to occur.

- Construction Workers - Potential receptor under future land use. No construction activities are currently planned at the site. However, the site could be developed or a small, short-term construction project, such as a utility installation, could result in exposure to potentially contaminated media. This receptor may be exposed to surface and subsurface soil, air, and ground water.

- Occupational Workers - Potential receptor under future land use. The site could be developed and used for occupational purposes. This receptor may be exposed to surface soil, air, and ground water.

- Recreational Users - Potential receptor under future land use. If the Facility were to close, the most likely scenario is that the property would be converted into a state park. This receptor may be exposed to potentially contaminated surface soil, air, and surface water and sediment in the unnamed tributaries located near the site. However, it is highly unlikely that NSWC Crane would close because principal base operations, the demilitarization of munitions, are critical to the support of the U.S. Naval fleet.

- Residents - Potential receptor under future land use. The site could be developed for residential land use, if the Facility were to close. Future residents may be exposed to potentially contaminated surface soil, air, ground water, and surface water and sediment. Although this scenario is highly unlikely, a future residential scenario is typically evaluated in the 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.

Table 6-19 presents a summary of the potentially complete and incomplete exposure pathways for potential receptors at SWMU 9. Details regarding the assumed receptor characteristics (intake rate, frequency and duration of exposure, body weight, etc.) are defined in Section 3.3, which presents the methodologies for the human health risk assessment.

As indicated in Section 3.3.3, the following exposure pathways are evaluated in the human health risk for SWMU 9.

- Ingestion of soil, sediment, ground water, and surface water
- Dermal contact with soil, sediment, ground water, and surface water
- Inhalation of air (transfers from soil to air)
- Inhalation of air (transfers from ground water to air for volatiles only)

Based on the human health risk screening presented in Table 6-13 (surface soil) and Table 6-15 (subsurface soil), exposure via inhalation of contaminants migrating from soil to air is not expected to be a significant exposure pathway. Maximum site concentrations do not exceed the available U.S. EPA generic SSLs for transfers from soil to air. In addition, a large portion of the site is overgrown with vegetation, which would limit emissions and mechanical suspension of soil particulates. Because VOCs

were selected as COPCs in ground water, the inhalation while showering pathway is quantified for hypothetical future residents in the risk assessment.

95% UCLs were used as the EPCs for exposure to surface soil, surface/subsurface soil, and ground water, and maximum detected concentrations were used as EPCs for surface water and sediment because the datasets consisted of fewer than 10 samples. The EPCs for those chemicals identified as COPCs in surface soil, subsurface soil, ground water, surface water, and sediment at SWMU 9 are presented in Table 6-20.

6.6.3 Risk Characterization

This section contains a summary of the human health risk assessment for SWMU 9. Uncertainties associated with the risk estimates are discussed in Section 6.6.4. The methodology used to calculate the risks presented in this section is provided in Section 3.3. Quantitative risk estimates for potential human receptors are developed for those chemicals identified as COPCs. Potential noncarcinogenic and carcinogenic risks for the construction worker, maintenance worker, occupational worker, adult recreational user, adolescent trespasser, and future residents (adult and child) under the RME and CTE scenarios are summarized in Tables 6-21 and 6-22, respectively. The RAGS Part D Table 9s in Appendix G.3 provide the chemical-specific risks for each COPC and the total HIs for affected target organs. Risks for each receptor are summed across all applicable exposure routes. Example risk spreadsheets containing the detailed, chemical-specific risks are included in Appendix G.1. A discussion of the estimated noncarcinogenic and carcinogenic risks is provided in the remainder of this section.

Noncarcinogenic Risks – RME

Cumulative HIs for the construction worker, maintenance worker, occupational worker, adult recreational user, and adolescent trespasser under the RME scenario are less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure conditions. Cumulative HIs for the future adult and child resident exceed unity.

Cumulative HIs for the future adult and child residents are 14 and 47, respectively. These risks result from exposure to the maximum concentration of cis-1,2-dichloroethene (adult HI = 0.49, child HI = 1.8), iron (adult HI = 1.7, child HI = 6.0), manganese (adult HI = 10, child HI = 35), and nickel (adult HI = 0.36, child HI = 1.3) in ground water, primarily by ingestion.

The HIs calculated for residential exposure to ground water are subject to the following sources of uncertainty:

- The calculated risks are based on analytical results for unfiltered ground water samples. Metal concentrations may be elevated because of suspended particulate matter in the samples.

- There is uncertainty associated with the toxicity criteria used to estimate potential risks for iron. The NCEA provisional RfD for iron, which is based on allowable daily intakes rather than adverse effect levels, was used to quantify risks from exposure to iron. Since the provisional RfD is not based on adverse health effects, the risks associated with iron are likely overestimated.

- The risks calculated for cis-1,2-dichloroethene were based on the maximum detected concentration (0.13 mg/L) of this compound (because the 95 percent UCL exceeded the maximum). Cis-1,2-dichloroethene was detected in three of 12 ground water samples, with an average concentration of 0.02 mg/L. It is likely that the risks from cis-1,2-dichloroethene in ground water are overestimated by assuming that hypothetical future residents are exposed to the maximum concentration for a lifetime.

- The residential ground water scenario assumes that ground water at the site is used as a source of domestic drinking water. However, because of the shallow depth to ground water and the nature of the site, it is unlikely that ground water at the site would be used as a source of potable water in the future.

The HIs associated with direct exposure to other media at the site are minimal for all receptors (i.e., HIs are less than unity).

Carcinogenic Risks

Cumulative ILCRs for the construction worker, maintenance worker, occupational worker, and adolescent trespasser are less than the U.S. EPA target risk range, $1x10^{-6}$ to $1x10^{-4}$. The ILCR for the future adult recreational user is within the U.S. EPA's target risk range. The total residential ILCR (adult + child) is 1.9×10^{-4}, which slightly exceeds the target risk range.

As shown in the RAGS Part D tables located in Appendix G.6, the elevated carcinogenic risks for residents are primarily a result of exposure to arsenic in ground water (by ingestion) and sediment and to chlorinated

volatile organics in ground water. Arsenic accounts for approximately 48 percent of the total carcinogenic risk, and volatiles (namely, 1,1-dichloroethene and trichloroethene) account for 46 percent of the cancer risk.

The carcinogenic risks calculated for residential exposure to ground water are subject to the following sources of uncertainty:

- Arsenic was detected in 12 of 12 ground water samples at SWMU 9 at a maximum concentration of 4.6 µg/L. This concentration is less than the current MCL for arsenic (50 µg/L) and the recently proposed MCL (10 µg/L). In addition, the concentrations of arsenic in eight of the 12 ground water samples were less than the sample quantitation limit for the upgradient well (1 µg/L) and it is likely that the concentrations of arsenic in ground water at the site are within naturally occurring levels. Carcinogenic risks from exposure to arsenic may be overestimated based on the body's ability to metabolize arsenic (see Section 6.6.4.5). If arsenic were not selected as a COPC, potential carcinogenic risks to hypothetical future residents would be within U.S. EPA's target risk range.

- Risks from exposure to volatiles in ground water are mainly attributable to 1,1-dichloroethene (1,1-DCE). 1,1-DCE was detected in one of 12 samples at a maximum concentration of 6.4 µg/L. This concentration is less than the current U.S. EPA MCL and IDEM residential default closure level for ground water. In addition, 1,1-DCE was classified as a Class C carcinogen by U.S. EPA, indicating that it is a possible human carcinogen and has not been shown to cause cancer in humans.

The carcinogenic risks associated with exposure to other media at the site are minimal for all receptors (i.e., ILCRs are less than or within the U.S. EPA target risk range).

The significant sources of uncertainty are further discussed in Section 6.6.4.

6.6.3.1 CTE Evaluation

As discussed in Section 3.3.2.2, an evaluation of the potential risks associated with the CTE scenario is included to provide a measure of the central or average case exposure. Summaries of the estimated risks for the CTE scenarios are contained in Table 6-22.

Cumulative HIs for the construction worker, maintenance worker, occupational worker, adult recreational user, and adolescent trespasser under the CTE scenario are less than unity (1), indicating that no toxic effects are anticipated for these receptors under the CTE exposure conditions. Cumulative HIs for the future adult and child resident exceed unity. Cumulative HIs for the CTE for future adult and child

residents are 9.1 and 20, respectively. These risks are the result of exposure to iron and manganese in ground water.

Cumulative ILCRs for the construction worker, maintenance worker, adult recreational user, occupational worker, and adolescent trespasser are less than the U.S. EPA target risk range, $1x10^{-6}$ to $1x10^{-4}$, and ILCRs for future residents (adult + child) were within the target risk range.

6.6.3.2 Evaluation of Chemicals Eliminated on the Basis of Background Comparison

This following chemicals were eliminated as COPCs solely on the basis of comparison to background.

Surface chemicals eliminated on the basis of background: Al, As, Fe, Mn.

Subsurface soils eliminated on the basis of background: As, Mn.

Ground water: None.

Surface water: Al, As, Fe, Mn.

Sediment: None.

Qualitative Risk Evaluation of Metals Eliminated as COPCS Based on Background Comparison.

Aluminum, arsenic, iron, and manganese were detected in soils and/or sediments at concentrations exceeding the conservative screening levels established for COPC selection but were not selected as COPCs because study area concentrations did not exceed background concentrations. The following table provides a qualitative risk evaluation of these metals by comparing the maximum detected concentrations to the EPA Region 9 PRGs for residential and industrial soil exposure.

Parameter	Surface Soil Concentration (mg/kg)	Subsurface Soil Concentration (mg/kg)	Sediment Concentration (mg/kg)	Region 9 Residential (mg/kg)	Region 9 Industrial PRG (mg/kg)	Literature Background (mg/kg)
Aluminum	12,900			76,000	100,000	10,000 – 300,000
Arsenic	9.6	9.6		0.39	1.6	0.1 - 97
Iron	20,100			23,000	100,000	7,000 – 555,000

Manganese	1,060	1,060		1,800	19,000	100 – 4,000

The PRGs presented for aluminum, iron, and manganese are based on the potential for non-cancer health effects (the values are 10 times the COPC screening levels used in this HHRA). The maximum detected concentration of aluminum is approximately one-sixth the relevant residential PRG, and one-eighth the relevant industrial PRG. However, based on toxicity information provided by EPA Region 1, the Region 9 PRG for aluminum is very conservative and may over predict the potential for non-cancer effects. The maximum detected concentration of manganese is two-thirds the relevant residential PRG, and approximately one-eighteenth of the relevant industrial PRG. The maximum detected concentration of iron does not exceed the PRG. The PRG for iron is a very conservative risk-based concentration based on a recommended daily intake for iron. The PRG presented for arsenic is based on the potential for cancer effects and represent the 1 $x10^{-6}$ (one-in-one-million) cancer risk level (the values are the COPC screening levels used in this HHRA). PRGs representing the 1 $x10^{-5}$ and 1 $x10^{-4}$ cancer risk levels would be 10 and 100 times the values presented for the 1 $x10^{-6}$ cancer risk level. Consequently, the maximum detected concentration of arsenic exceeds the 1 $x10^{-6}$ and 1 $x10^{-5}$ cancer risk levels, but not the1 $x10^{-4}$ risk level. Additionally, as indicated above, the metals concentrations reported in the soils and sediments are within the background range reported in the literature.

Aluminum, arsenic, iron, and manganese were detected in surface water at concentrations exceeding the conservative screening levels established for COPC selection but were not selected as COPCs because study area concentrations did not exceed background concentrations. The following table provides a qualitative risk evaluation of these metals by comparing the maximum detected concentrations to the EPA Region 9 PRGs for tap water and the Federal SDWA MCLs:

Parameter	Ground Water Concentration (µg/L)	Surface Water Concentration (µg/L)	Region 9 PRG (µg/L)	Federal SDWA MCL (µg/L)
Aluminum		245	36,000	50 to 200(1)
Arsenic		1.9	0.045	10
Iron		1,830	11,000	300(1)
Manganese		583	880	50(1)

1 Secondary (aesthetic-based) MCLs are presented for aluminum, iron and manganese.

The PRGs for aluminum, iron and manganese are based on the potential for non-cancer effects. The risk-based screening levels for surface water are based on COPC screening levels for tap water ingestion, which are based on daily, residential exposure assumptions, and are used to select COPCs for ground

water and surface water. In general, the use of tap water screening levels is regarded as a highly conservative approach to COPC selection for surface water. Potential human exposure to surface water at SWMU 9 is expected to be limited to incidental exposures (such as that which occurs during trespassing), which is significantly less than the daily exposure assumed during the development of the ground water screening criteria. Because of this, the risks from exposure to surface water were recalculated based on exposure to the maximum detected concentration for the future adult and child resident receptors. These receptors represent the most sensitive receptors assumed to be exposed to surface water. Non-cancer calculations show that the hazard indices for both the future adult and child resident are less than one. Cancer risk calculations show that the ILCR for the future adult resident is slightly more than 1×10^{-6}, and the ICLR for the future child resident is slightly less than 1×10^{-6}. As noted above, based on toxicity information provided by EPA Region 1, the Region 9 PRG for aluminum is very conservative and may over predict the potential for non-cancer effects. Also, as noted above, the PRG for iron is a very conservative risk-based concentration because it is actually based a recommended daily intake for iron. Based on this discussion, the results and conclusions of the risk assessment are not affected by the elimination of aluminum, arsenic, iron, and manganese from the quantitative risk assessment for surface water.

6.6.4 Uncertainty Analysis

A summary of the uncertainties specific to the human health risk screening for SWMU 9 is included in this section. The impact of a particular uncertainty on the results of the risk screening is also identified. General uncertainties associated with the risk estimates were discussed in Section 3.3.5.

6.6.4.1 Uncertainty in the Analytical Data

The databases for surface water and sediment at SWMU 9 contain fewer than 10 samples. However, the field sampling program for SWMU 9 was biased toward the areas most likely to demonstrate contamination (i.e., the buildings around which pesticide control activities occurred and area around the R-150 tank). The fact that only a small number of samples is used to estimate risks can result in uncertainty both with regard to the COPC selection and in the EPCs used to estimate potential risks. This may result in an overestimation of risks because maximum concentrations are used as EPCs when datasets contain fewer than 10 samples.

6.6.4.2 Uncertainty Associated with COPC Selection

Some constituents identified as COPCs in soil were conservatively selected as COPCs because maximum concentrations exceeded U.S. EPA and IDEM SSLs for migration from soil to ground water for a DAF of 1. However, U.S. EPA's Soil Screening Guidance (U.S. EPA, May 1996) states, "The EPA has

selected a default DAF of 20 to account for contaminant dilution and attenuation during transport through the saturated zone to a compliance point (i.e., receptor well). At most sites, this adjustment will more accurately reflect a contaminant's threat to ground water resources than assuming a DAF of 1 (i.e., no dilution or attenuation)." The guidance further states, "A DAF of 20 is protective for sources up to 0.5 acres in size" and "can be protective of larger sources as well." If a DAF of 20 had been used in the COPC selection process, some compounds, for example, methylene chloride, tetrachloroethene, trichloroethene, and pentachlorophenol, would not have been selected as COPCs. However, use of a DAF of 1 for screening is not expected to significantly affect the results of the risk assessment because the risks calculated for COPCs selected using a DAF of 1 were minimal.

COPCs for ground water were selected based on the analytical results from unfiltered ground water samples. It is possible that risk estimates based on the unfiltered ground water samples are overestimated.

Drinking water criteria were used as the basis of screening levels for surface water, and residential soil criteria were used for sediment. This assumes that the surface water is used as a drinking source (i.e., potential receptors ingest 2 liters of water per day/350 days per year) and potential receptors are exposed to sediment on a daily basis (i.e., 350 days a year). Drinking water criteria are used because surface water criteria for human health are currently not available. The use of these criteria for screening and risk assessment is conservative because it is unlikely that the water in the creek, drainageways, or marshy areas would ever be used as a source of drinking water. In addition, exposure to sediments in the streams and marshy areas of the site is expected to occur on a less frequent basis than is assumed for a typical residential exposure to soil.

6.6.4.3 Uncertainty Associated with the Use of Background

Aluminum, arsenic, barium, cadmium, chromium (total), iron, manganese, and nickel in surface soil and arsenic, cadmium, manganese, and nickel in surface/subsurface soil were eliminated from the list of COPCs for SWMU 9 because statistical analyses indicate that concentrations of these chemicals were shown to be within representative basewide background levels. Omission of these chemicals from the risk evaluation may underestimate the potential risks for exposure at SWMU 9. However, a high level of confidence is associated with the representative basewide background concentrations. Numerous background samples (greater than 100 samples) were collected during the Crane Background Soil Investigation. Additionally, the resultant background data were evaluated for outliers and statistically evaluated using various testing methods, which leads to a high degree of confidence in the established

representative concentrations. Consequently, omission of these metals from the soil risk assessment is unlikely to result in an underestimation of site-related chemical risks for SWMU 9.

Since basewide background data are not available for ground water, surface water, and sediment, concentrations in upgradient samples were used for background comparison by comparing the maximum site concentration of a constituent to the concentration in the sample from the upgradient location. This method of screening inorganic compounds may result in retaining inorganic compounds as COPCs that would not have been selected as COPCs based on a more rigorous statistical background evaluation. Therefore, risks for these media may be overestimated. This is especially important in the case of arsenic in ground water, which was identified as a risk driver in the risk assessment. Arsenic was detected in ground water samples at a maximum concentration of 4.6 µg/L, but the concentrations of arsenic in most ground water samples were less than the quantitation limit of arsenic in the upgradient well and it is likely that the concentrations of arsenic in ground water at the site are within naturally occurring levels. If arsenic were eliminated as a COPC, the total cancer risk estimates would be within the U.S. EPA's target range.

6.6.4.4 Uncertainty in the Exposure Assessment

General uncertainties associated with the exposure assessment are discussed in Section 3.3.1.5.2. A major source of uncertainty for SWMU 9 is the assumption of future residential use of the site. As stated previously, development of the site development of the site for future residential use is unlikely. Therefore, the calculated theoretical residential risks for soil, ground water, surface water, and sediment do not represent current site usage and overestimate risks for receptors under current and anticipated future land use patterns.

Risks from exposure to ground water are based on the assumption that the ground water at the site is used as a source of domestic drinking water. The residential drinking water scenario is evaluated to be conservative although ground water at the site is not used and is not expected to be used as a source of potable water. In addition, the risks calculated for the major noncarcinogenic risk drivers (cis-1,2-dichloroethene, iron, and manganese) were based on the maximum detected concentrations of these constituents because the 95% UCL exceeded the maximum. It is likely that the risks from these constituents in ground water are overestimated by assuming that hypothetical future residents are exposed to the maximum concentration for a lifetime.

Current U.S. EPA guidance (U.S. EPA, 2000) does not provide dermal absorption factors for exposure to volatiles and most metals (except arsenic and cadmium) in soil. Therefore, risks for dermal contact from

soil are not evaluated for volatiles and most metals in this risk assessment. Consequently, risks from exposure to soil may be underestimated by omitting dermal exposure to volatiles and metals from the quantitative risk assessment.

6.6.4.5 Uncertainty in the Toxicity Criteria

Aluminum and iron were identified as COPCs for surface/subsurface soil, ground water, and sediment at SWMU 9. There is uncertainty associated with the toxicity criteria used to estimate potential risks for these chemicals. Provisional RfDs for aluminum and iron, which are based on allowable daily intakes rather than adverse effect levels, were used to quantify risks from exposure to these constituents. Since the provisional RfDs are not based on adverse health effects, the risks associated with these chemicals are expected to be overstated. Additionally, risks calculated for iron are based on an RfD of 0.6 mg/kg/day. However, based on U.S. EPA Region 3 guidance received in March 2000, this RfD is not recommended for the evaluation of childhood exposures. The nutritional needs of children differ from adults, and a more appropriate RfD for children would be 1.1 mg/kg/day. Consequently, risks calculated for the child resident for exposure to iron may be overestimated by a factor of 1.83 (1.1/0.6).

Arsenic was identified as a risk driver in ground water. Although the more restrictive basis for evaluating risk associated with exposure to arsenic is to assume it is a carcinogen, carcinogenic effects are not primary health effects expected to be manifested upon exposure to arsenic. The preponderance of scientific information indicates that humans are capable of metabolizing arsenic to expedite its elimination from the body. Its elimination from the body obviously mitigates the possibility for arsenic to manifest carcinogenic effects. Therefore, evaluating arsenic as a noncarcinogen would be more appropriate. Specifically, the body methylates the arsenic to form monomethyl arsenic and dimethyl arsenic. There is a limited capacity for the body to metabolize methylate arsenic, but this limit is generally reached when the body's intake of arsenic approximately exceeds 500 µg/day. The maximum detected concentration of arsenic in ground water at the site is 4.6 µg/L. Assuming a water ingestion rate of 2 liters per day, exposure to this concentration corresponds to an approximate intake of 9.2 µg/day for exposure to ground water. This intake is well within the body's ability to metabolize arsenic. Although some humans may be more sensitive to arsenic, in that they are "poor methylators," the maximum exposure concentration for the site is more than an order of magnitude below the normal limit of metabolic saturation and is most likely below levels that would trigger responses in sensitive individuals.

Risks from exposure to volatiles in ground water are mainly attributable to 1,1-dichloroethene. However, 1,1-dichloroethene was classified as a Class C carcinogen by U.S. EPA indicating that it is a possible human carcinogen and has not been shown to cause cancer in humans. The CSF for 1,1-dichloroethene is based

on the presence of tumors in one mouse in one inhalation study (IRIS, 2001) and is, therefore, subject to much uncertainty.

6.6.5 Summary and Conclusions

This section summarizes the results of the human health risk assessment performed for SWMU 9. A brief summary of the information contained in the human health risk assessment is provided in this section.

SWMU 9 is an inactive site composed of three distinct areas: Building 55, Building 2189, and the R-150 Tank area. Pesticide control activities occurred at Buildings 55 and 2189, which are no longer present at the site. Waste solvents were stored at the R-150 Tank area; the tank has been removed from the site. The three areas are located near each other in a triangular configuration. Building 2189 is 1,150 feet north of Building 55. The R-150 Tank area is approximately 800 feet southwest of Building 2189 and 700 feet northwest of Building 55.

The baseline human health risk assessment for SWMU 9 was performed to characterize the potential risks to likely human receptors under current and future land use. Potential receptors under current land use are adolescent trespassers. Potential receptors under future land use are construction workers, maintenance workers, occupational workers, recreational users, and hypothetical residents (adults and children). Although future land use is likely to be the same as current land use, the potential future receptors were evaluated in the baseline human health risk assessment, primarily for decision-making purposes. The evaluation of these receptors is based on the assumption that, if various site conditions were to change in the future, potential exposure could occur if the site were developed.

Potential risks associated with inhalation exposures are considered to be minimal. Inhalation of volatile emissions and fugitive dust was evaluated qualitatively via a comparison of site data with U.S. EPA generic SSLs for transfers from soil to air. Inhalation exposure was considered to be relatively insignificant because all detected soil concentrations were less than the SSLs. In addition, the majority of the site is vegetated, thereby reducing the generation of fugitive dust via wind erosion. Inhalation of volatiles from surface water and sediment was considered to result in insignificant exposures compared to ingestion and dermal exposures. The inhalation of volatiles from ground water, which could occur during showering, bathing, and other routine household activities, was evaluated for SWMU 9 because several chlorinated volatile organics were identified as COPCs in ground water.

The list of COPCs for SWMU 9 includes the following:

- Surface soil - methylene chloride, benzo(a)anthracene, benzo(a)pyrene, naphthalene, 2-methylnaphthalene, pentachlorophenol, and antimony.

- Surface/subsurface soil - methylene chloride, tetrachloroethene, trichloroethene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, pentachlorophenol, Aroclor 1254, aluminum, antimony, barium, chromium (total), and iron

- Ground water - 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, trichloroethene, dieldrin, aluminum, arsenic, barium, beryllium, iron, manganese, and nickel.

- Surface Water - antimony.

- Sediment - Aroclor 1248, aluminum, antimony, iron, and manganese.

Quantitative estimates of noncarcinogenic and carcinogenic risks (HIs and ILCRs, respectively) were developed for potential human receptors. Minimal risks (i.e., HIs less than unity and ILCRs within the U.S. EPA target risk range) were calculated for construction workers, maintenance workers, occupational workers, adult recreational users, and adolescent trespassers. Elevated risks were estimated for residents (child and adult) under future land use. HIs for future adult and child residents exceeded unity, and the cumulative ILCRs for future residents (adult + child) exceeded 1.0×10^{-4}, the upper limit of the U.S. EPA target risk range.

The greater than unity HIs resulted from exposure to cis-1,2-dichloroethene, iron, manganese, and nickel in ground water, primarily by ingestion, and the ILCRs greater than the U.S. EPA target risk range are the result of exposure to arsenic and chlorinated volatile organics (primarily, 1,1-dichloroethene and trichloroethene) in ground water. However, significant uncertainties were associated with the risks calculated for residential exposure to ground water at SWMU 9:

- The calculated risks are based on analytical results for unfiltered ground water samples. Metal concentrations may be elevated because of suspended particulate matter in the samples.

- There is uncertainty associated with the toxicity criteria used to estimate potential risks for iron. The NCEA provisional RfD for iron, which is based on allowable daily intakes rather than adverse effect levels, were used to quantify risks from exposure to iron. Since the provisional RfD is not based on adverse health effects, the risks associated with iron are likely overestimated.

- The risks calculated for cis-1,2-dichloroethene, iron, and manganese were based on the maximum detected concentrations of these constituents (because the 95 percent UCL exceeded the maximum). Cis-1,2-dichloroethene was detected in three of 12 ground water samples with an average concentration of 0.02 mg/L. It is likely that the risks from these constituents in ground water are overestimated by assuming that hypothetical future residents are exposed to the maximum concentration for a lifetime.

- Arsenic was detected in 12 of 12 ground water samples at SWMU 9 at a maximum concentration of 4.6 µg/L. This concentration is less than the current MCL for arsenic (50 µg/L) and the recently proposed MCL (10 µg/L). In addition, the concentrations of arsenic in eight of the 12 ground water samples were less than the sample quantitation limit for the upgradient well (1 µg/L) and it is likely that the concentrations of arsenic in ground water at the site are within naturally occurring levels. In addition, carcinogenic risks from exposure to arsenic may be overestimated based on the body's ability to metabolize arsenic. If arsenic were not selected as a COPC, potential carcinogenic risks to hypothetical future residents would be within the U.S. EPA's target risk range.

- Risks from exposure to volatiles in ground water are mainly attributable to 1,1-dichloroethene. 1,1-dichloroethene was detected in one of 12 samples at a maximum concentration of 6.4 mg/L. This concentration is less than the current U.S. EPA MCL and IDEM residential default closure level for ground water. In addition, 1,1-dichloroethene was classified as a Class C carcinogen by U.S. EPA, indicating that it is a possible human carcinogen and has not been shown to cause cancer in humans. There is also uncertainty in the CSF for 1,1-dichloroethene because it is based on the presence of one tumor in one mouse in one inhalation study (IRIS, online 2001).

- The residential ground water scenario assumes that ground water at the site is used as a source of domestic drinking water. However, because of the shallow depth to ground water and the nature of the site, it is unlikely that ground water at the site would be used as a source of potable water in the future.

In summary, for SWMU 9, no significant potential health risks for human receptors were determined under current land use. Under future land use, elevated noncarcinogenic and carcinogenic risks were calculated for potential residential exposure to chlorinated volatile organics (cis-1,2-dichloroethene, 1,1-dichloroethene, trichloroethene), arsenic, iron, manganese, and nickel in ground water. However, significant uncertainties are associated with the risks calculated for these risk drivers: uncertainty in the assumption of residential exposure, uncertainty in the exposure point concentrations because of the use of maximum concentrations to estimate potential risks, uncertainty in the toxicity of 1,1-dichloroethene, arsenic, and iron, and uncertainty

in the selection of arsenic as a COPC because the concentrations of arsenic are probably within naturally occurring background levels at the site. A summary of the major contributors to risk at SWMU 9 is provided in Table 6-23.

6.7 ECOLOGICAL RISK ASSESSMENT

6.7.1 Site Description

Section 1.0 of this report presents the site background, site layout, and a general site description. The following text discusses the site description as it pertains to the ecological habitat at the site. The ecological checklist for the site is included in Appendix H.5.

SWMU 9, the Pesticide Control/R-150 Tank Area, has been stocked with locust trees in the past. Other trees near this site include white ash (*Fraxinus americana*), largetooth aspen (*Populus grandidentata*), black cherry (*Prunus serotina*), black gum (*Nyssa sylvatica*), pignut hickory (*Carya spp.*), shagbark hickory (*Carya spp.*), black locust (*Robinia pseudoacacia*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), black oak (*Quercus velutina*), chestnut and red oak (*Quercus spp.*), scarlet oak (*Quercus coccinea*), shingle oak (*Quercus imbricaria*), white oak (*Quercus alba*), persimmon (*Diospyros virginiana*), Virginia pine (*Pinus virginiana*), yellow poplar (*Liriodendron tuliplfera.*), redbud (*Cercis canadensis*), sassafras (*Sassafras albidum*), and black walnut (*Juglans nigra*).

The drainage ditches at SWMU 9 eventually discharge to Boggs Creek. The Boggs Creek-Goldsberry Hollow waterbody segment designated state water uses are aquatic life support, fish consumption, and primary contact. This waterbody segment was not assessed as part of the 2004 Indiana Integrated Water Quality Monitoring and Assessment Report to determine if the waterbody was supporting those uses (IDEM, 2004). However, the Boggs Creek-Buzzard Run waterbody segment, located downstream of the Boggs Creek-Goldsberry Hollow waterbody segment, is fully supporting the aquatic life support and primary contact water uses; it was not assessed for the fish consumption water use (IDEM, 2004).

Boggs Creek discharges off-site to the East Fork of the White River. River otters, a state endangered species, 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 (IDFW, 2000). Also, the East Fork of the White River is the site for an ongoing study of lake sturgeon populations, another state endangered species (IDFW, 2000). Finally, spotted darters, a state endangered species, has been found in the East Fork of the White River (IDFW, 2000). Note that other threatened, endangered, or special concern species also may be present in the water bodies just off-site of Crane, as well.

6.7.2 Potential Ecological Receptors and Exposure Pathways

Based on the above description of the site and potential contaminant migration pathways, ecological receptors could be directly exposed to chemicals in the surface water and surface soil (i.e., plant and soil invertebrates) and indirectly via the food chain (i.e., through the ingestion of plants and invertebrates). Figure 6-15 presents the conceptual site model for SWMU 9. Additionally, ecological receptors (i.e., aquatic invertebrates) could be exposed to chemicals in the surface water and sediment in the stream. The following assessment endpoints (and surrogate wildlife species where applicable) were selected for this site:

- Soil invertebrates
- Terrestrial vegetation
- Benthic invertebrates
- Fish
- Soil invertebrate-eating mammal (short-tailed shrew)
- Herbivorous mammal (meadow vole)
- Invertebrate-eating bird (American Robin)
- Herbivorous bird (bobwhite quail)
- Piscivorous mammal (raccoon)
- Piscivorous bird (belted kingfisher)

Although piscivorous mammals and birds are included as assessment endpoints, the actual exposure to site chemicals is expected to be low. The drainageways by the site are small and shallow and unlikely to sustain large fish populations, if any. The measurement endpoints for each of these assessment endpoints are presented in Section 3.4.

6.7.3 Sampling Investigation and Results

A total of 11 surface soil locations (Figures 6-7 and 6-8), five sediment locations (Figure 6-11), and five surface water (Figure 6-12) locations were sampled at the site and were evaluated as part of the SERA.

Section 6.4 of this report discusses the analytical results and the nature and extent of contamination for the site. In summary, VOCs, SVOCs, pesticides, herbicides, and/or inorganic chemicals are detected in the soil, sediment, and surface water. For the surface soil samples, a statistical comparison between the site data set and the background data set was conducted to determine if any of the inorganic chemicals in

the site samples are detected below background levels (see Section 6.4). Also, surface water and sediment station 09SW/SD01 was located in an upgradient drainageway. Therefore, the chemical concentrations in the samples from this station are assumed to represent concentrations in the surface water and sediment that are not related to activities at SWMU 9. As such, the inorganic chemical concentrations in the remaining surface water and sediment samples from SWMU 9 are compared to concentrations for this upgradient sample location for the selection of COPCs. If inorganic chemical concentrations are higher at the upgradient sample location versus the downgradient sample locations, the chemical is eliminated as a COPC.

6.7.4 Ecological Screening

This section contains the ecological risk screening evaluation conducted for the chemicals detected in the surface soil, sediment, and surface water samples. The general methodologies used for the exposure assessment and risk characterization are discussed in Section 3.4 of this report. The EDQLs used for screening are presented in Tables 3-14 and 3-15.

6.7.4.1 Surface Soil

Table 6-24 is the screening table for plants, invertebrates, and terrestrial wildlife exposed to chemicals detected in the surface soil samples. In addition to summary statistics (e.g., frequency of detection), the table also includes the results of a comparison to the representative soil background/anthropogenic values for inorganics, which are used to select COPCs. One VOC, 18 SVOCs, two pesticides, three herbicides, and 18 inorganic chemicals were detected in the surface soil samples.

Di-n-butyl phthalate, naphthalene, methoxychlor, antimony, copper, lead, and zinc were initially selected as COPCs because the maximum concentrations exceeded the surface soil COPC screening levels and because some site sample concentrations exceeded the background sample concentrations (for inorganics only). The highest EEQ is 650 for lead.

6.7.4.2 Sediment

Table 6-25 is the screening table for aquatic receptors and piscivorous wildlife exposed to chemicals detected in the sediment. In addition to summary statistics (e.g., frequency of detection), the table also includes a comparison of site concentrations to those detected in the upgradient sample, 09SD010006, which is considered representative of surface water background/anthropogenic conditions. One VOC, one SVOC, one PCB, and 16 inorganic chemicals were detected in the sediment samples.

Six inorganic chemicals including aluminum, antimony, barium, iron, manganese, and vanadium were initially selected as COPCs because no sediment COPC screening levels were available for these chemicals and the maximum downgradient concentration reported for these chemicals exceeded those reported for 09SD010006. Aroclor 1248, arsenic, and copper were initially selected as COPCs because the maximum concentrations exceeded the sediment COPC screening level, EEQs ranged from 1.03 for arsenic to 11.1 for Aroclor 1248.

6.7.4.3 Surface Water

Table 6-26 is the surface water screening table for aquatic receptors and piscivorous wildlife. In addition to summary statistics (e.g., frequency of detection), the table also includes a comparison of site concentrations to those detected in the upgradient sample, 09SW0101, which is considered representative of surface water background/anthropogenic conditions. One herbicide, 15 inorganic chemicals (in unfiltered samples), and 14 filtered inorganic chemicals were detected in the surface water samples.

2,4-D, iron, and manganese were initially selected as COPCs because no surface water COPC screening levels were available for these chemicals and the maximum downgradient concentration reported for these chemicals exceeded those reported for location 09SW0101 (for inorganics only). Cobalt, copper, and lead, for filtered organics, were initially selected as COPCs because the maximum concentrations exceeded the surface water COPC screening levels and the maximum downgradient concentration reported for these chemicals exceeded those reported for 09SW0101. All EEQs are low, with values of 1.77 and below.

6.7.5 Scientific/Management Decision Point

The SERA includes the estimation of exposure levels and screening for ecological risks. The SERA is concluded by a Scientific/Management Decision Point (SMDP) at which point one of the following decisions is made (DON, 1999):

(1) Adequate information exists to conclude that ecological threats at a site are negligible; no further evaluations of ecological risks are necessary.

(2) Adequate information exists and there is a potential for adverse ecological effects. In this case, the decision can be to either conduct an interim cleanup (if cost-effective to do so) or continue to Step 3.

Included in the decisions listed above is an evaluation of the adequacy of the available information on which the decisions are based. Questions answered during this evaluation include the following:

- Were adequate numbers of samples collected in the appropriate locations?
- Were the samples analyzed for the appropriate parameters and was the data of sufficient quality for use in a risk assessment?

This section of the ERA describes whether or not the collected data are adequate for making ecological risk decisions for SWMU 9. Section 6.4 of this report contains discussion of the nature and extent of contamination at SWMU 9, and Figures 1-11 and 1-12 show the site topography and site photographs, respectively.

SWMU 9 (Pesticide Control/R-150 Tank Area) is an inactive site composed of three distinct areas: Building 55, Building 2189, and the R-150 Tank area. The site (including space between the three distinct areas) occupies approximately 11 acres. Site operations were centered around the three areas. The site is bounded on the east by Highway 45. Pesticide storage and mixing activities occurred at Buildings 55 and 2189, which are no longer present at the site. Waste solvents were stored at the R-150 Tank area; the tank has been removed from the site. The three areas are located near each other in a triangular configuration. Building 2189 is 1,150 feet north of Building 55. The R-150 Tank area is approximately 800 feet southwest of Building 2189 and 700 feet northwest of Building 55.

6.7.5.1 Surface Soil

A total of 11 surface soil samples were collected at SWMU 9. All of the surface soil samples were collected in the vicinity of the three former pesticide storage buildings. Therefore, sampling was biased towards the areas where the chemical contamination was expected to be greatest. Surface soil samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, TAL metals (plus tin), and cyanide. Additionally three surface soil samples were analyzed for CEC, pH, and TOC. Figures 6-7 and 6-8 show analytical data on site figures. Table 6-2 presents the summary of positive analytical results for surface soils and Table 6-24 is the ecological risk screening table for surface soils. One VOC, 18 SVOCs, two pesticides, three herbicides, and 18 inorganics were detected in surface soil samples. Of these, two SVOCs, one pesticide, and four inorganics were initially selected as COPCs because their maximum detected concentrations exceeded EDQLs. COPCs considered bioaccumulative (U.S. EPA, 2000) were retained for food-chain modeling and are presented in Table 6-27. The SVOC and pesticide COPCs were detected at a low frequency (1 or 2 detected in 11 samples). Naphthalene concentrations exceeded the screening value in only one sample

from location 09SB09. As shown in Figure 6-7, boring 09SB09 is located along the eastern border of the site adjacent to several roads including Highway 45. All detected PAHs, including naphthalene may be attributable to asphalt, road traffic, or waste oil. Di-n-butyl phthalate detected at sample location 09SB02 (located on the western side of Building 2189) may be the result of site activities because di-n-butyl phthalate is used in the formulation of pesticides. Pesticide spray tanks and containers were reportedly rinsed on the western side of Building 2189. EEQs for di-n-butyl phthalate and naphthalene were 8.0 and 9.4, respectively. Methoxychlor was retained as a COPC because the single detected concentration of 0.025 mg/kg slightly exceeded the screening level of 0.020 mg/kg. The only pesticides detected at the site were found at location 09SB09. This boring is located in the southern portion of the site near the location of Former Building 55 and detections are likely attributable to former site activities. Methoxychlor had an EEQ of 1.3.

Four inorganics were retained as COPCs because their maximum concentrations were statistically determined to be greater than background concentrations and were also greater than the EDQLs. As determined in Section 6.4.1, metals detections do not indicate any apparent pattern of metals contamination. However, because EEQs for those metals retained as COPCs including antimony (21.8), copper (6.8), lead (650), and zinc (18.1) were greater than 1.0, potential ecological risks exist from metals in surface soils at SWMU 9; these metals are further evaluated in Step 3a of the Baseline Ecological Risk Assessment (BERA).

6.7.5.2 Surface Water/Sediment

To assess the potential risks associated with migration of chemicals from ground water and soil to surface water and sediment, surface water and sediment samples were collected from five locations at SMWU 9. Four sampling points were located in the unnamed tributary west of the former location of Building 2189 and the R-150 Tank. Locations in the tributary were sampled to monitor the stream at locations potentially affected by surface water runoff and/or ground water discharge. Surface water and sediment samples were also collected from a location potentially affected by surface water runoff and/or ground water discharge from Building 55. Additionally, one upgradient sample location 09SD/SW01 was selected to represent surface water and sediment conditions outside SMWU 9 boundaries; the results of this sample were not included in the SWMU 9 data representing potential SWMU 9 contamination. All sediment and surface water samples were analyzed for Appendix IX VOCs, Appendix IX SVOCs, Appendix IX pesticides, Appendix IX PCBs, Appendix IX herbicides, TAL metals (plus tin), cyanide, and total organic carbon. Surface water samples were analyzed for total and filtered inorganics.

6.7.5.2.1 Surface Water

Figure 6-12 is a tag map showing surface water analytical data for SWMU 9. Table 6-8 presents the summary of positive analytical results for surface water and Table 6-26 is the ecological risk screening table for surface water. One herbicide, 15 total inorganics, and 14 filtered inorganics were detected in the site surface water samples. Of these, one herbicide and five filtered inorganics were initially selected as COPCs. COPCs considered bioaccumulative (U.S. EPA, 2000) were retained for food-chain modeling and are presented in Table 6-27. 2,4-D was initially selected as a COPC because an EDQL is not available. 2,4-D was detected at sample location 09SW02 which is approximately 400 feet west of former Building 2189. The 2,4-D detection may be attributable to site activities. As shown in Figure 6-12, there does not appear to be a clear pattern of metals contamination in the surface water. Additionally, the upgradient sample contained some metals concentrations in excess of those found in the other surface water samples at SWMU 9. This is likely attributable to elevated TSS results in the upgradient sample 09SW0101, however the dissolved (filtered) results for the upgradient sample were similar to metals results for all other site samples. As discussed in Section 6.4.4, metals retained as COPCs were also detected in other media at SWMU 9 but do not coincide with significant VOC, pesticide, or herbicide detections, indicating metals concentrations are likely naturally occurring.

6.7.5.2.2 Sediment

Figure 6-13 is a tag map showing sediment analytical data for SWMU 9. Table 6-10 presents the summary of positive analytical results for sediment and Table 6-25 is the ecological risk screening table for sediment. One VOC, one SVOC, one PCB, and 16 inorganics were detected in the site sediment samples. Of these, one PCB and eight inorganics were initially selected as COPCs. COPCs considered bioaccumulative (U.S. EPA, 2000) were retained for food-chain modeling and are presented in Table 6-27. Aroclor 1248 was initially selected as a COPC because the maximum detected concentration exceeded the EDQL. Aluminum, antimony, barium, iron, manganese, and vanadium were initially selected as COPCs because no EDQLs were available for comparison and the maximum downgradient concentrations reported for these chemicals exceeded those reported for the upgradient location. Arsenic and copper were initially selected as COPCs because their maximum detected concentrations exceeded the EDQLs and were greater than concentrations reported for the upgradient sample location. Aroclor 1248 was detected at sample location 09SD03, which was collected west of the former R-150 Tank area. The only other detection of PCBs was reported for a subsurface soil sample from location 09SB07. This soil sample is located approximately 400 feet from sediment sample location 09SD03 and is also in the vicinity of former R-150 Tank, which was known to contain chlorinated hydrocarbons. Aroclor 1248 had an EEQ of 11.1. The inorganics detected at SMWU 9 indicate no clear pattern of contamination; in fact, all inorganics were detected at similar concentrations in all samples including the upgradient sample.

EEQs for arsenic and copper were 1.03 and 1.7, respectively. Because EEQs for several chemicals were greater than 1.0 and there is a lack of toxicity data for several chemicals, risks for chemicals in the sediment will be further evaluated in Step 3a of the BERA.

6.7.5.3 Summary

In summary, a SERA was performed for SWMU 9. Based on the results of the evaluation, adequate information exists to determine that potential risks are possible for receptors exposed to the selected COPCs. Also, sampling locations were biased towards areas where the contamination, if present, should be detected. Therefore, the SERA is advancing to the Step 3a of the BERA – the refinement of the site-related COPCs.

6.7.6 Step 3a Refinement

Subsequent to the initial screening, other factors are considered to further refine the list of COPCs. These factors include food chain modeling, habitat quality, area use factors, toxicological evaluation of COPCs, frequency of detection, background concentrations, and comparisons of COPCs to alternate guidelines (U.S. EPA, 1997 and 2001; Navy, 1999).

Food chain modeling is conducted to investigate potential risks to representative receptors from ingested doses of COPCs that are known to bioaccumulate or biomagnify (U.S. EPA, 2001). The methods used to model the doses that representative receptors could receive, as well as the selection of TRVs and the calculation sheets for the food chain model, are described and presented in Section 3.4.4.2 and Appendices H.4 and H.5. The assessment endpoints associated with the food chain modeling are the protection of ecological receptors from adverse effects of COPCs on growth, survival, and reproduction. The associated measurement endpoints are doses of COPCs associated with adverse effects on growth, survival, and reproduction of these receptor groups.

Concentrations of COPCs are compared to alternate (usually less conservative) guidelines in Step 3a of this assessment. These alternate guidelines are presented in Tables 6-28 (surface soil), 6-29 (sediment), 6-30 (surface water), and 6-35 (terrestrial food chain modeling). The use of guidelines that are less conservative than Region 5 ESVs provide balance to the conservative screening-level assessment.

6.7.6.1 Risks to Terrestrial Plants, Terrestrial and Sediment Invertebrates

Potential risks to terrestrial plants, terrestrial and aquatic invertebrates, and fish from exposure to COPCs were evaluated using the methodologies described in Section 3.4. The following subsections discuss

whether the chemicals initially selected as COPCs should be retained for further evaluation of risks to soil invertebrates and terrestrial vegetation (Section 6.7.6.1.1) and benthic invertebrates (Section 6.7.6.1.2).

6.7.6.1.1 Terrestrial Plants and Invertebrates – Surface Soil Risk

Risks to terrestrial plants and invertebrates resulting from exposure to the COPCs in surface soil are evaluated using the methodologies described in Section 3.4.4. Table 6-28 presents a summary of some of the common alternate benchmarks available for surface soil COPCs, along with a summary of the Step 3a evaluation. The toxicological basis of the alternate benchmarks is presented below. As presented in Table 6-24, several chemicals were detected at concentrations exceeding screening levels (or screening levels were not available) but were eliminated as COPCs because they were not detected at concentrations greater than background concentrations. For soil, these chemicals included aluminum, arsenic, barium, cadmium, chromium, cobalt, iron, manganese, mercury, nickel, and vanadium. Therefore, risks to these chemicals were not evaluated in the ERA, however, any risks would be within background risks and not related to site activities.

Di-n-butyl phthalate

Di-n-butyl phthalate was initially selected as a COPC because the single detected soil concentration (1.2 mg/kg) in sample 09SB020002 exceeds the Region 5 screening level of 0.15 mg/kg; however, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates. Therefore, the maximum di-n-butyl phthalate concentration was compared to other available benchmarks to evaluate risks to these receptors:

- Oak Ridge National Laboratory (ORNL) Plant – 200 mg/kg (Efroymson et al., 1997b)

The ORNL plant value of 200 mg/kg is based on plant growth of fescue, corn, and soybeans in two soil types at two pH levels. Fresh weights among the three species were reduced 23% to 44% by 200 mg/kg. The maximum di-n-butyl phthalate concentration is two orders of magnitude less than the ORNL plant value and so impacts to plants are not likely.

No benchmarks are available for di-n-butyl phthalate to evaluate risks to earthworms; therefore, the ORNL earthworm benchmark for dimethylphthalate of 200 mg/kg was used because the toxicity of these two phthalates is anticipated to be generally similar in magnitude. The ORNL earthworm benchmark for dimethylphthalate was developed based on survival of adults of four earthworm species. After 14 days, a three-fold difference in sensitivity of the earthworms was observed. An LC50 value of 1,064 mg/kg was

the lowest toxic concentration of the three reported. The ORNL earthworm vaue of 200 mg/kg for dimethylphthalate was obtained by dividing the LC50 (1,064 mg/kg) by a safety factor 5 (Efroymson et al., 1997). Although there are uncertainties in comparing the maximum di-n-butylphthalate concentration to toxicity information available for dimethylphthalate, the maximum di-n-butyl phthalate concentration is less than the ORNL earthworm benchmark for dimethylphthalate and impacts to invertebrates are not likely.

Di-n-butyl phthalate was only detected in sample 09SB020002. Sample 09SB020002 is located on the west side of Building 2189, where pesticide spray tanks and containers were reportedly rinsed (di-n-butyl phthalate was not detected in samples to the north, west, or south). For this reason, the single detection of di-n-butyl phthalate may be related to former site activities because di-n-butyl phthalate may be used in the formulation of some pesticides (ATSDR, September 2001); however, the extent of contamination is very limited. The location of the di-n-butyl phthalate detection is covered by gravel (see Figure 6-7 for location 09SB02 and Appendix A for the soil boring log at this location) so there is no habitat for earthworms or plants at this location. This, combined with the fact that the concentration of di-n-butyl phthalate is less than toxicity data indicates that risks to plants and invertebrates from di-n-butyl phthalate are acceptable; di-n-butyl phthalate is not retained as a COPC for plants and soil invertebrates.

Naphthalene

Napthalene was initially selected as a COPC because the maximum detected surface soil concentration (0.93 mg/kg) in sample 09SB090002 exceeded the Region 5 screening level (0.1 mg/kg); however the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates. Therefore, the maximum detected concentration was compared to the following alternate benchmark to evaluate risks to plants and invertebrates.

- Canadian Soil Quality Guideline SQG – 0.6 mg/kg [Canadian Council of Ministers of the Environment (CCME), 1997a]

The Canadian SQG for naphthalene of 0.6 mg/kg is based on an Effects Concentration (EC) 25 for lettuce of 3 mg/kg that was divided by an uncertainty factor of 5 to approximate a no effects concentration as presented in the protocol summary document. This method was used because only three studies were identified to evaluate risks from naphthalene; two were for plants and one was for invertebrates. The EC25 of 3 mg/kg was the lowest value of the three. The maximum detection does exceed the SQG; however, the maximum detection of naphthalene does not exceed the reported Lowest Observed Effect Concentration (LOEC) of 3 mg/kg.

Napthalene was only detected in two of the 11 samples collected. The only other naphthalene detection (sample 09SB030002) was 0.03 mg/kg which is less than the SQG and risks to plants and invertebrates at this location are acceptable. Naphthalene was not detected in the two locations nearest the maximum detection (09SB10 and 09SB11), indicating the naphthalene detection is an isolated occurrence and not widespread across the site. As indicated in Section 6.4.1, no distinguishable pattern of PAHs contamination exists; although samples 09SB030002 and 09SB090002 are located along the eastern border of the site along Highway 45. Detections of PAHs in these samples are likely attributable to vehicular traffic and not site activities. Also, as seen in photograph 3 in Figure 1-12, the area where sample 09SB090002 was collected consists of mowed grass surrounded by buildings and roads and not a high quality ecological habitat. Therefore, the risk to plants and invertebrates are acceptable and naphthalene is not retained as a COPC for risks to plants and invertebrates.

Methoxychlor

Methoxychlor was initially selected as a COPC because the maximum detected surface soil concentration (0.025 mg/kg) in sample 09SB090002 exceeded the Region 5 screening level (0.02 mg/kg); however, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates. No alternate benchmarks for methoxychlor are available and so other Step 3a considerations were evaluated.

The location with the maximum methoxychlor detection is near the former location of Building 55; methoxychlor was not detected in the two locations nearest the maximum detection (09SB10 and 09SB11), indicating the methoxychlor detection is an isolated occurrence and not widespread across the site. The pesticide was not detected at any other sampled location; thus, the extent of contamination is very limited. Also, as seen in photograph 3 in Figure 1-12, the area where sample 09SB090002 was collected consists of mowed grass surrounded by buildings and roads and not a high quality ecological habitat. Although the presence of methoxychlor is likely to be related to former site activities, current concentrations and the limited exposure area indicate the risk to plants and invertebrates are acceptable; methoxychlor is not retained as a COPC for risks to plants and invertebrates. Because methoxychlor is a bioaccumulative chemical, risks to wildlife from methoxychlor are evaluated in Section 6.7.6.3 of this ERA.

Antimony

Antimony was initially selected as a COPC because the maximum detected soil concentration (3.1 mg/kg) in sample 09SB060002 exceeded the Region 5 screening level of 0.14 mg/kg and because some site concentrations were greater than background concentrations; however, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates. Therefore, the maximum

antimony concentration was compared to other available benchmarks to evaluate risks to plants and invertebrates:

- ORNL Plant – 5 mg/kg (Efroymson et al., 1997b)
- Ecological Soil Screen Level (Eco-SSL) for soil invertebrates - 78 mg/kg (U.S. EPA, 2003c)

The Eco-SSL for soil invertebrates is the geometric mean of the EC20 values reported for each of three test species (i.e., Enchytraeid, Springtail, and Earthworm) under similar conditions. The maximum concentration of antimony at SWMU 9 is less than the Eco-SSL for soil invertebrates and so risks to these receptors are acceptable. An Eco-SSL for plants is not available; however there is an ORNL plant value. The ORNL plant value of 5 mg/kg is based on a report of unspecified toxic effects on plants grown in a surface soil with the addition of 5 mg/kg antimony. The maximum concentration is less than the ORNL plant value and so risks to plants are acceptable. Additionally, antimony was detected in just two of the 11 samples collected in areas where grass is present further indicating that significant impacts to vegetation are not occurring. Therefore, risks to both plants and invertebrates are acceptable and antimony is not retained as a COPC for risks to plants and invertebrates.

Copper

Copper was initially selected as a COPC because the maximum detected soil concentration (20.1 mg/kg) in sample 09SB100002 exceeded the Region 5 screening level of 2.96 mg/kg and because some site concentrations were greater than background concentrations; however, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates. Therefore, the maximum copper concentration was compared to the SQG to evaluate risks to plants and invertebrates.

- Canadian SQG – 63 mg/kg (CCME, 1997a)
- ORNL Plant – 100 mg/kg (Efroymson et al., 1997b)
- ORNL Earthworm – 60 mg/kg (Efroymson et al., 1997a)

The copper Canadian SQG of 63 mg/kg is the 25th percentile of effects and no effects data distribution for plants and invertebrates, which is the 17th of 69 data points and corresponds to an effect on radish seedling emergence. Copper concentrations below the Canadian SQG of 63 mg/kg are expected to be protective of plants and invertebrates. The copper sulfate, copper nitrate, and copper chloride used in the toxicity studies are likely to be more bioavailable than the copper in the soils from the site. Copper in soil is likely to form relatively insoluble carbonates, oxides, and hydroxides. Also, as discussed above, although some studies demonstrated measurable effects to plants and invertebrates at copper

concentrations less than 63 mg/kg, the effects concentrations in many other studies were much greater than 63 mg/kg.

The copper ORNL benchmark for plants (100 mg/kg) was based on toxicity data from three studies. Two of the studies demonstrated reductions in root and shoot weights of little bluestem grown in sandy soil to which 100 ppm copper (as copper sulfate) was added (Miles and Parker, 1979). The third study showed no effect on leaf and stem weights of bush beans grown in soil to which 100 ppm copper (as copper sulfate) was added, but leaf weight was reduced 26% when 200 ppm copper was added (Wallace et al., 1977).

The copper ORNL benchmark for invertebrates (60 mg/kg) was based on toxicity data from 10 to 20 studies. The endpoints for most of the studies cited in Efroymson et al., (1997a) are survival or impacts on reproduction (i.e., cocoon production, hatchling success). Because there were more than 10 studies, the benchmark was based on a 10th percentile LOEC value. However, a review of the data in Appendix A.1 of Efroymson et al., (1997a) shows that most of the studies cited in that document have NOECs that are greater than 60 mg/kg.

Although copper was statistically determined to be greater than background, the maximum concentration of copper (20.1 mg/kg) was similar to the background soil group 3 data set that ranged from 5.4 to 17.1 mg/kg. Additionally, the maximum detected copper concentration (20.1 mg/kg) is less than the Canadian SQG and ORNL values for earthworms and plants; therefore, impacts to plants and invertebrates are not expected to occur from the observed levels of copper in SWMU 9 soil. With these considerations, potential risks to plants and invertebrates are acceptable; therefore, copper is not retained as a COPC for risks to plants and invertebrates. However, because copper is a bioaccumulative chemical, risks to wildlife from copper are evaluated in Section 6.7.6.3 of this ERA.

Lead

Lead was initially selected as a COPC because the maximum detected soil concentration (34.9 mg/kg) in sample 09SB100002 exceeded the Region 5 screening level of 0.054 mg/kg and because some site concentrations were greater than background concentrations. However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates, so the maximum concentration of lead was compared to the Eco-SSLs to evaluate risks to these receptors.

- Eco-SSL for plants – 115 mg/kg (U.S. EPA, 2003e)
- Eco-SSL for soil invertebrates – 1,700 mg/kg (U.S. EPA, 2003e)

The Eco-SSL for plants is the geometric mean of the maximum acceptable toxicant concentration (MATC) values for four test species under three different test conditions. Soil pH values of the tests ranged from 4 to 6.3. The ecological endpoint for the derivation of the Eco-SSL for plants was growth. The maximum lead concentration is less than the Eco-SSL for plants. The Eco-SSL for soil invertebrates is the geometric mean of the MATC values for one test species (*Folsomia candida*) under three different test conditions (pH of 4.5 to 6.0) and is based on a reproductive endpoint. The maximum lead detection is less than the Eco-SSL for soil invertebrates.

Although lead was statistically determined to be greater than background, the maximum concentration of lead (34.9 mg/kg) was similar to the background soil group 3 data set that ranged from 9.4 to 21.5 mg/kg with a 95% UTL of 27 mg/kg. Because the maximum detected lead concentration is less than the plant and invertebrate U.S. EPA Eco-SSLs, risks to plants and invertebrates from lead are acceptable and lead is not retained as a COPC for risks to plants and invertebrates. However, because lead is a bioaccumulative chemical, risks to wildlife from lead are evaluated in Section 6.7.6.3 of this ERA.

Zinc

Zinc was initially selected as a COPC because the maximum detected soil concentration (120 mg/kg) in sample 09SB060002 exceeded the Region 5 screening level of 6.62 mg/kg and because some site concentrations were greater than background concentrations. However, even though the EDQL is based on risks to invertebrates, the following alternate benchmarks were used to further evaluate risks to plants and soil invertebrates:

- Canadian SQG – 200 mg/kg [Environment Canada (EC), 1999d]

The zinc Canadian SQG of 200 mg/kg is the lowest LOEC of the plants and invertebrate data set and is based on an effect on seedling emergence for radish (EC, 1999d). The weight-of-evidence method was not used to develop the SQG because greater than 50 percent of the "effects" data were dominated by median effective or median lethal concentrations (EC, 1999d). As presented in Appendix VI of the Canadian SQG document (EC, 1999d), all of the earthworm effects and no-effects data (with the exception of one test in one study) were equal to or greater than 200 mg/kg, indicating that earthworms appear to be less sensitive to zinc than plants. The maximum concentration of zinc is less than the SQG and so risks to plants and invertebrates from zinc are acceptable; therefore, zinc is not retained as a COPC for risks to plants and invertebrates. Because zinc is a bioaccumulative chemical, risks to wildlife from zinc are evaluated in Section 6.7.6.3 of this ERA.

6.7.6.1.2 Sediment

Table 6-29 presents a summary of the common alternate benchmarks used in refining the list of COPCs in sediment, along with a summary of the Step 3a evaluation. The upgradient sediment concentrations are presented in Table 6-25. As can be seen in Figure 1-12 (photographs 4, 5, and 6), aquatic habitat at SWMU 9 is very poor consisting of small drainageways. Aquatic and sediment dwelling organisms are not expected at these locations because of the poor habitat. However, sediment concentrations are compared to more appropriate benchmarks (when appropriate) to provide a quantitative evaluation.

Aroclor-1248

Aroclor-1248 was initially selected as a COPC because the maximum detected sediment concentration (0.38 mg/kg) exceeded the Region 5 screening level of 0.034 mg/kg. However, the most recent ESL (U.S. EPA, 2003) is based on the Consensus-based Threshold Effect Concentration (TEC) and is therefore a more appropriate value for evaluating risks to sediment invertebrates from Aroclor 1248:

- Consensus-based TEC – 0.0598 mg/kg (MacDonald et al., 2000)
- Consensus-based Probable Effects Concentration (PEC) – 0.676 mg/kg (MacDonald et al., 2000)

The consensus-based TEC is the geometric mean of the threshold effect level (TEL; Smith et al., 1996), effect range low value (ER-L; Long and Morgan, 1991), lowest effect level (LEL; OMOE, 1993), minimal effect threshold (MET; EC and MENVIQ, 1992), and sediment quality advisory levels (SQALs; U.S. EPA, 1997) for total PCBs. These individual effect levels for each of the studies cited above were calculated using slightly different methods, but they all represent concentrations below which impacts to sediment invertebrates are either unlikely or not expected. The maximum Aroclor-1248 concentration is greater than the consensus-based TEC and therefore, was compared to the consensus-based PEC to provide an estimate of the overall risk range. The PEC was derived similarly to the TEC but is the geometric mean of the probable effect levels (PELs; Smith et al., 1996), effect range median values (ER-Ms; Long and Morgan, 1991), severe effect levels (SELs; Persaud et al., 1993) and Toxic Effect Thresholds (TETs; Ec and MENVIQ, 1992). The PEC is the level above which harmful effects on sediment dwelling organisms are expected to frequently occur (MacDonald, et al., 2000). The maximum Aroclor-1248 concentration is less than the consensus-based PEC.

Aroclor-1248 was only detected at sample location 09SD03 indicating that the contaminant is not widespread in sediment at SWMU 9 which is supported by the fact that PCBs were not detected in any

surface soil samples. The ditch where this sample was collected is a small drainageway surrounded by thick brush. During the October 2001 site visit, sediments at this location were only moist; no standing water was observed. Aroclor-1248 is not expected to impact aquatic receptors at this location because of the poor aquatic habitat (i.e., the receptors are unlikely to be present). Although possible risks to sediment dwelling organisms can not be ruled out at location 09SD03, any potential site-related risks to sediment dwelling invertebrates are not great enough to warrant carrying Aroclor-1248 through the BERA process; Aroclor-1248 is eliminated as a COPC for risks to sediment dwelling invertebrates. However, because Aroclor-1248 is a bioaccumulative chemical, risks to piscivorous wildlife from Aroclor-1248 are evaluated in Section 6.7.6.3 of this ERA.

Aluminum

Aluminum was initially selected as a COPC because no EDQLs are available and because SWMU 9 concentrations were greater than the upgradient sediment concentration. The alternate benchmark selected for aluminum is the TEL of 25,500 mg/kg (Buchman, 1999). The TEL represents the concentration below which adverse effects on survival or growth of the amphipod Hyalella azteca are expected to occur only rarely in 28 day tests (MacDonald et al., 2000). The maximum aluminum (10,800 mg/kg) in sample 09SD050006 was below the TEL. Therefore, risks to sediment dwelling invertebrates from aluminum are acceptable; aluminum is not retained as a COPC for risks to sediment invertebrates.

Antimony

Antimony was initially selected as a COPC because no EDQLs are available and because SWMU 9 concentrations were greater than the upgradient sediment concentration. The maximum detected sediment concentration for antimony was detected in sample 09SD020006 at 1.3 mg/kg. The alternate benchmark selected for antimony is the ER-L of 2 mg/kg (Long and Morgan, 1991). The ER-L values were developed by first sorting the chemical concentrations in sediment samples that were associated with adverse effects by ascending concentrations. The ER-L is the lower 10th percentile of the data and indicates the low end of the range of concentrations observed or predicted to demonstrate effects. Because the maximum antimony concentration is below the ER-L, risks to sediment dwelling invertebrates are acceptable. Note that there is some uncertainty in using the ER-L to evaluate risks to sediment dwelling invertebrates at SWMU 9 because saltwater studies were used to develop the ER-L. Antimony is not retained as a COPC for risks to sediment invertebrates.

Arsenic

Arsenic was initially selected as a COPC because the maximum detected sediment concentration (6.1 mg/kg) exceeded the screening level of 5.9 mg/kg. However, the most recent ESL (U.S. EPA, 2003) is based on the TEC and is therefore a more appropriate value for evaluating risks to sediment invertebrates from arsenic:

- Consensus-based TEC – 9.79 mg/kg (MacDonald et al., 2000)

The maximum arsenic concentration is less than the consensus-based TEC so risks to sediment dwelling invertebrates are acceptable. Therefore, arsenic is not retained as a COPC for risks to sediment dwelling invertebrates. However, because arsenic is a bioaccumulative chemical, risks to piscivorous wildlife from arsenic are evaluated in Section 6.7.6.3 of this ERA.

Barium

Barium was initially selected as a COPC because no EDQL was available and the maximum concentration (103 mg/kg) exceeded the upgradient location concentration (78.1 mg/kg). Barium concentrations at the other three sediment locations were less than the upgradient sample concentration. The only available alternate benchmark for barium is the Apparent Effects Threshold (AET) of 48 mg/kg (Buchman, 1999). Based on the Navy's agreement with U.S. EPA, if a chemical only has a higher effects level such as an AET, the chemical will not be eliminated as a COPC even if the maximum detection is below the higher effects level, unless other Step 3a factors can be used to justify the chemical's elimination as a COPC. At SWMU 9, however, the maximum detected concentration and the upgradient sample concentration are both greater than the AET. As noted for Aroclor-1248, sediment location 09SD03 and all sediment samples at SWMU 9 were collected from very small drainage ditches that likely do not provide sufficient habitat to support aquatic receptors (see Figure 1-12 for photographs of SWMU 9). Additionally, the most likely source of chemical concentrations in the sediment is run-off from the SWMU and barium concentrations in the sediment are within the surface soil background range for barium (24.8 mg/kg to 155 mg/kg). Although risks to sediment dwelling invertebrates at SWMU 9 can not be ruled out because of the maximum concentration, any potential site-related risks from barium are not great enough to warrant carrying barium through the BERA process. Therefore, risks to sediment invertebrates are acceptable; barium is not retained as a COPC for risks to sediment invertebrates.

Copper

Copper was initially selected as a COPC because the maximum detected sediment concentration (27.7 mg/kg) exceeded the Region 5 screening level of 16 mg/kg and because SWMU 9 concentrations are above the upgradient sediment concentration. However, the most recent ESL (U.S. EPA, 2003) is based on the TEC and is therefore a more appropriate value for evaluating the maximum copper concentration:

- Consensus-based TEC – 31.6 mg/kg (MacDonald et al., 2000)

The maximum copper concentration is less than the consensus-based TEC so risks to sediment dwelling invertebrates are acceptable. Therefore, copper is not retained as a COPC for risks to sediment dwelling invertebrates. However, because copper is a bioaccumulative chemical, risks to piscivorous wildlife from copper are evaluated in Section 6.7.6.3 of this ERA.

Iron

Iron was initially selected as a COPC because an EDQL is not available and because SWMU 9 concentrations were greater than the upgradient sediment concentration. Because an EDQL and consensus based TEC are not available for the screening, iron concentrations are compared to the Canadian LEL:

- Canadian Sediment Guidelines LEL – 20,000 mg/kg [Ontario Ministers of the Environment (OMOE), 1993]

The LEL indicates the level of sediment contamination, which has no effect on and can be tolerated by the majority of sediment-dwelling organisms. The Canadian sediment guidelines were developed by first calculating the 90th percentile of the concentrations where a species was present, and then plotting the 90th percentile concentrations for all of the species that were used to develop the guideline. The 5th percentile of the plot was selected as the LEL and the 95th percentile from the plot was selected as the Severe Effects Level (SEL) for metals. The maximum iron concentration (18,600 mg/kg) was detected in sample 09SD030006 and is less than the LEL. Therefore, risks to sediment dwelling invertebrates from iron are acceptable; iron is not retained as a COPC for risks to sediment invertebrates.

Manganese

Manganese was initially selected as a COPC because an EDQL is not available and because SWMU 9 concentrations were greater than the upgradient sediment concentration. The alternate benchmark selected for manganese is the Canadian Sediment Guidelines LEL of 460 mg/kg (OMOE, 1993). Manganese was detected in all four site samples collected and detected at a maximum concentration of 1,300 mg/kg in sample 09SD030006. The maximum concentration is greater than the LEL. Manganese was also detected at location 09SD04 at a concentration (1,290 mg/kg) greater than the LEL. These two samples are located in the same tributary; 09SD03 is located within the SWMU boundaries while 09SD04 is located downstream (i.e., west of SWMU 9). However, this tributary is actually a small drainage ditch with very little aquatic habitat to support sediment dwelling invertebrates. The SEL for manganese is 1,100 mg/kg. The two greatest manganese detections at SWMU 9 exceed the SEL. Manganese concentrations in the other two samples (09SD02 and 09SD05) were less than the upgradient sample manganese concentration (350 mg/kg), the LEL and the SEL. Additionally, the most likely source of chemical concentrations in the sediment is run-off from the SWMU; however, manganese concentrations in the surface soil were less than background (which ranged from 23.2 mg/kg to 3,040 mg/kg) indicating manganese concentrations in the sediment are most likely naturally occurring. For these reasons, risks to sediment invertebrates from manganese are acceptable; manganese is not retained as a COPC for these receptors.

Vanadium

Vanadium was initially selected as a COPC because no EDQL was available and the maximum concentration (21.1 mg/kg) was greater than the upgradient concentration. The only available alternate benchmark for vanadium is the AET of 57 mg/kg (Buchman, 1999). As noted for barium, the Navy has agreed with the U.S. EPA to not eliminate COPC if the chemical only has a higher effects level, unless other Step 3a factors can be used to justify the chemical's elimination as a COPC. For vanadium, some of the chemical concentrations in the sediment (12.2 mg/kg to 21.2 mg/kg) are only marginally greater than the upgradient concentrations of 15.2 mg/kg and less than half of the AET. Additionally, vanadium concentrations in the sediment are within the surface soil background range for vanadium (14.1 mg/kg to 48.5 mg/kg). Therefore, although risks to benthic invertebrates can not be ruled out because of the lack of lower-effects toxicity data, any potential site-related risks from vanadium are not great enough to warrant carrying vanadium through the BERA process. Risks to sediment dwelling invertebrates are acceptable; vanadium is not retained as a COPC for risks to sediment invertebrates.

6.7.6.1.3 Surface Water

Table 6-30 presents a summary of the common alternate benchmarks used in refining the list of COPCs in surface water, along with a summary of the Step 3a evaluation. The upgradient surface water concentrations are presented in Table 6-26. Several inorganics in unfiltered surface water samples (aluminum, cobalt, copper, iron, lead, and manganese) were not detected in site samples at concentrations greater than the upgradient concentrations (background comparisons were not used as a COPC selection criterion for organics). Any risks to these inorganics would be within background risks and not related to site activities. No chemicals were eliminated as COPCs in filtered surface water samples due to background comparisons. As can be seen in Figure 1-12 (photographs 4, 5, and 6), aquatic habitat at SWMU 9 is very poor consisting of small drainageways. Aquatic and sediment dwelling organisms are not expected at these locations because of the poor habitat. Water-quality standards (WQS) for surface water have been developed for Indiana (IDEM, 1998). In addition, U.S. EPA has established water-quality criteria (WQC) for a few contaminants (U.S. EPA, 2002). The Indiana WQS were not used in the evaluation because the WQS are based on the old U.S. EPA WQC. Therefore, it is more appropriate to use the updated U.S. EPA WQC.

2,4-D

2,4-D was initially selected as a COPC because no Region 5 screening level was available; however the updated Region 5 ESLs list a screening level of 220 µg/L. 2,4-D was detected in only one site surface water sample at location 09SW02 at 0.18 µg/L. The single 2,4-D detection is less than the updated ESL and risks to aquatic invertebrates from 2,4-D are acceptable; 2,4-D is not retained as a COPC for risks to aquatic invertebrates. However, because 2,4-D is a bioaccumulative chemical, risks to wildlife from 2,4-D are evaluated in Section 6.7.6.2.

Cobalt

Cobalt was initially selected as a COPC because the maximum detected filtered surface water concentration (5.1 µg/L) at sample location 09SW05 exceeded the Region 5 screening level of 5 µg/L and was above the site-specific background concentration; however, the maximum concentration is less than the most recent ESL of 24 µg/L. Therefore, risks to aquatic invertebrates from cobalt are acceptable; cobalt is not retained as a COPC for risks to aquatic invertebrates.

Copper

Copper was initially selected as a COPC because the single detected surface water concentration (7.4 µg/L) in sample 09SW0501-F exceeded the Region 5 screening level of 5 µg/L and SWMU 9 concentrations were above site-specific upgradient concentrations. Because the WQC for copper is hardness-dependent, the chronic WQC was calculated as 14.8 µg/L using the average hardness concentration of 180 mg/L in sample 09SW0501-F. The maximum filtered copper concentration was less than the WQC. Therefore, risks to aquatic receptors from copper in the surface water are acceptable; copper is not retained as a COPC for risks to aquatic invertebrates. However, because copper is a bioaccumulative chemical, risks to wildlife from copper are evaluated in Section 6.7.6.2.

Iron

Iron was initially selected as a COPC because no EDQL was available and SWMU 9 concentrations were greater than the upgradient surface water concentration. The maximum detected iron concentration was 1,460 µg/L (filtered) and was detected in sample 09SW0501; this location was collected from a drainage culvert leading from Building 150. During sample collection, the sediment at this location was noted as having some orange staining (see Appendix B for the field sample form). Surface water depth was noted as two inches and so there is little aquatic habitat at this location. All other iron concentrations (both filtered and unfiltered) were below 400 µg/L. The U.S. EPA WQC (U.S. EPA, 2002) for iron is 1,000 µg/L so the detected concentration at 09SW05 exceeds the WQC. However, as noted previously, the aquatic habitat in the drainage ditches at SWMU 9 is very poor overall. Therefore, although risks to aquatic invertebrates are possible at location 09SW05, these risks are not great enough to warrant carrying iron through a BERA. Risks to aquatic invertebrates are acceptable and iron is not retained as a COPC for these receptors.

Lead

This inorganic chemical was retained as a COPC because the maximum detected surface water concentration (2.3 µg/L) exceeded the Region 5 screening level of 1 µg/L and SWMU 9 concentrations were above the upgradient concentration. Lead was only detected in one filtered sample (09SW0501-F). Because the WQC for lead is hardness-dependent, the chronic WQC was calculated as 4.7 µg/L using a hardness of 180 mg/L in sample 09SW0501-F. The maximum lead concentration is below the chronic WQC (U.S. EPA, 2002). Therefore, risks to aquatic receptors from lead in the surface water are acceptable; lead is not retained as a COPC for risks to these receptors. However, because lead is a bioaccumulative chemical, risks to wildlife from lead are also evaluated in Section 6.7.6.3.

Manganese

Because an EDQL and WQC are not available for manganese, concentrations in the surface water are compared to the ORNL chronic benchmark for aquatic life of 120 µg/L (Suter and Tsao, 1996). The ORNL chronic benchmark was developed using the Tier II method described in the U.S. EPA's Proposed Water Quality Guidance for the Great Lakes System in U.S. EPA (1993b) (Suter and Tsao, 1996). Tier II values were developed so that aquatic benchmarks could be established with fewer data than are required for the U.S. EPA water quality criteria. Tier II values are concentrations expected to be higher than AWQC in no more than 20 percent of cases (Suter and Tsao, 1996). Also, in the U.S. EPA 1986 Quality Criteria for Water (the Gold Book), it states that ions of manganese are rarely found at concentrations above 1 mg/L and, because the tolerance values reported range from 1.5 mg/L to over 1,000 mg/L manganese is not considered to be a problem in fresh waters (U.S. EPA, 1986). The ORNL benchmark is likely lower than the tolerance values cited in U.S. EPA (1986) because of the numerous uncertainty factors used to calculate the benchmark (Suter and Tsao, 1996). Although the maximum detected concentration in filtered samples was 532 µg/L (location 09SW02), the preceding information indicates the maximum manganese concentration is likely not adversely impacting aquatic invertebrates. Additionally, as has been previously noted, the aquatic habitat in the drainage ditches is very poor and aquatic receptors are not likely present. For these reasons, risks to aquatic invertebrates from manganese are acceptable; manganese is not retained as a COPC for risks to these receptors.

6.7.6.2 Risks to Terrestrial Wildlife

The discussions in Sections 6.7.6.1 and 6.7.6.2 were not designed to evaluate risks to wildlife through ingestion of food items, drinking water, and incidental ingestion of soil. Instead, a food-chain model was used to evaluate potential risks posed by COPCs to upper-level terrestrial wildlife receptors. Section 3.4.4.2 describes the food-chain model methodology. Chemicals evaluated in the terrestrial food-chain model were limited to those identified by the U.S. EPA as bioaccumulative (U.S. EPA, 2000). Separate discussions are provided below for evaluations of potential risk to insectivorous, herbivorous and piscivorous receptors. The maximum concentration detected in the surface water and sediment samples is used for the conservative food chain model because less than 10 samples of these media were collected. However, the 95% UCL was used in the conservative food chain model for surface soil. The average detected concentrations were used for the average food chain models. Appendix H.4 presents the spreadsheets used to calculate the doses and EEQs.

6.7.6.2.1 Risks to Insectivorous/Herbivorous Receptors

Table 6-31 presents the terrestrial wildlife model EEQs based on conservative input parameters for the meadow vole, short-tailed shrew, American robin, and bobwhite quail. All NOAEL based EEQs were less than 1.0 except for lead and zinc in the American robin model. NOAEL based EEQs for lead and zinc in the American robin food chain model were 12 and 15, respectively. LOAEL based EEQs for these metals were 1.2 and 1.7, respectively.

Table 6-32 presents the terrestrial wildlife model EEQs based on average input parameters (NOAELs and LOAELs) for the American robin. Food chain modeling was performed using exposure parameters for the American robin only for lead and zinc because only these chemicals had NOAEL based EEQs greater than 1.0 under the maximum input, conservative scenario. The NOAEL EEQs for lead and zinc are 3 and 2.7, respectively. LOAEL based EEQs for these metals were less than 1.0.

Average COPC concentrations are typically more realistic exposure point concentrations (EPCs) for birds than maximum concentrations because birds are exposed to COPC concentrations throughout the SWMU, rather than a single location. However, for SWMU 9, average COPC concentrations may overestimate risks to birds because some of the surface soil samples were collected in areas where there is little ecological habitat (i.e., covered by gravel).

The avian NOAEL and LOAEL for lead were developed from a study in which no adverse effects were observed among Japanese quail consuming 10 mg/kg lead, but where reproduction was less impaired at 100 mg/kg (Sample et al., 1996). Because the study was greater than 12 weeks in duration and considered exposure during reproduction, the 10 mg/kg dose was considered a chronic NOAEL (1.13 mg/kg-day) and the 100 mg/kg dose was considered a chronic LOAEL (11.3 mg/kg-day). The EEQ based on the NOAEL was slightly greater than 1 and the dose was closer to the NOAEL than the LOAEL so risks to birds are unlikely after consideration of other factors as discussed below.

The avian NOAEL and LOAEL for zinc were developed from a study in which no adverse effects were observed among hens consuming 48 and 228 mg/kg zinc, but where egg hatchability was less than 20% of controls among hens consuming 2,028 mg/kg zinc (Sample et al., 1996). Because the study was greater than 10 weeks in duration and considered exposure during reproduction, the 228 mg/kg dose was considered a chronic NOAEL (14.5 mg/kg-day) and the 2,028 mg/kg dose was considered a chronic LOAEL (131 mg/kg-day). The EEQ based on the NOAEL was slightly greater than 1 and the dose was closer to the NOAEL than the LOAEL so risks to birds are unlikely after consideration of other factors as discussed below.

Although, risks to birds consuming earthworms and other invertebrates are possible because the NOAEL EEQs calculated for lead and zinc were greater than 1.0, actual site-related risks are unlikely for the following reasons:

- Although the concentrations of lead and zinc in the surface soil were determined to be statistically greater than the concentrations in the background data set, the concentrations in most of the samples were less than the maximum concentrations in the background samples. Therefore, it is likely that lead and zinc in the surface soil are not related to site activities.

- The NOAEL EEQs were only slightly greater than 1.0 with values of 3.0 and 2.7 for lead and zinc, respectively. Although the exact threshold for effects is not known, the calculated dose for robins in the food chain model is closer to the no-effects level than the lowest-effects level so it is less likely that effects will occur. Also, the bioavailability of the metals used in the toxicity test to develop the NOAELs and LOAELs is greater than the bioavailability in the soil at the site.

- Several of the locations where samples were collected were in areas with poor habitat, if any. Therefore, robins would not obtain a significant portion of their food from this area.

For all these reasons, it is unlikely that lead and zinc will impact robins feeding at the site, but any impacts, would not likely be related to site activities. Therefore, risks from lead and zinc are acceptable; lead and zinc are not retained a COPCs for risks to birds.

6.7.6.2.2 Risks to Piscivorous Receptors

Table 6-33 presents the terrestrial wildlife model EEQs based on the conservative input parameters for the raccoon and belted kingfisher. Aroclor 1248 had NOAEL and LOAEL based EEQs greater than 1.0 in both the raccoon and kingfisher models. NOAEL and LOAEL EEQs for Aroclor 1248 were 190 and 19, respectively in the raccoon model and 11 and 1.1, respectively in the kingfisher model. All other chemicals (including 2,4-D, arsenic, copper, and lead) had NOAEL and LOAEL based EEQs greater than 1.0 in the raccoon food chain model but were less than 1.0 in the kingfisher model (a NOAEL and LOAEL was not available for 2,4-D for the kingfisher) (see Table 6-33).

Table 6-34 presents the terrestrial wildlife model EEQs based on average input parameters (NOAELs and LOAELs) for the raccoon and belted kingfisher. Overall, most EEQs were greater than 1.0. NOAEL and LOAEL based EEQs for Aroclor 1248 exceeded 1.0 with EEQs of 28 and 2.8, respectively in the raccoon

model. Only the NOAEL based EEQ for Aroclor 1248 exceeded 1.0 in the kingfisher model with an EEQ of 2.6. NOAEL and LOAEL based EEQs for 2,4-D were both below 1.0 in the raccoon model. However, NOAEL and LOAEL based EEQs for arsenic and copper were still greater than 1.0 in the raccoon model with EEQs of 1,600 and 160 (arsenic, respectively) and 1.8 and 1.4 (copper, respectively). Only the NOAEL based EEQ for lead (7.0) exceeded 1.0 in the raccoon model.

Aroclor-1248, arsenic, and copper are the only chemicals with EEQs greater than 1.0 using the LOAEL, average concentrations, and average exposure parameters for piscivorous species. All LOAEL based EEQs were greater than 1.0 in the raccoon food chain model. Although, risks to mammals consuming fish are possible because the LOAEL EEQs calculated for several inorganics were greater than 1.0, actual site-related risks are unlikely for the following reasons:

- The water bodies associated with SWMU 9 are expected to account for only a small portion of the raccoon's diet, because the home range of the raccoon (>250 acres) is much larger than the SWMU. Also, the streams are very small and likely do not have large enough numbers of fish, if any, to support the diet of raccoons.

- As presented in Section 6.7.6.1.3, the most likely source of metals in sediment is surface soil run-off from SWMU 9. Arsenic in the surface soil sample is within background concentrations (see Table 6-24) and is not site-related. Therefore, it is likely that risks from arsenic in the sediment are not related to site activities so any risks would not be related to site activities.

- All the metals have high EEQs, in part, because there are no sediment to fish BAF values for inorganics. Therefore, a BAF of 1.0 is used in the model, which assumes that the fish or invertebrate tissue concentrations are equal to the sediment concentrations. This likely overestimates the exposure dose to the raccoon, which then increases the calculated EEQs.

- EEQs for the metals are high in the raccoon food chain model in part due to the weight of the raccoon and the conservative scaling of the food chain modeling. Because the raccoon has a much greater body weight than the test species used in developing the TRVs, the NOAELs and LOAELs are calculated to be significantly lower than TRVs developed with the test species, increasing the calculated risk. This approach is conservative but may be overpredicting risk.

- The location of the only Aroclor-1248 detection (09SD03) was within a ditch; no water was observed within the ditch during the October 2001 site visit and no fish were present. Therefore, there is little exposure of piscivorous birds and mammals to PCBs

For the reasons listed above, risks to piscivorous birds and mammals are acceptable so Aroclor-1248 and metals are not retained as COPCs in sediment for risks to birds and mammals.

6.7.7 Ecological Risk Uncertainty Analysis

Section 3.4.6 in the general methodology section presents the uncertainties that apply to all of the SWMUs. The uncertainty analysis presented in this section includes the uncertainties associated with SWMU 9.

6.7.7.1 Measurement and Assessment Endpoints

As presented in Section 6.7.2, several assessment endpoints were selected for this risk assessment, including the selection of piscivorous wildlife. However, the drainageways adjacent to SWMU 9 are small and unlikely to contain a significant fish population, if any. Therefore, risks to piscivorous wildlife are overestimated.

Risks to reptiles and amphibians are not quantitatively evaluated because exposure factors are not established for most species and toxicity data are very limited. Using aquatic organisms as a surrogate species, risks to amphibians exposed to the surface water and sediment are expected to be low based on the Step 3a evaluations. Potential risks to reptiles cannot be evaluated in this ERA because of a lack of toxicity and exposure data (see below for a discussion of potential risks to the timber rattlesnake).

Food-chain modeling was not conducted for large carnivorous mammals and birds for several reasons including, the uncertainty of estimating contaminant uptake into the diet source (small mammal tissue) and area use factors discussed in Appendix H.2. Two SVOCs, one pesticide, and four inorganics were initially selected as COPCs for surface soil samples. Of these chemicals only the pesticide and three inorganics are considered important bioaccumulative chemicals (U.S. EPA, 2000). Methoxychlor was retained as a COPC with an EEQ of 1.26. Pesticides are known to be related to past site activities, however, detections are low and typical of concentrations associated with spot applications rather than an environmental release related to past SWMU 9 activities. Although methoxychlor is bioaccumulative, the low detection frequency and relatively low concentrations do not warrant concern for carnivorous mammals and birds. Finally, metals typically do not biomagnify in terrestrial systems (Newman, 1998). Therefore, although some chemicals detected at SWMU 9 may accumulate in the tissue of small mammals, risks to carnivorous birds and mammals are expected to be lower than the risks to the small herbivorous or insectivorous mammals and birds. This is because the accumulation factors from soil to

wildlife, soil to plants, and soil to invertebrate are similar (U.S. EPA, 1999) but carnivorous birds and mammals are expected to obtain only a small fraction of their food from SWMU 9. The boundaries of SWMU 9 are approximately 11 acres and home ranges of the red fox and red-tailed hawk are 193 acres and 370 acres, respectively (U.S. EPA, 1993). The food chain EEQs assume that the small herbivorous or insectivorous mammals and birds at SWMU 9 obtain all of their food from the site.

As discussed in Section 1.3.7, several endangered and threatened species or species of special concern are present at NSWC Crane, and potentially may inhabit SWMU 9. Risks to these species were not specifically calculated so the uncertainties of not calculating risks to these species are presented here. As discussed above, risks to large carnivorous mammals and birds are expected to be negligible so risks to the bobcat, bald eagle, Northern harrier, and osprey are expected to be negligible, as are risks to carnivorous reptiles such as the timber rattlesnake. Loggerhead shrikes and the sedge wren consume mostly aboveground insects such as caterpillars, beetles, spiders, and flies, as opposed to the worms that are consumed by the American robin in the food-chain model. Because worms are in direct contact with exposure to the soil, it is expected that they would have greater levels of contaminants at SWMU 9 than aboveground insects; therefore, risks to the robin from consuming worms are expected to be greater than risks to the loggerhead shrike and sedge wren from consuming aboveground insects. Risks to the worm eating American robin from chemicals in the surface soil and surface water were determined to be acceptable; therefore, risks to the loggerhead shrike and sedge wren also are expected to be even lower than risks to robins. The American bittern is a marshland loving bird that feeds on fish, frogs, eels, insects, and water snakes. Although there is some aquatic habitat that may be suitable for the bittern, the presence of the bittern is unlikely at SWMU 9 and risks to the belted kingfisher were very low. Therefore, risks which to the American bittern, if present at SMWU 9, also would be very low.

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 1.3.7, one threatened reptilian species is listed as potentially present at NSWC Crane. Based on the preferred habitat of the timber rattlesnake and the ecology of SWMU 9, this species may potentially inhabit areas of SWMU 9. Risks to these species were not specifically calculated so uncertainties exist as to how this species would be affected if an exposure to site chemical concentrations occurred.

6.7.7.2 Exposure Characterization

No additional uncertainty information on the exposure characterization was determined for SWMU 9.

6.7.7.3 Ecological Effects Data

Toxicological data for a few of the chemicals initially selected as COPCs are limited or do not exist. This occurred for a few inorganics in the surface soil, but it did not affect the outcome of the risk assessment because the chemicals without toxicity data are detected at concentrations below base-specific background levels. This also occurred for some inorganics in the sediment, but it did not affect the outcome of the risk assessment because other Step 3a factors were used to evaluate the chemicals without toxicity data.

Several alternative benchmark values were used to gain a better understanding of the relationship between the maximum concentration values of the selected COPCs and the overall risk. There is some uncertainty involved when using these alternative benchmarks (Table 6-28). The Canadian Soil Quality Guidelines, which are used as alternative benchmarks for both plants and invertebrates, are based on effects to either plants or invertebrates and thus, differentiation of risk to plants versus risk to invertebrates cannot be made using the Canadian guidelines. However, this did not affect the outcome of the risk assessment because the toxicological bases of the SQGs were reviewed before inclusion in the risk assessment. The ORNL values are separated into guidelines for plants and guidelines for invertebrates. However, the values are limited to only a few chemicals.

6.8 CONCLUSIONS

Tables 6-28, 6-29, 6-30, and 6-35 present summaries of the Step 3a evaluation including the overall conclusion of whether chemicals initially selected as COPCs are retained as COPCs after the refined evaluation.

Based on the SERA and the first step of the BERA (step 3a), the following conclusions were made:

Terrestrial Plants and Invertebrates

After the initial screening, two SVOCs and four inorganics were initially selected as COPCs. The potential risks to terrestrial vegetation and soil invertebrates associated with all the COPCs in the surface soil were further evaluated to determine whether site-related risks from the chemicals were acceptable or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

The di-n-butyl phthalate concentration, in the only sample in which it was detected, was less than benchmarks for plants and soil invertebrates. Also, the location of the only detection was in a surface soil

sample collected under a layer of gravel where there is no habitat for ecological receptors [see Figures 1-12 (site photographs) and 6-7 (sample locations)]. Therefore, impacts to plants and invertebrates from di-n-butyl phthalate are not expected. Naphthalene was detected in 2 of 12 samples, but only the detected concentration in one sample slightly exceeded the Canadian SQG for risks to plants and invertebrates. This sample was located adjacent to Highway 45 so it is likely that the PAHs are related to vehicular traffic. Also, the area where the sample had a detected concentration of naphthalene greater than the SQG consists of mowed grass surrounded by a buildings and roads and is not a high quality ecological habitat. Therefore, it was determined that risks to plants and invertebrates from SVOCs in the soil were acceptable so SVOCs were not retained as COPCs for risks to plants and invertebrates.

Of the four inorganics that were detected as COPCs in the surface soil, all of the detected concentrations were less than benchmarks for plants and invertebrates so impacts to plants and invertebrates from inorganics in the soil are not expected. Therefore, it was determined that risks to plants and invertebrates from inorganics in the soil were acceptable so inorganics were not retained as COPCs for risks to plants and invertebrates.

In summary, no chemicals were retained as COPCs for risks to plants or invertebrates. However, because some of the inorganics are considered to be bioaccumulative chemicals, risks to terrestrial wildlife from inorganics are evaluated in Section 6.7.6.2 of this ERA to be conservative.

Benthic Invertebrates

After the initial screening, Aroclor 1248 and eight inorganics were initially selected as COPCs. Potential risks to sediment invertebrates associated with all the COPCs in the sediment were further evaluated to determine whether site-related risks from the chemicals were acceptable and/or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

The only detected concentration of Aroclor-1248 was from a sample in a small drainageway surrounded by thick brush. During the October 2001 site visit, sediments at this location were only moist; no standing water was observed. Therefore, Aroclor-1248 is not expected to impact aquatic receptors at this location because of the poor aquatic habitat (i.e., the receptors are unlikely to be present). For that reason, it was determined that risks to sediment dwelling invertebrates are not great enough to warrant carrying Aroclor-1248 through the BERA process; Aroclor-1248 is eliminated as a COPC for risks to sediment dwelling invertebrates.

Aluminum, antimony, arsenic, copper, and iron, were detected at concentrations less than the lower effects levels indicating that impacts to benthic invertebrates are unlikely. The detected concentrations of vanadium were less than the higher effects levels. Finally, the detected concentrations of barium and manganese were greater than higher effects levels indicating the potential impacts to sediment invertebrates were probable. The detected concentrations of barium, manganese, and vanadium in the surface soil are within background concentrations and are not site-related. The most likely source of metals in sediment is surface soil run-off from SWMU 9. Therefore, although it is possible that the concentrations of some inorganics in the sediment are adversely impacting benthic invertebrates at some locations, the inorganics in the sediment do not appear to be related to site activities. Also, the aquatic habitat in the drainage ditches were the sediment samples were collected is relatively poor. For these reasons, site-related risks to benthic invertebrates from inorganics were determined to be acceptable so inorganics were not retained as COPCs for risks to sediment dwelling invertebrates.

In summary, no chemicals were retained as COPCs for risks to sediment invertebrates. However, because Aroclor-1248 and several of the inorganics are bioaccumulative chemicals, risks to piscivorous wildlife from these inorganics in the sediment are evaluated in Section 6.7.6.2 of this ERA.

Aquatic Organisms

After the initial screening, one herbicide and five inorganics were initially selected as COPCs. Potential risks to aquatic receptors associated with all the COPCs in the surface water were further evaluated to determine whether site-related risks from the chemicals were acceptable or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

The single 2,4-D and cobalt detections are less than the updated ESLs so risks to aquatic invertebrates from 2,4-D and cobalt are acceptable; 2,4-D and cobalt are not retained as COPCs for risks to aquatic invertebrates.

Also, the concentrations of copper and zinc were less than U.S. EPA WQC (after adjusting for site-specific hardness) so risks to aquatic receptors from these metals are not likely. The manganese levels in surface water are below levels expected to cause toxicity to aquatic receptors. Finally, the detected concentration of iron in one sample was greater than its WQC. However, the sample was collected from a drainage culvert with little ecological habitat. Therefore, risks to aquatic receptors from inorganics in the surface water at SWMU 9 are acceptable so the inorganics were eliminated as COPCs for risks to aquatic receptors.

In summary, no chemicals were retained as COPCs for risks to aquatic organisms. However, because 2,4-D, copper, and zinc are bioaccumulative, risks to piscivorous wildlife from the these chemicals are evaluated in Section 6.7.6.2 of this ERA.

Summary of Food Chain Modeling

After the initial screening, methoxychlor, and three several inorganics were initially selected as COPCs for potential risks to mammals and birds. Also, Aroclor-1248, 2,4-D, and three inorganics in sediment/surface water were included in the food chain model for piscivorous mammals and birds. The potential risks to mammals and birds associated with all the COPCs in the surface soil, sediment, and/or surface water were further evaluated to determine whether site-related risks from the chemicals were acceptable or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

Risks to Insectivorous/Herbivorous Receptors

In the less conservative food chain model, the NOAEL EEQs calculated for lead and zinc in the American robin model are greater than 1.0. No LOAEL: EEQs were greater than 1.0 in the less conservative food chain model.

Although the NOAEL EEQs calculated for lead and zinc in the robin model are greater than 1.0, site-related impacts to birds are not expected from lead and zinc for several reasons:

- Although the concentrations of lead and zinc in the surface soil were determined to be statistically greater than the concentrations in the background data set, the concentrations in most of the samples were less than the maximum concentrations in the background samples. Therefore, it is likely that lead and zinc in the surface soil are not related to site activities.

- The NOAEL EEQs were only slightly greater than 1.0 with values of 3.0 and 2.7 for lead and zinc, respectively. Although the exact threshold for effects is not known, the calculated dose for robins in the food chain model is closer to the no-effects level than the lowest-effects level so it is less likely that effects will occur than will occur. Also, the bioavailability of the metals used in the toxicity test to develop the NOAELs and LOAELs are greater than the bioavailability in the soil at the site.

- Several of the locations where samples were collected were in areas with poor habitat, if any. Therefore, robins would not obtain a significant portion of their food from this area.

For all these reasons, it is unlikely that lead and zinc will impact robins feeding at the site, but any impacts, would not likely be related to site activities. Therefore, risks from lead and zinc are acceptable; lead and zinc are not retained a COPCs for risks to birds.

Risks to Piscivorous Receptors

In the less conservative food chain model, the NOAEL and LOAEL EEQs calculated for Aroclor-1248, 2,4-D, and three inorganics in the raccoon model are greater than 1.0, and NOAEL and LOAEL EEQs calculated for Aroclor 1248 for the kingfisher are greater than 1.0. Although, risks to mammals consuming fish are possible because the LOAEL EEQs calculated for several chemicals were greater than 1.0, actual site-related risks are unlikely for the following reasons:

- The drainage ditches are very small and do not support many fish, if any. Also, though the piscivorous wildlife may consume some small invertebrates from the drainage ways, the water bodies associated with SWMU 9 are expected to account for only a small portion of the raccoon's diet, because of the raccoon's home range an because the streams are very small and likely do not have large enough numbers of fish to support the diet of raccoons.

- The exposure dose to the raccoon is likely overestimated by using default BAFs of 1.0 are used in the food chain model to estimate fish tissue concentrations from the sediment because chemical-specific BAFs for metals are not available. This overestimate of dose causes the EEQ to be overestimated.

- Because the raccoon has a greater body weight than the test species used in developing the TRVs, the NOAELs and LOAELs calculated for the raccoon are lower than TRVs developed with the test species, increasing the calculated risk. This is especially true for 2,4-D and metals which have calculated NOAELs and LOAELs for the raccoon of 7 (copper), 20 (2,4-D and lead), and 228 (arsenic) times lower than the NOAELs and LOAELs for the test species.

In summary, for the reasons listed above, but primarily because of the lack of aquatic habitat, risks to piscivorous birds and mammals are acceptable; Aroclor-1248, 2,4-D, arsenic, copper, and lead are not retained as COPC in sediment for risks to mammals.

TABLE 6-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 – PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA
PAGE 1 OF 4

Location	Sample Depth	Sample Number	Analyses							
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs (PAHs via SIM)	App. IX Pest./PCBs	App. IX Herbicides	TAL Metals + Sn	Cyanide	Miscellaneous Parameters (1)
GROUND WATER										
09-02		09GW0201	X	X	X	X	X	X	X	NA
09-03		09GW0301	X	X	X	X	X	X	X	NA
09-04		09GW0401	X	X	X	X	X	X	X	NA
09-07		09GW0701	X	X	X	X	X	X	X	NA
09-10		09GW1001	X	X	X	X	X	X	X	NA
09-12		09GW1201	X	X	X	X	X	X	X	NA
09T01		09GWT0101	X	X	X	X	X	X	X	NA
09T02		09GWT0201	X	X	X	X	X	X	X	NA
09T03		09GWT0301	X	X	X	X	X	X	X	NA
09T04		09GWT0401	X	X	X	X	X	X	X	NA
09T05		09GWT0501	X	X	X	X	X	X	X	NA
09-WTP5		09GWTP0501	X	X	X	X	X	X	X	NA
09-WTP6		09GWTP0601 (upgradient)	X	X	X	X	X	X	X	NA
SURFACE WATER										
09SW/SD01		09SW0101 (upgradient)	X	X	X	X	X	X	X	X
		09SW0101-F	NA	NA	NA	NA	NA	X	NA	NA
09SW/SD02		09SW0201	X	X	X	X	X	X	X	X
		09SW0201-F	NA	NA	NA	NA	NA	X	NA	NA
09SW/SD03		09SW0301	X	X	X	X	X	X	X	X
		09SW0301-F	NA	NA	NA	NA	NA	X	NA	NA
09SW/SD04		09SW0401	X	X	X	X	X	X	X	X
		09SW0401-F	NA	NA	NA	NA	NA	X	NA	NA
09SW/SD05		09SW0501	X	X	X	X	X	X	X	X
		09SW0501-F	NA	NA	NA	NA	NA	X	NA	NA

TABLE 6-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 – PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Location	Sample Depth	Sample Number	Analyses							
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs (PAHs via SIM)	App. IX Pest./PCBs	App. IX Herbicides	TAL Metals + Sn	Cyanide	Miscellaneous Parameters (1)
SURFACE/SUBSURFACE SOIL										
09SB01	0 - 2 feet bgs	09SB010002	NA	NA	X	X	X	X	X	NA
	1 - 2 feet bgs	09SB010102	X	X	NA	NA	NA	NA	NA	NA
	8 - 10 feet bgs	09SB010810	X	X	X	X	X	X	X	X
09SB02	0 - 2 feet bgs	09SB020002	NA	NA	X	X	X	X	X	NA
	1 - 2 feet bgs	09SB020102	X	X	NA	NA	NA	NA	NA	NA
	6 - 8 feet bgs	09SB020608	X	X	X	X	X	X	X	NA
09SB03	0 - 2 feet bgs	09SB030002	NA	NA	X	X	X	X	X	NA
	1 - 2 feet bgs	09SB030102	X	X	NA	NA	NA	NA	NA	NA
	4 - 6 feet bgs	09SB030406	X	X	X	X	X	X	X	X
09SB04	0 - 2 feet bgs	09SB040002	NA	NA	X	X	X	X	X	X
	1 - 2 feet bgs	09SB040102	X	X	NA	NA	NA	NA	NA	NA
	4 - 6 feet bgs	09SB040406	X	X	X	X	X	X	X	NA
09SB05	0 - 2 feet bgs	09SB050002	NA	NA	X	X	X	X	X	X
	1 - 2 feet bgs	09SB050102	X	X	NA	NA	NA	NA	NA	NA
	4 - 6 feet bgs	09SB050406	X	X	X	X	X	X	X	NA
09SB06	0 - 2 feet bgs	09SB060002	NA	NA	X	X	X	X	X	NA
	1 - 2 feet bgs	09SB060102	X	X	NA	NA	NA	NA	NA	NA
	8 - 10 feet bgs	09SB060810	X	X	X	X	X	X	X	NA
09SB07	0 - 2 feet bgs	09SB070002	NA	NA	X	X	X	X	X	X
	1 - 2 feet bgs	09SB070102	X	X	NA	NA	NA	NA	NA	NA
	7 - 9 feet bgs	09SB070709	X	X	X	X	X	X	X	NA

TABLE 6-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 – PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Location	Sample Depth	Sample Number	Analyses							
			App. IX VOCs (8260B)	App. IX VOCs (8015B)	App. IX SVOCs (PAHs via SIM)	App. IX Pest./PCBs	App. IX Herbicides	TAL Metals + Sn	Cyanide	Miscellaneous Parameters (1)
09SB08	0 - 2 feet bgs	09SB080002	NA	NA	X	X	X	X	X	NA
	1 - 2 feet bgs	09SB080102	X	X	NA	NA	NA	NA	NA	NA
	4 - 6 feet bgs	09SB080406	X	X	X	X	X	X	X	X
09SB09	0 - 2 feet bgs	09SB090002	NA	NA	X	X	X	X	X	NA
	1 - 2 feet bgs	09SB090102	X	X	NA	NA	NA	NA	NA	NA
	8 - 10 feet bgs	09SB090810	X	X	X	X	X	X	X	X
09SB10	0 - 2 feet bgs	09SB100002	NA	NA	X	X	X	X	X	NA
	1 - 2 feet bgs	09SB100102	X	X	NA	NA	NA	NA	NA	NA
	2 - 4 feet bgs	09SB100204	X	X	X	X	X	X	X	X
09SB11	0 - 2 feet bgs	09SB110002	NA	NA	X	X	X	X	X	NA
	1 - 2 feet bgs	09SB110102	X	X	NA	NA	NA	NA	NA	NA
	4 - 6 feet bgs	09SB110406	X	X	X	X	X	X	X	NA
SEDIMENT										
09SW/SD01	0-6 inches	09SD010006 (upgradient)	X	X	X	X	X	X	X	X
09SW/SD02	0-6 inches	09SD020006	X	X	X	X	X	X	X	X
09SW/SD03	0-6 inches	09SD030006	X	X	X	X	X	X	X	X
09SW/SD04	0-6 inches	09SD040006	X	X	X	X	X	X	X	X
09SW/SD05	0-6 inches	09SD050006	X	X	X	X	X	X	X	X

App. IX = Appendix IX.
NA = Not analyzed.
PAHs = Polycyclic aromatic hydrocarbons.
Pest/PCBs = Pesticides and polychlorinated biphenyls.
SIM = Selective ion monitoring.
Sn = Tin.
SVOCs = Semivolatile organic compounds.
TAL = Target analyte list.
VOCs = Volatile organic compounds.

TABLE 6-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 – PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Note: Sample numbers ending with "F" were field filtered prior to metals analyses,

1 Miscellaneous Parameters
- surface and subsurface soil samples were analyzed for Cation Exchange Capacity, pH, and total organic carbon.
- ground water samples were not analyzed for miscellaneous parameters.
- surface water samples were analyzed for hardness and total suspended solids.
- sediment samples were analyzed for total organic carbon.

TABLE 6-2

SUMMARY OF POSITIVE SURFACE SOIL ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Sample Identification	09SB010002	09SB010102	09SB020002	09SB020102	09SB030002	09SB030102	09SB040002	09SB040102	09SB050002	09SB050102	09SB060002	09SB060102	09SB070002	09SB070102
Depth Range (feet bgs)	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2
Soil Group:	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Volatiles (µg/kg)														
METHYLENE CHLORIDE		4 J		4 U		5 J		3 U		3 U		3 U		3 U
Semi-Volatiles (µg/kg)														
2-METHYLNAPHTHALENE	8 U		8 U		40		8.00 U		9.00 U		8.00 U		8.00 U	
ACENAPHTHENE	8 U		8 U		20		8.00 U		9.00 U		8.00 U		8.00 U	
ACENAPHTHYLENE	8 U		8 U		18		8.00 U		9.00 U		8.00 U		8.00 U	
ANTHRACENE	8 U		8 U		52		8.00 U		9.00 U		8.00 U		8.00 U	
BENZO(A)ANTHRACENE	8 U		8 U		150		8.00 U		9.00 U		18.0		8.00 U	
BENZO(A)PYRENE	8 U		8 U		130		8.00 U		9.00 U		22.0 J		8.00 U	
BENZO(B)FLUORANTHENE	8 U		8 U		120		8.00 U		9.00 U		40.0 J		9.00	
BENZO(G,H,I)PERYLENE	8 U		9		57		8.00 U		9.00 U		26.0 J		8.00 U	
BENZO(K)FLUORANTHENE	8 U		8 U		110 J		8.00 U		9.00 U		18.0 J		8.00 U	
CHRYSENE	8 U		8 U		140		8.00 U		9.00 U		29.0		10.0	
DI-N-BUTYL PHTHALATE	380 U		1200		410 U		420 U		440 U		400 U		400 U	
DIBENZO(A,H)ANTHRACENE	8 U		8 U		29		8.00 U		9.00 U		8.00 UJ		8.00 U	
FLUORANTHENE	8 U		8		300 J		8.00 UJ		9.00 U		23.0		8.00 U	
FLUORENE	8 U		8 U		29		8.00 U		9.00 U		8.00 U		8.00 U	
INDENO(1,2,3-CD)PYRENE	8 U		8 U		58		8.00 U		9.00 U		14.0 J		8.00 U	
NAPHTHALENE	8 U		8 U		30		8.00 U		9.00 U		8.00 U		8.00 U	
PHENANTHRENE	8 U		8 U		300 J		8.00 U		9.00 U		8.00 U		13.0	
PYRENE	8 U		8 U		230 J		8.00 UJ		9.00 U		28.0		13.0	
Pesticides (µg/kg)														
4,4'-DDT	3.8 UJ		4.0 U		4.0 U		4.2 U		4.3 U		3.9 U		3.9 U	
METHOXYCHLOR	20 UJ		20 UJ		21 U		22 U		22 U		20 U		20 U	
Herbicides (µg/kg)														
2,4-D	3.1 UJ		17 R		3.3 U		20 J		18 R		3.2 U		8.5 R	
DINOSEB	3.1 UJ		3.2 U		3.3 U		22 R		3.5 U		3.2 U		14 R	
PENTACHLOROPHENOL	0.77 UJ		3.5		0.82 U		2.0 J		0.88 U		0.80 U		1.2 J	
Inorganics (mg/kg)														
ALUMINUM	8680 J		11900 J		8950 J		10900		12000		5140		8450	
ANTIMONY	0.89 U		0.91 U		0.90 U		0.97 UJ		1.0 UJ		3.1 J		0.93 UJ	
ARSENIC	5.2		7.6		5.5		6.4 J		7.0 J		2.9 J		5.1 J	
BARIUM	49.6 J		98.8 J		62.8 J		104 J		85.2 J		52.9 J		78.7 J	
CADMIUM	0.82 U		0.89 U		0.93 U		0.91 U		1.0 U		0.90 U		0.91 U	
CALCIUM	1430 J		15900 J		15700 J		1350 J		1780 J		71700 J		93500 J	
CHROMIUM	8.4		12.9		11.3		10.6 J		13.4 J		11.2 J		10.9 J	
COBALT	5.4 J		14.0 J		5.1 J		23.0		16.8		5.1		8.7	
COPPER	9.3 J		13.6 J		11.9 J		9.5 J		11.4 J		12.4 J		9.8 J	
IRON	16300		19800		18000		16100		18300		13600		13600	
LEAD	8.6 J		19.8 J		18.7 J		19.8 J		18.3 J		14.3 J		18.2 J	
MAGNESIUM	731 J		1950 J		3070 J		1490 J		1480 J		1510 J		4490 J	
MANGANESE	333 J		755 J		225 J		1060 J		903 J		135 J		531 J	
MERCURY	0.04 U		0.04 U		0.05 U		0.06		0.04		0.04 U		0.05	
NICKEL	9.5 J		12.8 J		11.7 J		12.5		12.4		12.1		13.5	
POTASSIUM	409 UJ		545 J		466 UJ		479 J		533 J		449 UJ		464 J	
VANADIUM	14.6		24.4		18.5		22.4 J		26.3 J		16.6 J		20.2 J	
ZINC	30.3 J		54.1 J		39.8 J		37.3 J		44.3 J		120 J		39.4 J	
Miscellaneous Parameters														
CATION EXCHANGE CAPACITY (MEQ/100 g)							11.0 J		9.8 J				8.4 J	
pH S.U.							6.9 J		7.2 J				8.0 J	
TOTAL ORGANIC CARBON (mg/kg)							8500		5700				6400	

TABLE 6-2

SUMMARY OF POSITIVE SURFACE SOIL ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Sample Identification	09SB080002	09SB080102	09SB090002	09SB090102	09SB100002	09SB100102	09SB110002	09SB110102
Depth Range (feet bgs)	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2	0 - 2	1 - 2
Soil Group:	3	3	3	3	3	3	3	3
Volatiles (µg/kg)								
METHYLENE CHLORIDE		6 J		6 J		5 J		3 U
Semi-Volatiles (µg/kg)								
2-METHYLNAPHTHALENE	8.00 U		1800		8 UJ		8.00 U	
ACENAPHTHENE	8.00 U		8.00 U		8 UJ		8.00 U	
ACENAPHTHYLENE	8.00 U		8.00 U		8 UJ		8.00 U	
ANTHRACENE	8.00 U		8.00 U		8 UJ		8.00 U	
BENZO(A)ANTHRACENE	8.00 U		100		56 J		8.00 U	
BENZO(A)PYRENE	8.00 U		65.0 J		64 J		8.00 U	
BENZO(B)FLUORANTHENE	8.00 U		61.0 J		69 J		8.00 U	
BENZO(G,H,I)PERYLENE	8.00 U		29.0 J		37 J		8.00 U	
BENZO(K)FLUORANTHENE	8.00 U		47.0 J		54 J		8.00 U	
CHRYSENE	8.00 U		98.0		67 J		8.00 U	
DI-N-BUTYL PHTHALATE	420 U		430 U		400 U		390 U	
DIBENZO(A,H)ANTHRACENE	8.00 U		10.0 J		14 J		8.00 U	
FLUORANTHENE	8.00 U		100		130 J		8.00 U	
FLUORENE	8.00 U		8.00 U		8 UJ		8.00 U	
INDENO(1,2,3-CD)PYRENE	8.00 U		15.0 J		35 J		8.00 U	
NAPHTHALENE	8.00 U		930		8 UJ		8.00 U	
PHENANTHRENE	8.00 U		630		55 J		8.00 U	
PYRENE	8.00 U		140		110 J		8.00 U	
Pesticides (µg/kg)								
4,4'-DDT	4.1 U		4.7		4.0 UJ		3.8 U	
METHOXYCHLOR	21 U		25 J		20 UJ		20 U	
Herbicides (µg/kg)								
2,4-D	82 R		12 R		3.2 UJ		3.1 U	
DINOSEB	14 J		3.4 U		3.2 UJ		3.1 U	
PENTACHLOROPHENOL	5.4 R		6.0 R		0.81 UJ		0.78 U	
Inorganics (mg/kg)								
ALUMINUM	12900		10500		5480 J		5040	
ANTIMONY	0.95 UJ		0.91 UJ		0.97		0.92 UJ	
ARSENIC	8.6 J		9.6 J		4.2		3.4 J	
BARIUM	105 J		106 J		68.1 J		103 J	
CADMIUM	1.0 U		0.92 U		0.96 J		0.83 U	
CALCIUM	843 J		2150 J		130000 J		175000 J	
CHROMIUM	13.7 J		13.1 J		8.7		7.6 J	
COBALT	13.4		13.6		4.8 J		5.5	
COPPER	13.4 J		12.7 J		20.1 J		7.6 J	
IRON	20100		18700		10500		8840	
LEAD	16.8 J		25.8 J		34.9 J		12.7 J	
MAGNESIUM	1750 J		1490 J		10800 J		32500 J	
MANGANESE	782 J		912 J		327 J		385 J	
MERCURY	0.05		0.06		0.04 U		0.04 U	
NICKEL	13.7		15.0		18.3 J		14.5	
POTASSIUM	618 J		462 UJ		489 J		417 UJ	
VANADIUM	27.6 J		29.3 J		22.5		14.5 J	
ZINC	48.6 J		43.0 J		63.7 J		49.2 J	
Miscellaneous Parameters								
CATION EXCHANGE CAPACITY (MEQ/100 g)								
pH S.U.								
TOTAL ORGANIC CARBON (mg/kg)								

TABLE 6-2

SUMMARY OF POSITIVE SURFACE SOIL ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

bgs = Below ground surface.

Blank cells indicate the sample was not analyzed for this parameter.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical results reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected n this sample as well as the associated laboratory method blank but has been qualified non-detected resultant of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

MEQ = milliequivalents

S.U. = standard units.

Soil Group 3 - Alluvial, Mississippian, and Pennsylvanian surface soil as per "Basewide Background Soil Investigation Report." NSWC Crane, Indiana (TtNUS, January 2001).

TABLE 6-3

SURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?(2)
Volatile Organics (µg/kg)									
75-09-2	METHYLENE CHLORIDE	5/11	4	J	6	J	3 - 4	09SB080102	---
Semi-Volatile Organics (µg/kg)									
91-57-6	2-METHYLNAPHTHALENE	2/11	40		1800		8 - 9	09SB090002	---
83-32-9	ACENAPHTHENE	1/11	20		20		8 - 9	09SB030002	---
208-96-8	ACENAPHTHYLENE	1/11	18		18		8 - 9	09SB030002	---
120-12-7	ANTHRACENE	1/11	52		52		8 - 9	09SB030002	---
56-55-3	BENZO(A)ANTHRACENE	4/11	18		150		8 - 9	09SB030002	---
50-32-8	BENZO(A)PYRENE	4/11	22	J	130		8 - 9	09SB030002	---
205-99-2	BENZO(B)FLUORANTHENE	5/11	9		120		8 - 9	09SB030002	---
191-24-2	BENZO(G,H,I)PERYLENE	5/11	9		57		8 - 9	09SB030002	---
207-08-9	BENZO(K)FLUORANTHENE	4/11	18	J	110	J	8 - 9	09SB030002	---
218-01-9	CHRYSENE	5/11	10		140		8 - 9	09SB030002	---
84-74-2	DI-N-BUTYL PHTHALATE	1/11	1200		1200		380 - 440	09SB020002	---
53-70-3	DIBENZO(A,H)ANTHRACENE	3/11	10	J	29		8 - 9	09SB030002	---
206-44-0	FLUORANTHENE	5/11	8		300	J	8 - 9	09SB030002	---
86-73-7	FLUORENE	1/11	29		29		8 - 9	09SB030002	---
193-39-5	INDENO(1,2,3-CD)PYRENE	4/11	14	J	58		8 - 9	09SB030002	---
91-20-3	NAPHTHALENE	2/11	30		930		8 - 9	09SB090002	---
85-01-8	PHENANTHRENE	4/11	13		630		8 - 9	09SB090002	---
129-00-0	PYRENE	5/11	13		230	J	8 - 9	09SB030002	---
Pesticides/PCB's (µg/kg)									
50-29-3	4,4'-DDT	1/11	4.7		4.7		3.8 - 4.3	09SB090002	---
72-43-5	METHOXYCHLOR	1/11	25	J	25	J	20 - 22	09SB090002	---
Herbicides (µg/kg)									
94-75-7	2,4-D	1/6	20	J	20	J	3.1 - 3.3	09SB040002	---
88-85-7	DINOSEB	1/9	14	J	14	J	3.1 - 3.5	09SB080002	---
87-86-5	PENTACHLOROPHENOL	3/9	1.2	J	3.5		0.77 - 0.88	09SB020002	---
Inorganics (mg/kg)									
7429-90-5	ALUMINUM	11/11	5040		12900		---	09SB080002	NO
7440-36-0	**ANTIMONY**	**2/11**	**0.97**		**3.1**	**J**	**0.89 - 1**	**09SB060002**	**YES**
7440-38-2	ARSENIC	11/11	2.9	J	9.6	J	---	09SB090002	NO
7440-39-3	BARIUM	11/11	49.6	J	106	J	---	09SB090002	NO
7440-43-9	CADMIUM	1/11	0.96	J	0.96	J	0.82 - 1	09SB100002	NO
7440-70-2	**CALCIUM**	**11/11**	**843**	**J**	**175000**	**J**	---	**09SB110002**	**YES**

TABLE 6-3

SURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?(2)
7440-47-3	CHROMIUM	11/11	7.6	J	13.7	J	---	09SB080002	NO
7440-48-4	COBALT	11/11	4.8	J	23		---	09SB040002	NO
7440-50-8	**COPPER**	**11/11**	**7.6**	**J**	**20.1**	**J**	---	**09SB100002**	**YES**
7439-89-6	IRON	11/11	8840		20100		---	09SB080002	NO
7439-92-1	**LEAD**	**11/11**	**8.6**	**J**	**34.9**	**J**	---	**09SB100002**	**YES**
7439-95-4	**MAGNESIUM**	**11/11**	**731**	**J**	**32500**	**J**	---	**09SB110002**	**YES**
7439-96-5	MANGANESE	11/11	135	J	1060	J	---	09SB040002	NO
7439-97-6	MERCURY	5/11	0.04		0.06		0.04 - 0.05	09SB040002	NO
7440-02-0	NICKEL	11/11	9.5	J	18.3	J	---	09SB100002	NO
7440-09-7	POTASSIUM	6/11	464	J	618	J	409 - 466	09SB080002	NO
7440-62-2	VANADIUM	11/11	14.5	J	29.3	J	---	09SB090002	NO
7440-66-6	**ZINC**	**11/11**	**30.3**	**J**	**120**	**J**	---	**09SB060002**	**YES**
Miscellaneous Parameter (MEQ/100 g)									
	CATION EXCHANGE CAPACITY	3/3	8.4	J	11	J	---	09SB040002	---
Miscellaneous Parameter (S.U.)									
	pH	3/3	6.9	J	8	J	---	09SB070002	---
Miscellaneous Parameter (mg/kg)									
TTNUS003	TOTAL ORGANIC CARBON	3/3	5700		8500		---	09SB040002	---

1 - Associated Samples:

09SB010002	09SB040102	09SB080002
09SB010102	09SB050002	09SB080102
09SB020002	09SB050102	09SB090002
09SB020102	09SB060002	09SB090102
09SB030002	09SB060102	09SB100002
09SB030102	09SB070002	09SB100102
09SB040002	09SB070102	09SB110002
		09SB110102

2 - Background Samples:

BG1SBA0101	BG3SBA0301
BG1SBA0401	BG3SBA0501
BG1SBP0401	BG3SBM0201
BG1SBP0601	BG3SBM0401
BG1SBP0701	BG3SBM0601
BG1SBP0801	BG3SBM0701
BG1SBP0901	BG3SBM0801
BG3SBA0101	

CAS = Chemical abstract services.

--- = Not applicable.

Bolding indicates that parameter is in excess of background.

Note:

Surface soil samples were collected from the 0 to 2 foot depth interval. Samples collected for all analyses other than VOCs were taken from the full interval.

Samples collected for VOC analyses were taken from the 1 to 2 foot interval because the 0 to 1 foot interval would be depleted in VOCs.

TABLE 6-4

SUMMARY OF POSITIVE SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Sample Identification	09SB010810	09SB020608	09SB030406	09SB040406	09SB050406	09SB060810	09SB070709	09SB080406	09SB090810	09SB100204	09SB110406
Depth Range (feet bgs)	8 - 10	6 - 8	4 - 6	4 - 6	4 - 6	8 - 10	7 - 9	4 - 6	8 - 10	2 - 4	4 - 6
Soil Group:	8	8	8	9	8	8	9	8	9	8	8
Volatiles (µg/kg)											
METHYLENE CHLORIDE	3 J	4 J	3 J	3 U	3 U	3 J	3 U	3 J	3 U	6 J	3 U
TETRACHLOROETHENE	3 U	3 U	3 U	3 U	3 U	3 U	4	3 U	3 U	3 U	3 U
TRICHLOROETHENE	3 U	3 U	3 U	3 U	3 U	3 U	18	3 U	3 U	3 U	3 U
Semi-Volatiles (µg/kg)											
BIS(2-ETHYLHEXYL)PHTHALATE	380 U	380 U	410 U	380 U	390 U	390 U	660	390 U	370 U	400 U	390 U
Pesticides (µg/kg)											
AROCLOR-1254	38 UJ	38 UJ	41 UJ	38 U	38 U	39 U	460	39 U	37 U	39 UJ	38 U
Herbicides (µg/kg)											
PENTACHLOROPHENOL	0.77 U	0.77 U	0.83 U	0.77 U	0.78 U	0.79 U	0.77 U	0.79 U	0.75 U	0.80 U	1.4 J
Inorganics (mg/kg)											
ALUMINUM	8690 J	9480 J	11000 J	8340	8930	9820	7460	7370	3280	10000 J	8330
ANTIMONY	0.85 U	0.89 U	1.9	0.83 UJ	0.86 UJ	1.7 J	0.85 UJ	0.87 UJ	0.84 UJ	0.93 U	0.86 UJ
ARSENIC	3.0	2.2	3.0	3.4 J	4.8 J	3.8 J	3.4 J	3.3 J	0.26 J	5.8	4.8 J
BARIUM	62.5 J	94.2 J	108 J	34.3 J	41.7 J	92.7 J	77.1 J	30.3 J	15.8 J	51.5 J	90.3 J
BERYLLIUM	0.87 U	1.0 J	0.93 U	0.89 U	0.92 U	0.91 U	1.0 J	0.94 U	0.82 U	0.85 U	0.84 U
CALCIUM	480 J	602 J	604 J	447 UJ	458 UJ	1740 J	516 J	472 UJ	409 UJ	1760 J	1380 J
CHROMIUM	11.7	12.0	13.9	12.6 J	12.9 J	12.7 J	9.1 J	8.8 J	3.0 J	12.2	10.1 J
COBALT	5.6 J	13.8 J	32.2 J	8.0	4.3	7.0	37.0	4.9	1.4	4.9 J	12.8
COPPER	6.1 J	11.5 J	8.2 J	9.8 J	11.2 J	13.5 J	11.6 J	9.1 J	2.3 J	12.1 J	7.2 J
IRON	17900	31900	29100	26300	18100	19200	24200	26200	2610	18000	13100
LEAD	11.5 J	13.6 J	13.4 J	13.2 J	10.1 J	15.2 J	15.9 J	9.5 J	6.7 J	11.3 J	14.6 J
MAGNESIUM	925 J	2510 J	1600 J	2010 J	1570 J	1550 J	1270 J	765 J	409 U	1350 J	1090 J
MANGANESE	117 J	335 J	275 J	116 J	106 J	255 J	494 J	84.7 J	4.4 J	236 J	516 J
MERCURY	0.05 U	0.04 U	0.04 U	0.04 U	0.04 U	0.03	0.04 U	0.04 U	0.04 U	0.05 U	0.05
NICKEL	7.0 J	24.3 J	13.1 J	12.8	8.0	9.5	14.6	8.1	2.7	8.2 J	9.4
POTASSIUM	434 UJ	411 UJ	464 UJ	447 UJ	458 UJ	630 J	443 UJ	472 UJ	409 UJ	424 UJ	418 UJ
VANADIUM	19.0	15.9	21.4	19.8 J	20.1 J	22.4 J	13.3 J	13.5 J	2.4 J	19.7	19.4 J
ZINC	17.5 J	73.8 J	36.4 J	49.1 J	30.5 J	37.3 J	39.8 J	28.4 J	9.9 J	30.6 J	26.7 J
Miscellaneous Parameters											
CATION EXCHANGE CAPACITY (MEQ/100 g)	8.7		10.0					13.0 J	7.4 J	7.6	
pH S.U.	5.1 J		5.5 J					4.9 J	4.3 J	6.9 J	
TOTAL ORGANIC CARBON (mg/kg)	1200		2200					2400	1000 U	6500	

TABLE 6-4

SUMMARY OF POSITIVE SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Blank cells indicate the sample was not analyzed for this parameter.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical results reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected n this sample as well as the associated laboratory method blank but has been qualified non-detected resultant of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is

MEQ - milliequivalents

S.U. = Standard units.

Soil Group 8 - Pennsylvanian subsurface clay and silt as per "Basewide Background Soil Investigation Report," NSWC Crane, Indiana (TtNUS, January 2001).

Soil Group 9 - Pennsylvanian subsurface sand as per "Basewide Background Soil Investigation Report," NSWC Crane, Indiana (TtNUS, January 2001).

bgs - Below ground surface.

TABLE 6-5

SUBSURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?(2)
Volatile Organics (µg/kg)									
75-09-2	METHYLENE CHLORIDE	6/11	3	J	6	J	3	09SB100204	---
127-18-4	TETRACHLOROETHENE	1/11	4		4		3	09SB070709	---
79-01-6	TRICHLOROETHENE	1/11	18		18		3	09SB070709	---
Semi-Volatile Organics (µg/kg)									
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	1/11	660		660		370 - 410	09SB070709	---
Pesticides/PCB's (µg/kg)									
11097-69-1	AROCLOR-1254	1/11	460		460		37 - 41	09SB070709	---
Herbicides (µg/kg)									
87-86-5	PENTACHLOROPHENOL	1/11	1.4	J	1.4	J	0.75 - 0.83	09SB110406	---
Inorganics (mg/kg)									
7429-90-5	**ALUMINUM**	**11/11**	**3280**		**11000**	**J**	**---**	**09SB030406**	**YES**
7440-36-0	ANTIMONY	2/11	1.7	J	1.9		0.83 - 0.93	09SB030406	NO
7440-38-2	ARSENIC	11/11	0.26	J	5.8		---	09SB100204	NO
7440-39-3	**BARIUM**	**11/11**	**15.8**	**J**	**108**	**J**	**---**	**09SB030406**	**YES**
7440-41-7	**BERYLLIUM**	**2/11**	**1**	**J**	**1**	**J**	**0.82 - 0.94**	**9SB070709, 09SB02060**	**YES**
7440-70-2	**CALCIUM**	**7/11**	**480**	**J**	**1760**	**J**	**409 - 472**	**09SB100204**	**YES**
7440-47-3	**CHROMIUM**	**11/11**	**3**	**J**	**13.9**		**---**	**09SB030406**	**YES**
7440-48-4	**COBALT**	**11/11**	**1.4**		**37**		**---**	**09SB070709**	**YES**
7440-50-8	**COPPER**	**11/11**	**2.3**	**J**	**13.5**	**J**	**---**	**09SB060810**	**YES**
7439-89-6	**IRON**	**11/11**	**2610**		**31900**		**---**	**09SB020608**	**YES**
7439-92-1	**LEAD**	**11/11**	**6.7**	**J**	**15.9**	**J**	**---**	**09SB070709**	**YES**
7439-95-4	**MAGNESIUM**	**10/11**	**765**	**J**	**2510**	**J**	**409**	**09SB020608**	**YES**
7439-96-5	**MANGANESE**	**11/11**	**4.4**	**J**	**516**	**J**	**---**	**09SB110406**	**NO**
7439-97-6	MERCURY	2/11	0.03		0.05		0.04 - 0.05	09SB110406	NO
7440-02-0	**NICKEL**	**11/11**	**2.7**		**24.3**	**J**	**---**	**09SB020608**	**YES**
7440-09-7	POTASSIUM	1/11	630	J	630	J	409 - 472	09SB060810	NO
7440-62-2	VANADIUM	11/11	2.4	J	22.4	J	---	09SB060810	NO
7440-66-6	**ZINC**	**11/11**	**9.9**	**J**	**73.8**	**J**	**---**	**09SB020608**	**YES**
Miscellaneous Parameter (MEQ/100 g)									
	CATION EXCHANGE CAPACITY	5/5	7.4	J	13	J	---	09SB080406	---
Miscellaneous Parameter (S.U.)									
	pH	5/5	4.3	J	6.9	J	---	09SB100204	---
Miscellaneous Parameter (mg/kg)									
	TOTAL ORGANIC CARBON	4/5	1200		6500		1000	09SB100204	---

TABLE 6-5

SUBSURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

1 - Associated Samples:

09SB010810
09SB020608
09SB030406
09SB040406
09SB050406
09SB060810
09SB070709
09SB080406
09SB090810
09SB100204
09SB110406

2 - Background Samples:

BG1SBP0806
BG1SBP0103
BG1SBP0204
BG1SBP0206
BG1SBP0305
BG1SBP0406
BG1SBP0505
BG1SBP0603
BG1SBP0804
BG1SBP1004

--- = Not applicable.
Bolding indicates that parameter is in excess of background.

CAS = chemical abstract services.
bgs = Below ground surface.

TABLE 6-6

SUMMARY OF POSITIVE GROUND WATER ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Well Number	09-02	09-03	09-04	09-07	09-10	09-12	09WTP05	09WTP06 09GWTP0601[1] (upgradient)	09T01	09T02	09T03	09T04	09T05
Sample Identification	09GW0201	09GW0301	09GW0401	09GW0701	09GW1001	09GW1201	09GWTP0501		09GWT0101	09GWT0201	09GWT0301	09GWT0401	09GWT0501
Volatile Organics (µg/L)													
1,1,1-TRICHLOROETHANE	1 U	26	50 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	1 U	14	50 U	1 U	1 U	1 U	1 UJ	1 UJ	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHENE	0.5 U	6.4	25 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	1 U	69	130	1 U	1 U	1 U	1 U	1 U	1 U	1.7	1 U	1 U	1 U
METHYLENE CHLORIDE	1 U	1 U	58 J	1 U	1 U	1 U	1 UJ	1 UJ	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	1 U	55	50 U	1 U	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Pesticides/PCB's (µg/L)													
DIELDRIN	0.019 U	0.020 U	0.022 U	0.020 U	0.019 U	0.020 U	0.019 U	0.020 U	0.030	0.021 U	0.019 U	0.020 U	0.019 U
Herbicides (µg/L)													
2,4,5-T	0.080 UJ	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.13	0.080 U	0.080 U	0.080 U	0.080 U
2,4,5-TP (SILVEX)	0.080 UJ	0.080 U	0.080 U	0.080 U	0.080 U	0.17 J	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Inorganics (µg/L)													
ALUMINUM	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	1290 J	364 J	200 U	200 U
ARSENIC	4.3	0.29	0.95	0.57	0.75	0.45	1.1	1.0 U	2.9	0.97	0.84	2.9	1.5
BARIUM	323	29.6	78.9	6.6	68.4	21.4	171	19.3	52.6	17.8	66.0	74.1	90.7
BERYLLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.4	1.0	1.0 U	1.0 U
CALCIUM	18200	32200	62100	118000	25800	64600	79900	59300	39400	63100	7950	21100	24000
COBALT	27.4	3.0 U	11.6	3.0 U	3.0 U	54.2	3.0 U	3.0 U	3.0 U	109	12.2	15.2	18.2
COPPER	2.0 U	2.0 U	2.1	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.4	8.4	2.0 U	2.0 U	2.0
IRON	37300	217	833	623	136	20400	15200	149	144	561	217	24700	100 U
LEAD	1.0 U	1.0 U	1.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
MAGNESIUM	11100 J	15800 J	24300 J	81500 J	10600 J	23300 J	14100 J	19800 J	26500 J	68300 J	8360 J	9570 J	21900 J
MANGANESE	7920	176	671	187	164	2550	385	15.0	34.8	7160	75.4	6550	178
NICKEL	10.0 U	20.1	43.5	10.0 U	10.0 U	140	10.0 U	10.0 U	10.0 U	279	16.3	10.0 U	51.2
SELENIUM	1.0 U	1.0 U	1.3	1.2	1.0 U	1.0 U	1.0 U	1.1 J	1.0 U	1.7	1.0 U	1.0 U	1.0 U
SODIUM	6730 J	20200 J	28200 J	110000 J	57600 J	22700 J	5000 U	48900 J	134000 J	115000 J	26700 J	25100 J	102000 J
VANADIUM	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.1	2.0 U	2.0 U	2.0 U	2.0 U
ZINC	10.0 U	12.1	67.1	10.0 U	10.0 U	100	10.0 U	13.2	10.0 U	166	16.2	10.0 U	25.4

1 - Sample was designated the SWMU 9 upgradient ground water sample.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical results reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected n this sample as well as the associated laboratory method blank but has been qualified non-detected resultant of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration i

TABLE 6-7

GROUND WATER ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Site Above Upgradient Concentration?
Volatile Organics (µg/L)										
71-55-6	1,1,1-TRICHLOROETHANE	1/12	26		26		1 - 50	09GW0301	---	---
75-34-3	1,1-DICHLOROETHANE	1/12	14		14		1 - 50	09GW0301	---	---
75-35-4	1,1-DICHLOROETHENE	1/12	6.4		6.4		0.5 - 25	09GW0301	---	---
156-59-2	CIS-1,2-DICHLOROETHENE	3/12	1.7		130		1	09GW0401	---	---
75-09-2	METHYLENE CHLORIDE	1/12	58	J	58	J	1	09GW0401	---	---
79-01-6	TRICHLOROETHENE	2/12	1		55		1 - 50	09GW0301	---	---
Pesticides/PCB's (µg/L)										
60-57-1	DIELDRIN	1/12	0.03		0.03		0.019 - 0.022	09GWT0101	---	---
Herbicides (µg/L)										
93-76-5	2,4,5-T	1/12	0.13		0.13		0.08	09GWT0101	---	---
93-72-1	2,4,5-TP (SILVEX)	1/12	0.17	J	0.17	J	0.08	09GW1201	---	---
Inorganics (µg/L)										
7429-90-5	ALUMINUM	2/12	364	J	1290	J	200	09GWT0201	ND	YES
7440-38-2	ARSENIC	12/12	0.29		4.3		---	09GW0201	ND	YES
7440-39-3	BARIUM	12/12	6.6		323		---	09GW0201	19.3	YES
7440-41-7	BERYLLIUM	2/12	1		4.4		1	09GWT0201	ND	YES
7440-70-2	CALCIUM	12/12	7950		118000		---	09GW0701	59300	YES
7440-48-4	COBALT	7/12	11.6		109		3	09GWT0201	ND	YES
7440-50-8	COPPER	4/12	2		8.4		2	09GWT0201	ND	YES
7439-89-6	IRON	11/12	136		37300		100	09GW0201	149	YES
7439-92-1	LEAD	1/12	1.1		1.1		1	09GW0401	ND	YES
7439-95-4	MAGNESIUM	12/12	8360	J	81500	J	---	09GW0701	19800	YES
7439-96-5	MANGANESE	12/12	34.8		7920		---	09GW0201	15.0	YES
7440-02-0	NICKEL	6/12	16.3		279		10	09GWT0201	ND	YES
7782-49-2	SELENIUM	3/12	1.2		1.7		1	09GWT0201	1.1	YES
7440-23-5	SODIUM	11/12	6730	J	134000	J	5000	09GWT0101	48900	YES
7440-62-2	VANADIUM	1/12	2.1		2.1		2	09GWT0101	ND	YES
7440-66-6	ZINC	6/12	12.1		166		10	09GWT0201	13.2	YES

1 - Associated Samples:

09GW0201	09GW0701	09GWT0101	09GWT0401
09GW0301	09GW1001	09GWT0201	09GWT0501
09GW0401	09GW1201	09GWT0301	09GWTP0501

2 - Upgradient Samples:
B09GWTP0601

ND = Not detected.
CAS = Chemical abstract services.

--- = Not applicable.
Bolding indicates parameter is in excess of upgradient concentration.

TABLE 6-8

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Sample Identification	09SW0101[1] (upgradient)	09SW0101-F	09SW0201	09SW0201-F	09SW0301	09SW0301-F	09SW0401	09SW0401-F	09SW0501	09SW0501-F
Herbicides (µg/L)										
2,4-D	0.080 U		0.18		0.080 U		0.080 U		0.080 U	
Inorganics (µg/L)										
ALUMINUM	5990 J		245 J		200 U		220 J		200 U	
ANTIMONY	1.0 U		1.0 U		1.0 U		1.0 U		1.6	
ARSENIC	4.6 J		0.75 J		0.49 J		0.41 J		1.9 J	
BARIUM	173		55.5		47.0		37.3		72.5	
CALCIUM	34800		42200		49400		17600		57300	
CHROMIUM	7.1		5.0 U		5.0 U		5.0 U		5.0 U	
COBALT	9.8		3.0 U		3.0 U		3.0 U		5.5	
COPPER	18.5		2.0 U		2.0 U		2.0 U		12.4	
IRON	8390 J		526 J		288 J		358 J		1830 J	
LEAD	21.9		1.0 U		1.0 U		1.0 U		3.6	
MAGNESIUM	15400 J		15000 J		6580 J		5960 J		9720 J	
MANGANESE	637		583		76.6		57.6		438	
NICKEL	14.5		10.0 U		10.0 U		10.0 U		10.0 U	
POTASSIUM	5000 U		5000 U		5000 U		5000 U		5310 J	
SELENIUM	1.1		1.0 U		1.0 U		1.0 U		1.0 U	
SODIUM	36000		36400		18500		12600		175000	
VANADIUM	14.3		2.0 U		2.0 U		2.0 U		3.1	
ZINC	50.4		10.0 U		10.0 U		10.0 U		11.9	
Filtered Metals (µg/L)										
ANTIMONY		1.0 U		1.0 U		1.0 U		1.0 U		1.6
ARSENIC		1.1 J		0.70 J		0.42 J		0.27 J		2.3 J
BARIUM		94.9		51.9		45.8		33.2		71.0
CALCIUM		40300		40400		49500		17800		57100
COBALT		3.0 U		3.0 U		3.0 U		3.0 U		5.1
COPPER		2.0 U		2.0 U		2.0 U		2.0 U		7.4
IRON		138 J		214 J		145 J		100 UJ		1460 J
LEAD		1.0 U		1.0 U		1.0 U		1.0 U		2.3
MAGNESIUM		17800 J		14100 J		6560 J		6210 J		10000 J
MANGANESE		239		532		61.2		18.0		451
POTASSIUM		5000 U		5000 U		5000 U		5000 U		5390 J
SODIUM		43200		39000		18200		12700		182000
VANADIUM		2.0 U		2.0 U		2.0 U		2.0 U		3.8
ZINC		10.0 U		10.0 U		10.0 U		10.0 U		10.2
Miscellaneous Parameters (mg/L)										
HARDNESS	150		170		150		70.0		180	
TOTAL SUSPENDED SOLIDS	640		8.0		3.0		10.0		2.0 U	

TABLE 6-8

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

1 - Sample was designated the SWMU 9 upgradient surface water sample.

Blank cells indicate saple was ot analyzed for this parameter.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical results reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected n this sample as well as the associated laboratory method blank but has been qualified non-detected resultant of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is

TABLE 6-9

SURFACE WATER ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Site Above Upgradient Concentration?
Herbicides (µg/L)										
94-75-7	2,4-D	1/4	0.18		0.18		0.08	09SW0201	---	---
Inorganics (µg/L)										
7429-90-5	ALUMINUM	2/4	220	J	245	J	200	09SW0201	5990	NO
7440-36-0	**ANTIMONY**	**1/4**	**1.6**		**1.6**		**1**	**09SW0501**	ND	**YES**
7440-38-2	ARSENIC	4/4	0.41	J	1.9	J	---	09SW0501	4.6	NO
7440-39-3	BARIUM	4/4	37.3		72.5		---	09SW0501	173	NO
7440-70-2	**CALCIUM**	**4/4**	**17600**		**57300**		---	**09SW0501**	**34800**	**YES**
7440-48-4	COBALT	1/4	5.5		5.5		3	09SW0501	9.8	NO
7440-50-8	COPPER	1/4	12.4		12.4		2	09SW0501	18.5	NO
7439-89-6	IRON	4/4	288	J	1830	J	---	09SW0501	8390	NO
7439-92-1	LEAD	1/4	3.6		3.6		1	09SW0501	21.9	NO
7439-95-4	MAGNESIUM	4/4	5960	J	15000	J	---	09SW0201	15400	NO
7439-96-5	MANGANESE	4/4	57.6		583		---	09SW0201	637	NO
7440-09-7	**POTASSIUM**	**1/4**	**5310**	**J**	**5310**	**J**	**5000**	**09SW0501**	**ND**	**YES**
7440-23-5	**SODIUM**	**4/4**	**12600**		**175000**		---	**09SW0501**	**36000**	**YES**
7440-62-2	VANADIUM	1/4	3.1		3.1		2	09SW0501	14.3	NO
7440-66-6	ZINC	1/4	11.9		11.9		10	09SW0501	50.4	NO
Filtered Metals (µg/L)										
7440-36-0	**ANTIMONY, FILTERED**	**1/4**	**1.6**		**1.6**		**1**	**09SW0501-F**	ND	**YES**
7440-38-2	**ARSENIC, FILTERED**	**4/4**	**0.27**	**J**	**2.3**	**J**	---	**09SW0501-F**	**1.1**	**YES**
7440-39-3	BARIUM, FILTERED	4/4	33.2		71		---	09SW0501-F	94.9	NO
7440-70-2	**CALCIUM, FILTERED**	**4/4**	**17800**		**57100**		---	**09SW0501-F**	**40300**	**YES**
7440-48-4	**COBALT, FILTERED**	**1/4**	**5.1**		**5.1**		**3**	**09SW0501-F**	**ND**	**YES**
7440-50-8	**COPPER, FILTERED**	**1/4**	**7.4**		**7.4**		**2**	**09SW0501-F**	**ND**	**YES**
7439-89-6	**IRON, FILTERED**	**3/4**	**145**	**J**	**1460**	**J**	**100**	**09SW0501-F**	**138**	**YES**
7439-92-1	**LEAD, FILTERED**	**1/4**	**2.3**		**2.3**		**1**	**09SW0501-F**	**ND**	**YES**
7439-95-4	MAGNESIUM, FILTERED	4/4	6210	J	14100	J	---	09SW0201-F	17800	NO
7439-96-5	**MANGANESE, FILTERED**	**4/4**	**18**		**532**		---	**09SW0201-F**	**239**	**YES**
7440-09-7	**POTASSIUM, FILTERED**	**1/4**	**5390**	**J**	**5390**	**J**	**5000**	**09SW0501-F**	**ND**	**YES**

TABLE 6-9

SURFACE WATER ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Site Above Upgradient Concentration?
7440-23-5	**SODIUM, FILTERED**	**4/4**	**12700**		**182000**		**---**	**09SW0501-F**	**43200**	**YES**
7440-62-2	**VANADIUM, FILTERED**	**1/4**	**3.8**		**3.8**		**2**	**09SW0501-F**	**ND**	**YES**
7440-66-6	**ZINC, FILTERED**	**1/4**	**10.2**		**10.2**		**10**	**09SW0501-F**	**ND**	**YES**
Miscellaneous Parameters (mg/L)										
	HARDNESS	4/4	70		180		---	09SW0501	---	NO
	TOTAL SUSPENDED SOLIDS	3/4	3		10		2	09SW0401	---	NO

1 - Associated Samples:
09SW0201
09SW0201-F
09SW0301
09SW0301-F
09SW0401
09SW0401-F
09SW0501
09SW0501-F

2 - Upgradient Samples:
B09SW0101
B09SW0101-F

--- = Not applicable.
Bolding indicates parameter is in excess of upgradient concentration.
ND = Not detected.
CAS - Chemical abstract services.

TABLE 6-10

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Sample Identification	09SD010006[1] (upgradient)	09SD020006	09SD030006	09SD040006	09SD050006
Volatiles (µg/kg)					
METHYLENE CHLORIDE	8 J	4 U	4 J	4 J	4 U
Semi-Volatiles (µg/kg)					
BENZO(B)FLUORANTHENE	14.0 J	9.00 U	9.00 UJ	9.00 UJ	9.00 UJ
CHRYSENE	11.0	9.00 U	9.00 U	9.00 U	9.00 U
FLUORANTHENE	13.0	9.00 U	10.0	9.00 U	9.00 U
PYRENE	14.0	9.00 U	9.00 U	9.00 U	9.00 U
Pesticides (µg/kg)					
AROCLOR-1248	53 U	43 U	380 J	45 U	43 U
Herbicides (µg/kg)					
DINOSEB	8.2 J	3.5 U	3.6 U	3.6 U	3.5 U
PENTACHLOROPHENOL	2.7 J	0.88 U	0.89 U	7.1 R	0.88 U
Inorganics (mg/kg)					
ALUMINUM	7600 J	8690 J	7900 J	5470 J	10800 J
ANTIMONY	1.2 U	1.3 J	1.0 U	0.96 U	0.98 U
ARSENIC	3.7	4.5	6.1	5.4	0.77
BARIUM	78.1	43.2	103	77.0	39.3
CALCIUM	2120 J	1010 J	1470 J	786 J	1130 J
CHROMIUM	8.7	11.9	11.4	11.1	13.0
COBALT	9.2	4.8	10.9	14.5	7.2
COPPER	16.0	9.1	10.3	9.0	27.7
IRON	9620 J	16700 J	18600 J	15700 J	16000 J
LEAD	22.1 J	10.1 J	22.7 J	14.5 J	6.6 J
MAGNESIUM	1290 J	1450 J	760 J	597 J	1820 J
MANGANESE	350	181	1300	1290	86.8
MERCURY	0.05 J	0.05 U	0.05 U	0.05 U	0.04 U
NICKEL	12.2	7.4	9.8	11.6	10.7
POTASSIUM	589 UJ	487 UJ	413 UJ	411 UJ	913 J
VANADIUM	15.2	19.9	21.2	16.8	12.2
ZINC	40.9	27.7	95.3	33.4	72.2
Miscellaneous Parameter (mg/kg)					
TOTAL ORGANIC CARBON	38000	5500	7600	14000	1600

TABLE 6-10

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

1 - Sample was designated as the SWMU 9 upgradient sediment sample.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

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R - Indicates that the chemical may or may not be present. The positive analytical results reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected n this sample as well as the associated laboratory method blank but has been qualified non-detected resultant of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

TABLE 6-11

SEDIMENT ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient[2]	Site Above Upgradient Concentration?
Volatile Organics (µg/kg)										
75-09-2	METHYLENE CHLORIDE	2/4	4	J	4	J	4	09SD030006, 09SD040006	---	---
Semi-Volatile Organics (µg/kg)										
206-44-0	FLUORANTHENE	1/4	10		10		9	09SD030006	---	---
Pesticides/PCB's (µg/kg)										
12672-29-6	AROCLOR-1248	1/4	380	J	380	J	43 - 45	09SD030006	---	---
Inorganics (mg/kg)										
7429-90-5	**ALUMINUM**	**4/4**	**5470**	**J**	**10800**	**J**	**---**	**09SD050006**	**7600**	**YES**
7440-36-0	**ANTIMONY**	**1/4**	**1.3**	**J**	**1.3**	**J**	**0.96 - 1**	**09SD020006**	**ND**	**YES**
7440-38-2	**ARSENIC**	**4/4**	**0.77**		**6.1**		**---**	**09SD030006**	**3.7**	**YES**
7440-39-3	**BARIUM**	**4/4**	**39.3**		**103**		**---**	**09SD030006**	**78.1**	**YES**
7440-70-2	CALCIUM	4/4	786	J	1470	J	---	09SD030006	2120	NO
7440-47-3	**CHROMIUM**	**4/4**	**11.1**		**13**		**---**	**09SD050006**	**8.7**	**YES**
7440-48-4	**COBALT**	**4/4**	**4.8**		**14.5**		**---**	**09SD040006**	**9.2**	**YES**
7440-50-8	**COPPER**	**4/4**	**9**		**27.7**		**---**	**09SD050006**	**16.0**	**YES**
7439-89-6	**IRON**	**4/4**	**15700**	**J**	**18600**	**J**	**---**	**09SD030006**	**9620**	**YES**
7439-92-1	**LEAD**	**4/4**	**6.6**	**J**	**22.7**	**J**	**---**	**09SD030006**	**22.1**	**YES**
7439-95-4	**MAGNESIUM**	**4/4**	**597**	**J**	**1820**	**J**	**---**	**09SD050006**	**1290**	**YES**
7439-96-5	**MANGANESE**	**4/4**	**86.8**		**1300**		**---**	**09SD030006**	**350**	**YES**
7440-02-0	NICKEL	4/4	7.4		11.6		---	09SD040006	12.2	NO
7440-09-7	**POTASSIUM**	**1/4**	**913**	**J**	**913**	**J**	**411 - 487**	**09SD050006**	**ND**	**YES**
7440-62-2	**VANADIUM**	**4/4**	**12.2**		**21.2**		**---**	**09SD030006**	**15.2**	**YES**
7440-66-6	**ZINC**	**4/4**	**27.7**		**95.3**		**---**	**09SD030006**	**40.9**	**YES**
Miscellaneous Parameters (mg/kg)										
	TOTAL ORGANIC CARBON	4/4	1600		14000		---	09SD040006	7170	---

1 - Associated Samples:
09SD020006
09SD030006
09SD040006
09SD050006

2 - Upgradient Sample:
B09SD010006

--- = Not applicable.
Bolding indicates parameter is in excess of upgradient concentration.

ND = Not detected.
CAS = Chemical abstract services.

TABLE 6-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
VOLATILE ORGANICS																	
75-09-2	METHYLENE CHLORIDE	0.004	J	0.006	J	mg/kg	09SB080102, 09SB090102	5/11	0.003 - 0.004	0.006	NA	8.9	C	120	IDEM	No	BSL
SEMIVOLATILE ORGANICS																	
91-57-6	2-METHYLNAPHTHALENE	0.04		1.8		mg/kg	09SB090002	2/11	0.008 - 0.009	1.8	NA	5.6(7)	N	3200(7)	IDEM	No	BSL
83-32-9	ACENAPHTHENE	0.02		0.02		mg/kg	09SB030002	1/11	0.008 - 0.009	0.02	NA	370	N	9500	IDEM	No	BSL
208-96-8	ACENAPHTHYLENE	0.018		0.018		mg/kg	09SB030002	1/11	0.008 - 0.009	0.018	NA	370(8)	N	9500(8)	IDEM	No	BSL
120-12-7	ANTHRACENE	0.052		0.052		mg/kg	09SB030002	1/11	0.008 - 0.009	0.052	NA	2200	N	47000	IDEM	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.018		0.15		mg/kg	09SB030002	4/11	0.008 - 0.009	0.15	NA	0.62	C	5	IDEM	No	BSL
50-32-8	BENZO(A)PYRENE	0.022	J	0.13		mg/kg	09SB030002	4/11	0.008 - 0.009	0.13	NA	0.062	C	0.5	IDEM	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.009		0.12		mg/kg	09SB030002	5/11	0.008 - 0.009	0.12	NA	0.62	C	5	IDEM	No	BSL
191-24-2	BENZO(G,H,I)PERYLENE	0.009		0.057		mg/kg	09SB030002	5/11	0.008 - 0.009	0.057	NA	230(9)	N	5500(9)	IDEM	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.018	J	0.11	J	mg/kg	09SB030002	4/11	0.008 - 0.009	0.11	NA	6.2	C	50	IDEM	No	BSL
218-01-9	CHRYSENE	0.01		0.14		mg/kg	09SB030002	5/11	0.008 - 0.009	0.14	NA	62	C	500	IDEM	No	BSL
84-74-2	DI-N-BUTYL PHTHALATE	1.2		1.2		mg/kg	09SB020002	1/11	0.38 - 0.44	1.2	NA	610	N	18000	IDEM	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.01	J	0.029		mg/kg	09SB030002	3/11	0.008 - 0.009	0.029	NA	0.062	C	0.5	IDEM	No	BSL
206-44-0	FLUORANTHENE	0.008		0.3	J	mg/kg	09SB030002	5/11	0.008 - 0.009	0.3	NA	230	N	6300	IDEM	No	BSL
86-73-7	FLUORENE	0.029		0.029		mg/kg	09SB030002	1/11	0.008 - 0.009	0.029	NA	260	N	6300	IDEM	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.014	J	0.058		mg/kg	09SB030002	4/11	0.008 - 0.009	0.058	NA	0.62	C	5	IDEM	No	BSL
91-20-3	NAPHTHALENE	0.03		0.93		mg/kg	09SB090002	2/11	0.008 - 0.009	0.93	NA	5.6	N	3200	IDEM	No	BSL
85-01-8	PHENANTHRENE	0.013		0.63		mg/kg	09SB090002	4/11	0.008 - 0.009	0.63	NA	230(9)	N	5500(9)	IDEM	No	BSL
129-00-0	PYRENE	0.013		0.23	J	mg/kg	09SB030002	5/11	0.008 - 0.009	0.23	NA	230	N	5500	IDEM	No	BSL
PESTICIDES/PCBs																	
50-29-3	4,4'-DDT	0.0047		0.0047		mg/kg	09SB090002	1/11	0.0038 - 0.0043	0.0047	NA	1.7	C	20	IDEM	No	BSL
72-43-5	METHOXYCHLOR	0.025	J	0.025	J	mg/kg	09SB090002	1/11	0.02 - 0.022	0.025	NA	31	N	910	IDEM	No	BSL
HERBICIDES																	
94-75-7	2,4-D	0.02	J	0.02	J	mg/kg	09SB040002	1/6	0.0031 - 0.0033	0.02	NA	69	N	NA	IDEM	No	BSL
88-85-7	DINOSEB	0.014	J	0.014	J	mg/kg	09SB080002	1/9	0.0031 - 0.0035	0.014	NA	6.1	N	NA	IDEM	No	BSL
87-86-5	PENTACHLOROPHENOL	0.0012	J	0.0035		mg/kg	09SB020002	3/9	0.00077 - 0.00088	0.0035	NA	3	C	20	IDEM	No	BSL
INORGANICS																	
7429-90-5	ALUMINUM	5040		12900		mg/kg	09SB080002	11/11	---	12900	No	7600	N	NA	IDEM	No	BKG
7440-36-0	ANTIMONY	0.97		3.1	J	mg/kg	09SB060002	2/11	0.89 - 1	3.1	Yes	3.1	N	140	IDEM	No	BSL
7440-38-2	ARSENIC	2.9	J	9.6	J	mg/kg	09SB090002	11/11	---	9.6	No	0.39	C	3.9	IDEM	No	BKG
7440-39-3	BARIUM	49.6	J	106	J	mg/kg	09SB090002	11/11	---	106	No	540	N	23000	IDEM	No	BSL,BKG
7440-43-9	CADMIUM	0.96	J	0.96	J	mg/kg	09SB100002	1/11	0.82 - 1	0.96	No	3.7	N	12	IDEM	No	BSL,BKG
7440-70-2	CALCIUM	843	J	175000	J	mg/kg	09SB110002	11/11	---	175000	Yes	NA		NA	IDEM	No	NUT
7440-47-3	CHROMIUM	7.6	J	13.7	J	mg/kg	09SB080002	11/11	---	13.7	No	30(10)	C	430(10)	IDEM	No	BSL,BKG
7440-48-4	COBALT	4.8	J	23		mg/kg	09SB040002	11/11	---	23	No	470	N	NA	IDEM	No	BSL,BKG
7440-50-8	COPPER	7.6	J	20.1	J	mg/kg	09SB100002	11/11	---	20.1	Yes	290	N	13000	IDEM	No	BSL
7439-89-6	IRON	8840		20100		mg/kg	09SB080002	11/11	---	20100	No	2300	N	NA	IDEM	No	BKG
7439-92-1	LEAD	8.6	J	34.9	J	mg/kg	09SB100002	11/11	---	34.9	Yes	400(11)	N	400	IDEM	No	BSL
7439-95-4	MAGNESIUM	731	J	32500	J	mg/kg	09SB110002	11/11	---	32500	Yes	NA		NA	IDEM	No	NUT
7439-96-5	MANGANESE	135	J	1060	J	mg/kg	09SB040002	11/11	---	1060	No	180	N	NA	IDEM	No	BKG
7439-97-6	MERCURY	0.04		0.06		mg/kg	09SB040002, 09SB090002	5/11	0.04 - 0.05	0.06	No	2.3(12)	N	55	IDEM	No	BSL,BKG
7440-02-0	NICKEL	9.5	J	18.3	J	mg/kg	09SB100002	11/11	---	18.3	No	160	N	6900	IDEM	No	BSL,BKG
7440-09-7	POTASSIUM	464	J	618	J	mg/kg	09SB080002	6/11	409 - 466	618	No	NA		NA	IDEM	No	NUT, BKG
7440-62-2	VANADIUM	14.5	J	29.3	J	mg/kg	09SB090002	11/11	---	29.3	No	55	N	NA	IDEM	No	BSL,BKG
7440-66-6	ZINC	30.3	J	120	J	mg/kg	09SB060002	11/11	---	120	Yes	2300	N	100000	IDEM	No	BSL
MISCELLANEOUS PARAMETERS																	
	CATION EXCHANGE CAPACITY	8.4	J	11	J	meq/100 g	09SB040002	3/3	---	11	NA	NA		NA	IDEM	No	NTX
	pH	6.9	J	8	J	S.U.	09SB070002	3/3	---	8	NA	NA		NA	IDEM	No	NTX
	TOTAL ORGANIC CARBON	5700		8500		mg/kg	09SB040002	3/3	---	8500	NA	NA		NA	IDEM	No	NTX

TABLE 6-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to Base-wide background data presented in the Basewide Background Soil Investigation Report (TtNUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 The risk-based soil COPC screening level for residential land use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, November 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Naphthalene is used as a surrogate for 2-methylnaphthalene.
8 Acenaphthene is used as a surrogate for acenaphthylene.
9 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
10 Hexavalent chromium.
11 OSWER soil screening level for residential land use (U.S. EPA, July 1994).
12 Value is for mercuric chloride (U.S. EPA, Region 3, October 2001).

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Associated Samples:

09SB010002	09SB040102	09SB080002
09SB010102	09SB050002	09SB080102
09SB020002	09SB050102	09SB090002
09SB020102	09SB060002	09SB090102
09SB030002	09SB060102	09SB100002
09SB030102	09SB070002	09SB100102
09SB040002	09SB070102	09SB110002
		09SB110102

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 6-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)		USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
VOLATILE ORGANICS																	
75-09-2	METHYLENE CHLORIDE	0.004	J	0.006	J	mg/kg	09SB080102, 09SB090102	5/11	0.003 - 0.004	0.006	NA	0.001	C	13	0.023	Yes	ASL
SEMIVOLATILE ORGANICS																	
91-57-6	2-METHYLNAPHTHALENE	0.04		1.8		mg/kg	09SB090002	2/11	0.008 - 0.009	1.8	NA	4(8)	N	NA	0.7(8)	Yes	ASL
83-32-9	ACENAPHTHENE	0.02		0.02		mg/kg	09SB030002	1/11	0.008 - 0.009	0.02	NA	29	N	NA	130	No	BSL
208-96-8	ACENAPHTHYLENE	0.018		0.018		mg/kg	09SB030002	1/11	0.008 - 0.009	0.018	NA	29(9)	N	NA	130(9)	No	BSL
120-12-7	ANTHRACENE	0.052		0.052		mg/kg	09SB030002	1/11	0.008 - 0.009	0.052	NA	590	N	NA	51	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.018		0.15		mg/kg	09SB030002	4/11	0.008 - 0.009	0.15	NA	0.08	C	NA	19	Yes	ASL
50-32-8	BENZO(A)PYRENE	0.022	J	0.13		mg/kg	09SB030002	4/11	0.008 - 0.009	0.13	NA	0.4	C	NA	8.2	No	BSL
205-99-2	BENZO(B)FLUORANTHENE	0.009		0.12		mg/kg	09SB030002	5/11	0.008 - 0.009	0.12	NA	0.2	C	NA	57	No	BSL
191-24-2	BENZO(G,H,I)PERYLENE	0.009		0.057		mg/kg	09SB030002	5/11	0.008 - 0.009	0.057	NA	210(10)	N	NA	570(10)	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.018	J	0.11	J	mg/kg	09SB030002	4/11	0.008 - 0.009	0.11	NA	2	C	NA	39	No	BSL
218-01-9	CHRYSENE	0.01		0.14		mg/kg	09SB030002	5/11	0.008 - 0.009	0.14	NA	8	C	NA	25	No	BSL
84-74-2	DI-N-BUTYL PHTHALATE	1.2		1.2		mg/kg	09SB020002	1/11	0.36 - 0.44	1.2	NA	270	N	2300	5000	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.01	J	0.029		mg/kg	09SB030002	3/11	0.008 - 0.009	0.029	NA	0.08	C	NA	18	No	BSL
206-44-0	FLUORANTHENE	0.008		0.3	J	mg/kg	09SB030002	5/11	0.008 - 0.009	0.3	NA	210	N	NA	880	No	BSL
86-73-7	FLUORENE	0.029		0.029		mg/kg	09SB030002	1/11	0.008 - 0.009	0.029	NA	28	N	NA	170	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.014	J	0.058		mg/kg	09SB030002	4/11	0.008 - 0.009	0.058	NA	0.7	C	NA	3.1	No	BSL
91-20-3	NAPHTHALENE	0.03		0.93		mg/kg	09SB090002	2/11	0.008 - 0.009	0.93	NA	4	N	NA	0.7	Yes	ASL
85-01-8	PHENANTHRENE	0.013		0.63		mg/kg	09SB090002	4/11	0.008 - 0.009	0.63	NA	210(10)	N	NA	570(10)	No	BSL
129-00-0	PYRENE	0.013		0.23	J	mg/kg	09SB030002	5/11	0.008 - 0.009	0.23	NA	210	N	NA	570	No	BSL
PESTICIDES/PCBs																	
50-29-3	4,4'-DDT	0.0047		0.0047		mg/kg	09SB090002	1/11	0.0038 - 0.0043	0.0047	NA	2	C	NA	260	No	BSL
72-43-5	METHOXYCHLOR	0.025	J	0.025	J	mg/kg	09SB090002	1/11	0.02 - 0.022	0.025	NA	8	N	NA	160	No	BSL
HERBICIDES																	
94-75-7	2,4-D	0.02	J	0.02	J	mg/kg	09SB040002	1/6	0.0031 - 0.0033	0.02	NA	NA	N	NA	NA	No	NTX
88-85-7	DINOSEB	0.014	J	0.014	J	mg/kg	09SB080002	1/9	0.0031 - 0.0035	0.014	NA	NA	N	NA	NA	No	NTX
87-86-5	PENTACHLOROPHENOL	0.0012	J	0.0035		mg/kg	09SB020002	3/9	0.00077 - 0.00088	0.0035	NA	0.001	C	NA	0.028	Yes	ASL
INORGANICS																	
7429-90-5	ALUMINUM	5040		12900		mg/kg	09SB080002	11/11	---	12900	No	NA	N	NA	NA	No	NTX, BKG
7440-36-0	ANTIMONY	0.97		3.1	J	mg/kg	09SB060002	2/11	0.89 - 1	3.1	Yes	0.3	N	NA	5.4	Yes	ASL
7440-38-2	ARSENIC	2.9	J	9.6	J	mg/kg	09SB090002	11/11	---	9.6	No	1	C	750	29	No	BKG
7440-39-3	BARIUM	49.6	J	106	J	mg/kg	09SB090002	11/11	---	106	No	82	N	690000	1600	No	BKG
7440-43-9	CADMIUM	0.96	J	0.96	J	mg/kg	09SB100002	1/11	0.82 - 1	0.96	No	0.4	N	1800	7.5	No	BKG
7440-70-2	CALCIUM	843	J	175000	J	mg/kg	09SB110002	11/11	---	175000	Yes	NA		NA	NA	No	NUT
7440-47-3	CHROMIUM	7.6	J	13.7	J	mg/kg	09SB080002	11/11	---	13.7	No	2	C	270	38	No	BKG
7440-48-4	COBALT	4.8	J	23		mg/kg	09SB040002	11/11	---	23	No	NA	N	NA	NA	No	NTX, BKG
7440-50-8	COPPER	7.6	J	20.1	J	mg/kg	09SB100002	11/11	---	20.1	Yes	NA	N	NA	580	No	NTX
7439-89-6	IRON	8840		20100		mg/kg	09SB080002	11/11	---	20100	No	NA	N	NA	NA	No	NTX, BKG
7439-92-1	LEAD	8.6	J	34.9	J	mg/kg	09SB100002	11/11	---	34.9	Yes	NA	N	NA	81	No	BSL
7439-95-4	MAGNESIUM	731	J	32500	J	mg/kg	09SB110002	11/11	---	32500	Yes	NA		NA	NA	No	NUT
7439-96-5	MANGANESE	135	J	1060	J	mg/kg	09SB040002	11/11	---	1060	No	NA	N	NA	NA	No	NTX, BKG
7439-97-6	MERCURY	0.04		0.06		mg/kg	09SB040002, 09SB090002	5/11	0.04 - 0.05	0.06	No	0.1	N	10	2.1	No	BSL,BKG
7440-02-0	NICKEL	9.5	J	18.3	J	mg/kg	09SB100002	11/11	---	18.3	No	7	N	13000	950	No	BKG
7440-09-7	POTASSIUM	464	J	618	J	mg/kg	09SB080002	6/11	409 - 466	618	No	NA		NA	NA	No	NUT, BKG
7440-62-2	VANADIUM	14.5	J	29.3	J	mg/kg	09SB090002	11/11	---	29.3	No	300	N	NA	NA	No	BSL,BKG
7440-66-6	ZINC	30.3	J	120	J	mg/kg	09SB060002	11/11	---	120	Yes	620	N	NA	14000	No	BSL
MISCELLANEOUS PARAMETERS																	
	CATION EXCHANGE CAPACITY	8.4	J	11	J	meq/100 g	09SB040002	3/3	---	11	NA	NA		NA	NA	No	NTX
	pH	6.9	J	8	J	S.U.	09SB070002	3/3	---	8	NA	NA		NA	NA	No	NTX
	TOTAL ORGANIC CARBON	5700		8500		mg/kg	09SB040002	3/3	---	8500	NA	NA		NA	NA	No	NTX

TABLE 6-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TINUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 Soil Screening Guidance: Technical Background Document. (U.S. EPA, May 1996). The migration to groundwater value represents a dilution and attenuation factor (DAF) of 1.
6 Residential levels for migration from soil to groundwater (IDEM, July 2001).
7 The chemical is selected as a COPC if the maximum detected concentration exceeds any screening level.
8 Naphthalene is used as a surrogate for 2-methylnaphthalene.
9 Acenaphthene is used as a surrogate for acenaphthylene.
10 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.

Associated Samples:

09SB010002	09SB040102	09SB080002
09SB010102	09SB050002	09SB080102
09SB020002	09SB050102	09SB090002
09SB020102	09SB060002	09SB090102
09SB030002	09SB060102	09SB100002
09SB030102	09SB070002	09SB100102
09SB040002	09SB070102	09SB110002
		09SB110102

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for migration from soil to groundwater (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicte that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 6-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE/SUBSURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
VOLATILE ORGANICS																	
75-09-2	METHYLENE CHLORIDE	0.003	J	0.006	J	mg/kg	09SB100204, 09SB090102, 09SB080102	11/22	0.003 - 0.004	0.006	NA	8.9	C	120	IDEM	No	BSL
127-18-4	TETRACHLOROETHENE	0.004		0.004		mg/kg	09SB070709	1/22	0.003 - 0.004	0.004	NA	5.7	C	48	IDEM	No	BSL
79-01-6	TRICHLOROETHENE	0.018		0.018		mg/kg	09SB070709	1/22	0.003 - 0.004	0.018	NA	2.8	C	45	IDEM	No	BSL
SEMIVOLATILE ORGANICS																	
91-57-6	2-METHYLNAPHTHALENE	0.04		1.8		mg/kg	09SB090002	2/22	0.008 - 0.009	1.8	NA	5.6(7)	N	3200(7)	IDEM	No	BSL
83-32-9	ACENAPHTHENE	0.02		0.02		mg/kg	09SB030002	1/22	0.008 - 0.009	0.02	NA	370	N	9500	IDEM	No	BSL
208-96-8	ACENAPHTHYLENE	0.018		0.018		mg/kg	09SB030002	1/22	0.008 - 0.009	0.018	NA	370(8)	N	9500(8)	IDEM	No	BSL
120-12-7	ANTHRACENE	0.052		0.052		mg/kg	09SB030002	1/22	0.008 - 0.009	0.052	NA	2200	N	47000	IDEM	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.018		0.15		mg/kg	09SB030002	4/22	0.008 - 0.009	0.15	NA	0.62	C	5	IDEM	No	BSL
50-32-8	BENZO(A)PYRENE	0.022	J	0.13		mg/kg	09SB030002	4/22	0.008 - 0.009	0.13	NA	0.062	C	0.5	IDEM	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.009		0.12		mg/kg	09SB030002	5/22	0.008 - 0.009	0.12	NA	0.62	C	5	IDEM	No	BSL
191-24-2	BENZO(G,H,I)PERYLENE	0.009		0.057		mg/kg	09SB030002	5/22	0.008 - 0.009	0.057	NA	230(9)	N	5500(9)	IDEM	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.018	J	0.11	J	mg/kg	09SB030002	4/22	0.008 - 0.009	0.11	NA	6.2	C	50	IDEM	No	BSL
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	0.66		0.66		mg/kg	09SB070709	1/22	0.37 - 0.44	0.66	NA	35	C	300	IDEM	No	BSL
218-01-9	CHRYSENE	0.01		0.14		mg/kg	09SB030002	5/22	0.008 - 0.009	0.14	NA	62	C	500	IDEM	No	BSL
84-74-2	DI-N-BUTYL PHTHALATE	1.2		1.2		mg/kg	09SB020002	1/22	0.37 - 0.44	1.2	NA	610	N	18000	IDEM	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.01	J	0.029		mg/kg	09SB030002	3/22	0.008 - 0.009	0.029	NA	0.062	C	0.5	IDEM	No	BSL
206-44-0	FLUORANTHENE	0.008		0.3	J	mg/kg	09SB030002	5/22	0.008 - 0.009	0.3	NA	230	N	6300	IDEM	No	BSL
86-73-7	FLUORENE	0.029		0.029		mg/kg	09SB030002	1/22	0.008 - 0.009	0.029	NA	260	N	6300	IDEM	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.014	J	0.058		mg/kg	09SB030002	4/22	0.008 - 0.009	0.058	NA	0.62	C	5	IDEM	No	BSL
91-20-3	NAPHTHALENE	0.03		0.93		mg/kg	09SB090002	2/22	0.008 - 0.009	0.93	NA	5.6	N	3200	IDEM	No	BSL
85-01-8	PHENANTHRENE	0.013		0.63		mg/kg	09SB090002	4/22	0.008 - 0.009	0.63	NA	230(9)	N	5500(9)	IDEM	No	BSL
129-00-0	PYRENE	0.013		0.23	J	mg/kg	09SB030002	5/22	0.008 - 0.009	0.23	NA	230	N	5500	IDEM	No	BSL
PESTICIDES/PCBs																	
50-29-3	4,4'-DDT	0.0047		0.0047		mg/kg	09SB090002	1/22	0.0037 - 0.0043	0.0047	NA	1.7	C	20	IDEM	No	BSL
11097-69-1	AROCLOR-1254	0.46		0.46		mg/kg	09SB070709	1/22	0.037 - 0.043	0.46	NA	0.22	C	1.8	IDEM	Yes	ASL
72-43-5	METHOXYCHLOR	0.025	J	0.025	J	mg/kg	09SB090002	1/22	0.019 - 0.022	0.025	NA	31	N	910	IDEM	No	BSL
HERBICIDES																	
94-75-7	2,4-D	0.02	J	0.02	J	mg/kg	09SB040002	1/16	0.003 - 0.0033	0.02	NA	69	N	NA	IDEM	No	BSL
88-85-7	DINOSEB	0.014	J	0.014	J	mg/kg	09SB080002	1/19	0.003 - 0.0035	0.014	NA	6.1	N	NA	IDEM	No	BSL
87-86-5	PENTACHLOROPHENOL	0.0012	J	0.0035		mg/kg	09SB020002	4/20	0.00075 - 0.00088	0.0035	NA	3	C	20	IDEM	No	BSL
INORGANICS																	
7429-90-5	ALUMINUM	3280		12900		mg/kg	09SB080002	22/22	---	12900	Yes	7600	N	NA	IDEM	Yes	ASL
7440-36-0	ANTIMONY	0.97		3.1	J	mg/kg	09SB060002	4/22	0.83 - 1	3.1	Yes	3.1	N	140	IDEM	No	BSL
7440-38-2	ARSENIC	0.26	J	9.6	J	mg/kg	09SB090002	22/22	---	9.6	No	0.39	C	3.9	IDEM	No	BKG
7440-39-3	BARIUM	15.8	J	108	J	mg/kg	09SB030406	22/22	---	108	Yes	540	N	23000	IDEM	No	BSL
7440-41-7	BERYLLIUM	1	J	1	J	mg/kg	09SB020608, 09SB070709	2/22	0.82 - 1	1	Yes	15	N	680	IDEM	No	BSL
7440-43-9	CADMIUM	0.96	J	0.96	J	mg/kg	09SB100002	1/22	0.82 - 1	0.96	No	3.7	N	12	IDEM	No	BSL,BKG
7440-70-2	CALCIUM	480	J	175000	J	mg/kg	09SB110002	18/22	409 - 472	175000	Yes	NA		NA	IDEM	No	NUT
7440-47-3	CHROMIUM	3	J	13.9		mg/kg	09SB030406	22/22	---	13.9	Yes	30(10)	C	430(10)	IDEM	No	BSL
7440-48-4	COBALT	1.4		37		mg/kg	09SB070709	22/22	---	37	Yes	470	N	NA	IDEM	No	BSL
7440-50-8	COPPER	2.3	J	20.1	J	mg/kg	09SB100002	22/22	---	20.1	Yes	290	N	13000	IDEM	No	BSL
7439-89-6	IRON	2610		31900		mg/kg	09SB020608	22/22	---	31900	Yes	2300	N	NA	IDEM	Yes	ASL
7439-92-1	LEAD	6.7	J	34.9	J	mg/kg	09SB100002	22/22	---	34.9	Yes	400(11)	N	400	IDEM	No	BSL
7439-95-4	MAGNESIUM	731	J	32500	J	mg/kg	09SB110002	21/22	409 - 409	32500	Yes	NA		NA	IDEM	No	NUT
7439-96-5	MANGANESE	4.4	J	1060	J	mg/kg	09SB040002	22/22	---	1060	No	180	N	NA	IDEM	No	BKG
7439-97-6	MERCURY	0.03		0.06		mg/kg	09SB090002, 09SB040002	7/22	0.04 - 0.05	0.06	Yes	2.3(12)	N	55	IDEM	No	BSL
7440-02-0	NICKEL	2.7		24.3	J	mg/kg	09SB020608	22/22	---	24.3	No	160	N	6900	IDEM	No	BSL,BKG

TABLE 6-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE/SUBSURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
7440-09-7	POTASSIUM	464	J	630	J	mg/kg	09SB060810	7/22	409 - 472	630	No	NA		NA	IDEM	No	NUT, BKG
7440-62-2	VANADIUM	2.4	J	29.3	J	mg/kg	09SB090002	22/22	---	29.3	No	55	N	NA	IDEM	No	BSL,BKG
7440-66-6	ZINC	9.9	J	120	J	mg/kg	09SB060002	22/22	---	120	Yes	2300	N	100000	IDEM	No	BSL
MISCELLANEOUS PARAMETERS																	
	CATION EXCHANGE CAPACITY	7.4	J	13	J	meq/100 g	09SB080406	8/8	---	13	NA	NA		NA	IDEM	No	NTX
	pH	4.3	J	8	J	S.U.	09SB070002	8/8	---	8	NA	NA		NA	IDEM	No	NTX
	TOTAL ORGANIC CARBON	1200		8500		mg/kg	09SB040002	7/8	1000 - 1000	8500	NA	NA		NA	IDEM	No	NTX

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TtNUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 The risk-based soil COPC screening level for residential land use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, November 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Naphthalene is used as a surrogate for 2-methylnaphthalene.
8 Acenaphthene is used as a surrogate for acenaphthylene.
9 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
10 Hexavalent chromium.
11 OSWER soil screening level for residential land use (U.S. EPA, July 1994).
12 Value is for mercuric chloride (U.S. EPA, Region 3, October 2001).

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of Potential Concern
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not available.
meq = milliequivalent.
S.U. = Standard unts.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Associated Samples:

09SB010002	09SB040002	09SB070002	09SB100002	09SB030406	09SB090810
09SB010102	09SB040102	09SB070102	09SB100102	09SB040406	09SB100204
09SB020002	09SB050002	09SB080002	09SB110002	09SB050406	09SB110406
09SB020102	09SB050102	09SB080102	09SB110102	09SB060810	
09SB030002	09SB060002	09SB090002	09SB010810	09SB070709	
09SB030102	09SB060102	09SB090102	09SB020608	09SB080406	

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 6-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE/SUBSURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NWSC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)		USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
75-09-2	METHYLENE CHLORIDE	0.003	J	0.006	J	mg/kg	09SB100204, 09SB090102, 09SB080102	11/22	0.003 - 0.004	0.006	NA	0.001	C	13	0.023	Yes	ASL
127-18-4	TETRACHLOROETHENE	0.004		0.004		mg/kg	09SB070709	1/22	0.003 - 0.004	0.004	NA	0.003	C	11	0.058	Yes	ASL
79-01-6	TRICHLOROETHENE	0.018		0.018		mg/kg	09SB070709	1/22	0.003 - 0.004	0.018	NA	0.003	C	5	0.057	Yes	ASL
SEMIVOLATILE ORGANICS																	
91-57-6	2-METHYLNAPHTHALENE	0.04		1.8		mg/kg	09SB090002	2/22	0.008 - 0.009	1.8	NA	4(8)	N	NA	0.7(8)	Yes	ASL
83-32-9	ACENAPHTHENE	0.02		0.02		mg/kg	09SB030002	1/22	0.008 - 0.009	0.02	NA	29	N	NA	130	No	BSL
208-96-8	ACENAPHTHYLENE	0.018		0.018		mg/kg	09SB030002	1/22	0.008 - 0.009	0.018	NA	29(9)	N	NA	130(9)	No	BSL
120-12-7	ANTHRACENE	0.052		0.052		mg/kg	09SB030002	1/22	0.008 - 0.009	0.052	NA	590	N	NA	51	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.018		0.15		mg/kg	09SB030002	4/22	0.008 - 0.009	0.15	NA	0.08	C	NA	19	Yes	ASL
50-32-8	BENZO(A)PYRENE	0.022	J	0.13		mg/kg	09SB030002	4/22	0.008 - 0.009	0.13	NA	0.4	C	NA	8.2	No	BSL
205-99-2	BENZO(B)FLUORANTHENE	0.009		0.12		mg/kg	09SB030002	5/22	0.008 - 0.009	0.12	NA	0.2	C	NA	57	No	BSL
191-24-2	BENZO(G,H,I)PERYLENE	0.009		0.057		mg/kg	09SB030002	5/22	0.008 - 0.009	0.057	NA	210(10)	N	NA	570(10)	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.018	J	0.11	J	mg/kg	09SB030002	4/22	0.008 - 0.009	0.11	NA	2	C	NA	39	No	BSL
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	0.66		0.66		mg/kg	09SB070709	1/22	0.37 - 0.44	0.66	NA	180	C	31000	3600	No	BSL
218-01-9	CHRYSENE	0.01		0.14		mg/kg	09SB030002	5/22	0.008 - 0.009	0.14	NA	8	C	NA	25	No	BSL
84-74-2	DI-N-BUTYL PHTHALATE	1.2		1.2		mg/kg	09SB020002	1/22	0.37 - 0.44	1.2	NA	270	N	2300	5000	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.01	J	0.029		mg/kg	09SB030002	3/22	0.008 - 0.009	0.029	NA	0.08	C	NA	18	No	BSL
206-44-0	FLUORANTHENE	0.008		0.3	J	mg/kg	09SB030002	5/22	0.008 - 0.009	0.3	NA	210	N	NA	880	No	BSL
86-73-7	FLUORENE	0.029		0.029		mg/kg	09SB030002	1/22	0.008 - 0.009	0.029	NA	28	N	NA	170	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.014	J	0.058		mg/kg	09SB030002	4/22	0.008 - 0.009	0.058	NA	0.7	C	NA	3.1	No	BSL
91-20-3	NAPHTHALENE	0.03		0.93		mg/kg	09SB090002	2/22	0.008 - 0.009	0.93	NA	4	N	NA	0.7	Yes	ASL
85-01-8	PHENANTHRENE	0.013		0.63		mg/kg	09SB090002	4/22	0.008 - 0.009	0.63	NA	210(10)	N	NA	570(10)	No	BSL
129-00-0	PYRENE	0.013		0.23	J	mg/kg	09SB030002	5/22	0.008 - 0.009	0.23	NA	210	N	NA	570	No	BSL
PESTICIDES/PCBs																	
50-29-3	4,4'-DDT	0.0047		0.0047		mg/kg	09SB090002	1/22	0.0037 - 0.0043	0.0047	NA	2	C	NA	260	No	BSL
11097-69-1	AROCLOR-1254	0.46		0.46		mg/kg	09SB070709	1/22	0.037 - 0.043	0.46	NA	NA	C	NA	6.2	No	BSL
72-43-5	METHOXYCHLOR	0.025	J	0.025	J	mg/kg	09SB090002	1/22	0.019 - 0.022	0.025	NA	8	N	NA	160	No	BSL
HERBICIDES																	
94-75-7	2,4-D	0.02	J	0.02	J	mg/kg	09SB040002	1/16	0.003 - 0.0033	0.02	NA	NA	N	NA	NA	No	NTX
88-85-7	DINOSEB	0.014	J	0.014	J	mg/kg	09SB080002	1/19	0.003 - 0.0035	0.014	NA	NA	N	NA	NA	No	NTX
87-86-5	PENTACHLOROPHENOL	0.0012	J	0.0035		mg/kg	09SB020002	4/20	0.00075 - 0.00088	0.0035	NA	0.001	C	NA	0.028	Yes	ASL
INORGANICS																	
7429-90-5	ALUMINUM	3280		12900		mg/kg	09SB080002	22/22	---	12900	Yes	NA	N	NA	NA	No	NTX
7440-36-0	ANTIMONY	0.97		3.1	J	mg/kg	09SB060002	4/22	0.83 - 1	3.1	Yes	0.3	N	NA	5.4	Yes	ASL
7440-38-2	ARSENIC	0.26	J	9.6	J	mg/kg	09SB090002	22/22	---	9.6	No	1	C	750	29	No	BKG
7440-39-3	BARIUM	15.8	J	108	J	mg/kg	09SB030406	22/22	---	108	Yes	82	N	690000	1600	Yes	ASL
7440-41-7	BERYLLIUM	1	J	1	J	mg/kg	09SB020608, 09SB070709	2/22	0.82 - 1	1	Yes	3	N	1300	63	No	BSL
7440-43-9	CADMIUM	0.96	J	0.96	J	mg/kg	09SB100002	1/22	0.82 - 1	0.96	No	0.4	N	1800	7.5	No	BKG
7440-70-2	CALCIUM	480	J	175000	J	mg/kg	09SB110002	18/22	409 - 472	175000	Yes	NA		NA	NA	No	NUT
7440-47-3	CHROMIUM	3	J	13.9		mg/kg	09SB030406	22/22	---	13.9	Yes	2	C	270	38	Yes	ASL
7440-48-4	COBALT	1.4		37		mg/kg	09SB070709	22/22	---	37	Yes	NA	N	NA	NA	No	NTX
7440-50-8	COPPER	2.3	J	20.1	J	mg/kg	09SB100002	22/22	---	20.1	Yes	NA	N	NA	580	No	BSL
7439-89-6	IRON	2610		31900		mg/kg	09SB020608	22/22	---	31900	Yes	NA	N	NA	NA	No	NTX
7439-92-1	LEAD	6.7	J	34.9	J	mg/kg	09SB100002	22/22	---	34.9	Yes	NA	N	NA	81	No	BSL
7439-95-4	MAGNESIUM	731	J	32500	J	mg/kg	09SB110002	21/22	409 - 409	32500	Yes	NA		NA	NA	No	NUT
7439-96-5	MANGANESE	4.4	J	1060	J	mg/kg	09SB040002	22/22	---	1060	No	NA	N	NA	NA	No	NTX, BKG
7439-97-6	MERCURY	0.03		0.06		mg/kg	09SB090002, 09SB040002	7/22	0.04 - 0.05	0.06	Yes	0.1	N	10	2.1	No	BSL
7440-02-0	NICKEL	2.7		24.3	J	mg/kg	09SB020608	22/22	---	24.3	No	7	N	13000	950	No	BKG
7440-09-7	POTASSIUM	464	J	630	J	mg/kg	09SB060810	7/22	409 - 472	630	No	NA		NA	NA	No	NUT, BKG

TABLE 6-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE/SUBSURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NWSC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil
Exposure Point: Surface/Subsurface Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)		USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
7440-62-2	VANADIUM	2.4	J	29.3	J	mg/kg	09SB090002	22/22	---	29.3	No	300	N	NA	NA	No	BSL,BKG
7440-66-6	ZINC	9.9	J	120	J	mg/kg	09SB060002	22/22	---	120	Yes	620	N	NA	14000	No	BSL
MISCELLANEOUS PARAMETERS																	
	CATION EXCHANGE CAPACITY	7.4	J	13	J	meq/100 g	09SB080406	8/8	---	13	NA	NA		NA	NA	No	NTX
	pH	4.3	J	8	J	S.U.	09SB070002	8/8	---	8	NA	NA		NA	NA	No	NTX
	TOTAL ORGANIC CARBON	1200		8500		mg/kg	09SB040002	7/8	1000 - 1000	8500	NA	NA		NA	NA	No	NTX

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TtNUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 Soil Screening Guidance: Technical Background Document. (U.S. EPA, May 1996). The migration to groundwater value represents a dilution and attenuation factor (DAF) of 1.
6 Residential levels for migration from soil to groundwater (IDEM, July 2001).
7 The chemical is selected as a COPC if the maximum detected concentration exceeds any screening level.
8 Naphthalene is used as a surrogate for 2-methylnaphthalene.
9 Acenaphthene is used as a surrogate for acenaphthylene.
10 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.

Associated Samples:

09SB010002	09SB050002	09SB090002	09SB030406
09SB010102	09SB050102	09SB090102	09SB040406
09SB020002	09SB060002	09SB100002	09SB050406
09SB020102	09SB060102	09SB100102	09SB060810
09SB030002	09SB070002	09SB110002	09SB070709
09SB030102	09SB070102	09SB110102	09SB080406
09SB040002	09SB080002	09SB010810	09SB090810
09SB040102	09SB080102	09SB020608	09SB100204
			09SB110406

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for migration from soil to groundwater (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.
meq = milliequivalents.
S.U. = Standard units.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicate that the specified

TABLE 6-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUND WATER
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
VOLATILE ORGANICS																	
71-55-6	1,1,1-TRICHLOROETHANE	26		26		µg/L	09GW0301	1/12	1 - 50	26	NA	54	N	200 200	FED-MCL IDEM	No	BSL
75-34-3	1,1-DICHLOROETHANE	14		14		µg/L	09GW0301	1/12	1 - 50	14	NA	81	C	NA 990	FED-MCL IDEM	No	BSL
75-35-4	1,1-DICHLOROETHENE	6.4		6.4		µg/L	09GW0301	1/12	0.5 - 25	6.4	NA	0.046	C	7 7	FED-MCL IDEM	Yes	ASL
156-59-2	CIS-1,2-DICHLOROETHENI	1.7		130		µg/L	09GW0401	3/12	1	130	NA	6.1	N	70 70	FED-MCL IDEM	Yes	ASL
75-09-2	METHYLENE CHLORIDE	58	J	58	J	µg/L	09GW0401	1/12	1	58	NA	4.3	C	5 5	FED-MCL IDEM	Yes	ASL
79-01-6	TRICHLOROETHENE	1		55		µg/L	09GW0301	2/12	1 - 50	55	NA	1.6	C	5 5	FED-MCL IDEM	Yes	ASL
PESTICIDE/PCBS																	
60-57-1	DIELDRIN	0.03		0.03		µg/L	09GWT0101	1/12	0.019 - 0.022	0.03	NA	0.0042	N	NA 0.053	FED-MCL IDEM	Yes	ASL
HERBIDICES																	
93-76-5	2,4,5-T	0.13		0.13		µg/L	09GWT0101	1/12	0.08	0.13	NA	36	C	NA NA	FED-MCL IDEM	No	BSL
93-72-1	2,4,5-TP (SILVEX)	0.17	J	0.17	J	µg/L	09GW1201	1/12	0.08	0.17	NA	29	N	50 NA	FED-MCL IDEM	No	BSL
INORGANICS																	
7429-90-5	ALUMINUM	364	J	1290	J	µg/L	09GWT0201	2/12	200	1290	ND	3600	N	50 to 200(7) NA	FED-MCL IDEM	Yes	ASL
7440-38-2	ARSENIC	0.29		4.3		µg/L	09GW0201	12/12	---	4.3	ND	0.045	N	50 50	FED-MCL IDEM	Yes	ASL
7440-39-3	BARIUM	6.6		323		µg/L	09GW0201	12/12	---	323	19.3	260		2000 2000	FED-MCL IDEM	Yes	ASL
7440-41-7	BERYLLIUM	1		4.4		µg/L	09GWT0201	2/12	1	4.4	ND	7.3	N	4 4	FED-AL IDEM	Yes	ASL
7440-70-2	CALCIUM	7950		118000		µg/L	09GW0701	12/12	---	118000	59300	NA	N	NA NA	FED-MCL IDEM	No	NUT
7440-48-4	COBALT	11.6		109		µg/L	09GWT0201	7/12	3	109	ND	220	N	NA NA	FED-MCL IDEM	No	BSL
7440-50-8	COPPER	2		8.4		µg/L	09GWT0201	4/12	2	8.4	ND	140	N	1000(7) 1300	FED-MCL IDEM	No	BSL
7439-89-6	IRON	136		37300		µg/L	09GW0201	11/12	100	37300	149	1100	N	300(7) NA	FED-MCL IDEM	Yes	ASL
7439-92-1	LEAD	1.1		1.1		µg/L	09GW0401	1/12	1	1.1	ND	15	N	15 NA	FED-AL IDEM	No	BSL
7439-95-4	MAGNESIUM	8360	J	81500	J	µg/L	09GW0701	12/12	---	81500	19800	NA		NA NA	FED-MCL IDEM	No	NUT
7439-96-5	MANGANESE	34.8		7920		µg/L	09GW0201	12/12	---	7920	15	88	N	50(7) NA	FED-MCL IDEM	Yes	ASL
7440-02-0	NICKEL	16.3		279		µg/L	09GWT0201	6/12	10	279	10	73	N	NA 730	FED-MCL IDEM	Yes	ASL
7782-49-2	SELENIUM	1.2		1.7		µg/L	09GWT0201	3/12	1	1.7	1.1	18	N	50 50	FED-MCL IDEM	No	BSL
7440-23-5	SODIUM	6730	J	134000	J	µg/L	09GWT0101	11/12	5000	134000	48900	NA		NA NA	FED-MCL IDEM	No	NUT
7440-62-2	VANADIUM	2.1		2.1		µg/L	09GWT0101	1/12	2	2.1	ND	26	N	NA NA	FED-MCL IDEM	No	BSL
7440-66-6	ZINC	12.1		166		µg/L	09GWT0201	6/12	10	166	13.2	1100	N	5000(7) 11000	FED-MCL IDEM	No	BSL

TABLE 6-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUND WATER
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)

Footnotes:

1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, maximum groundwater concentrations were compared to concentrations in upgradient groundwater sample 09GWTP0601. If the concentration in the site groundwater concentration was less than the upgradient concentration, that metal was not selected as a COPC.
5 The risk-based COPC screening level for tap water use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, October 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Secondary MCL, based on aesthetic water quality (i.e., color, odor, taste, etc.).

Associated Samples:

09GW0201	09GWT0101
09GW0301	09GWT0201
09GW0401	09GWT0301
09GW0701	09GWT0401
09GW1001	09GWT0501
09GW1201	09GWTP0501

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
J = Estimated value.
N = Noncarcinogen.
NA = Not analyzed / not applicable.
ND = Not detected.
FED-AL = Federal action level (U.S. EPA, 2000).
FED-MCL = Federal Maximum Contaminant Level (USEPA, 2000).
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential closure levels for ground water (IDEM, July 2001).

Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

TABLE 6-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA
PAGE 1 OF 2

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
HERBICIDES																
94-75-7	2,4-D	0.18		0.18		µg/L	09SW0201	1/4	0.08	0.18	NA	36 N	70 NA	FED-MCL IDEM	No	BSL
INORGANICS																
7429-90-5	ALUMINUM	220	J	245	J	µg/L	09SW0201	2/4	200	245	5990	3600 N	50 to 200(7) NA	FED-MCL IDEM	No	BKG
7440-36-0	ANTIMONY	1.6		1.6		µg/L	09SW0501	1/4	1	1.6	ND	1.5 N	6 NA	FED-MCL IDEM	Yes	ASL
7440-38-2	ARSENIC	0.41	J	1.9	J	µg/L	09SW0501	4/4	---	1.9	4.6	0.045 C	50 50	FED-MCL IDEM	No	BKG
7440-39-3	BARIUM	37.3		72.5		µg/L	09SW0501	4/4	---	72.5	173	260 N	2000 2000	FED-MCL IDEM	No	BSL,BKG
7440-70-2	CALCIUM	17600		57300		µg/L	09SW0501	4/4	---	57300	34800	NA	NA NA	FED-MCL IDEM	No	NUT
7440-48-4	COBALT	5.5		5.5		µg/L	09SW0501	1/4	3	5.5	9.8	220 N	NA NA	FED-MCL IDEM	No	BSL,BKG
7440-50-8	COPPER	12.4		12.4		µg/L	09SW0501	1/4	2	12.4	18.5	140 N	1000(7) 1300	FED-MCL IDEM	No	BSL,BKG
7439-89-6	IRON	288	J	1830	J	µg/L	09SW0501	4/4	---	1830	8390	1100 N	300(7) NA	FED-MCL IDEM	No	BKG
7439-92-1	LEAD	3.6		3.6		µg/L	09SW0501	1/4	1	3.6	21.9	15	15 NA	FED-AL IDEM	No	BSL,BKG
7439-95-4	MAGNESIUM	5960	J	15000	J	µg/L	09SW0201	4/4	---	15000	15400	NA	NA NA	FED-MCL IDEM	No	NUT, BKG
7439-96-5	MANGANESE	57.6		583		µg/L	09SW0201	4/4	---	583	637	88 N	50(7) NA	FED-MCL IDEM	No	BKG
7440-09-7	POTASSIUM	5310	J	5310	J	µg/L	09SW0501	1/4	5000	5310	ND	NA	NA NA	FED-MCL IDEM	No	NUT
7440-23-5	SODIUM	12600		175000		µg/L	09SW0501	4/4	---	175000	36000	NA	NA NA	FED-MCL IDEM	No	BSL
7440-62-2	VANADIUM	3.1		3.1		µg/L	09SW0501	1/4	2	3.1	14.3	26 N	NA NA	FED-MCL IDEM	No	BSL,BKG
7440-66-6	ZINC	11.9		11.9		µg/L	09SW0501	1/4	10	11.9	50.4	1100 N	5000(7) 11000	FED-MCL IDEM	No	BSL,BKG
FILTERED METALS																
7440-36-0	ANTIMONY, FILTERED	1.6		1.6		µg/L	09SW0501-F	1/4	1	1.6	ND	1.5 N	6 NA	FED-MCL IDEM	Yes	ASL
7440-38-2	ARSENIC, FILTERED	0.27	J	2.3	J	µg/L	09SW0501-F	4/4	---	2.3	1.1	0.045 C	50 50	FED-MCL IDEM	Yes	ASL
7440-39-3	BARIUM, FILTERED	33.2		71		µg/L	09SW0501-F	4/4	---	71	94.9	260 N	2000 2000	FED-MCL IDEM	No	BSL,BKG
7440-70-2	CALCIUM, FILTERED	17800		57100		µg/L	09SW0501-F	4/4	---	57100	40300	NA	NA NA	FED-MCL IDEM	No	NUT
7440-48-4	COBALT, FILTERED	5.1		5.1		µg/L	09SW0501-F	1/4	3	5.1	ND	220 N	NA NA	FED-MCL IDEM	No	BSL
7440-50-8	COPPER, FILTERED	7.4		7.4		µg/L	09SW0501-F	1/4	2	7.4	ND	140 N	1000(7) 1300	FED-MCL IDEM	No	BSL
7439-89-6	IRON, FILTERED	145	J	1460	J	µg/L	09SW0501-F	3/4	100	1460	138	1100 N	300(7) NA	FED-MCL IDEM	Yes	ASL
7439-92-1	LEAD, FILTERED	2.3		2.3		µg/L	09SW0501-F	1/4	1	2.3	ND	15	15 NA	FED-AL IDEM	No	BSL
7439-95-4	MAGNESIUM, FILTERED	6210	J	14100	J	µg/L	09SW0201-F	4/4	---	14100	17800	NA	NA NA	FED-MCL IDEM	No	NUT, BKG
7439-96-5	MANGANESE, FILTERED	18		532		µg/L	09SW0201-F	4/4	---	532	239	88 N	50(7) NA	FED-MCL IDEM	Yes	ASL

TABLE 6-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
7440-09-7	POTASSIUM, FILTERED	5390	J	5390	J	µg/L	09SW0501-F	1/4	5000	5390	ND	NA	NA NA	FED-MCL IDEM	No	BSL
7440-23-5	SODIUM, FILTERED	12700		182000		µg/L	09SW0501-F	4/4	---	182000	43200	NA	NA NA	FED-MCL IDEM	No	NUT
7440-62-2	VANADIUM, FILTERED	3.8		3.8		µg/L	09SW0501-F	1/4	2	3.8	ND	26 N	NA NA	FED-MCL IDEM	No	BSL
7440-66-6	ZINC, FILTERED	10.2		10.2		µg/L	09SW0501-F	1/4	10	10.2	ND	1100 N	5000(7) 11000	FED-MCL IDEM	No	BSL
MISCELLANEOUS PARAMETERS																
	HARDNESS	70		180		µg/L	09SW0501	4/4	---	180	NA	NA	NA NA	FED-MCL IDEM	No	NTX
	TOTAL SUSPENDED SOLIDS	3		10		µg/L	09SW0401	3/4	2	10	NA	NA	NA NA	FED-MCL IDEM	No	NTX

Footnotes:

1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, maximum surface water concentrations were compared to concentrations in upgradient surface water sample 09SW0101. If the concentration in the site surface water concentration was less than the upgradient concentration, that metal was not selected as a COPC.
5 The risk-based COPC screening level for tap water use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, October 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Secondary MCL, based on aesthetic water quality (i.e., color, odor, taste, etc.).

Associated Samples:

09SW0201	09SW0201-F
09SW0301	09SW0301-F
09SW0401	09SW0401-F
09SW0501	09SW0501-F

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
J = Estimated value.
N = Noncarcinogen.
NA = Not analyzed / not applicable.
ND = Not detected.
FED-AL = Federal action level (U.S. EPA, 2000).
FED-MCL = Federal Maximum Contaminant Level (U.S. EPA, 2000).
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential closure levels for groundwater (IDEM, July 2001)

Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.
For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 6-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
VOLATILE ORGANICS																	
75-09-2	METHYLENE CHLORIDE	0.004	J	0.004	J	mg/kg	09SD030006, 09SD040006	2/4	0.004	0.004	NA	8.9	C	120	IDEM	No	BSL
SEMIVOLATILE ORGANICS																	
206-44-0	FLUORANTHENE	0.01		0.01		mg/kg	09SD030006	1/4	0.009	0.01	NA	230	N	6300	IDEM	No	BSL
PESTICIDES/PCBs																	
12672-29-6	AROCLOR-1248	0.38	J	0.38	J	mg/kg	09SD030006	1/4	0.043 - 0.045	0.38	NA	0.22	C	1.8	IDEM	Yes	ASL
INORGANICS																	
7429-90-5	ALUMINUM	5470	J	10800	J	mg/kg	09SD050006	4/4	---	10800	7600	7600	N	NA	IDEM	Yes	ASL
7440-36-0	ANTIMONY	1.3	J	1.3	J	mg/kg	09SD020006	1/4	0.96 - 1	1.3	ND	3.1	N	140	IDEM	No	BSL
7440-38-2	ARSENIC	0.77		6.1		mg/kg	09SD030006	4/4	---	6.1	3.7	0.39	C	3.9	IDEM	Yes	ASL
7440-39-3	BARIUM	39.3		103		mg/kg	09SD030006	4/4	---	103	78.1	540	N	23000	IDEM	No	BSL
7440-70-2	CALCIUM	786	J	1470	J	mg/kg	09SD030006	4/4	---	1470	2120	NA		NA	IDEM	No	NUT, BKG
7440-47-3	CHROMIUM	11.1		13		mg/kg	09SD050006	4/4	---	13	8.7	30(7)	C	430(7)	IDEM	No	BSL
7440-48-4	COBALT	4.8		14.5		mg/kg	09SD040006	4/4	---	14.5	9.2	470	N	NA	IDEM	No	BSL
7440-50-8	COPPER	9		27.7		mg/kg	09SD050006	4/4	---	27.7	16	290	N	13000	IDEM	No	BSL
7439-89-6	IRON	15700	J	18600	J	mg/kg	09SD030006	4/4	---	18600	9620	2300	N	NA	IDEM	Yes	ASL
7439-92-1	LEAD	6.6	J	22.7	J	mg/kg	09SD030006	4/4	---	22.7	22.1	400(8)	N	400	IDEM	No	BSL
7439-95-4	MAGNESIUM	597	J	1820	J	mg/kg	09SD050006	4/4	---	1820	1290	NA		NA	IDEM	No	NUT
7439-96-5	MANGANESE	86.8		1300		mg/kg	09SD030006	4/4	---	1300	350	180	N	NA	IDEM	Yes	ASL
7440-02-0	NICKEL	7.4		11.6		mg/kg	09SD040006	4/4	---	11.6	12.2	160	N	6900	IDEM	No	BSL,BKG
7440-09-7	POTASSIUM	913	J	913	J	mg/kg	09SD050006	1/4	411 - 487	913	ND	NA		NA	IDEM	No	NUT
7440-62-2	VANADIUM	12.2		21.2		mg/kg	09SD030006	4/4	---	21.2	15.2	55	N	NA	IDEM	No	BSL
7440-66-6	ZINC	27.7		95.3		mg/kg	09SD030006	4/4	---	95.3	40.9	2300	N	100000	IDEM	No	BSL
MISCELLANEOUS PARAMETERS																	
	TOTAL ORGANIC CARBON	1600		14000		mg/kg	09SD040006	4/4	---	14000	NA	NA		NA	IDEM	No	NTX

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, maximum sediment concentrations were compared to concentrations in upgradient sediment sample 09SD01. If the concentration in the site sediment concentration was less than the upgradient concentration, that metal was not selected as a COPC.
5 The risk-based soil COPC screening level for residential land use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, November 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Hexavalent chromium.
8 OSWER soil screening level for residential land use (U.S. EPA, July 1994).

Associated Samples:

09SD020006
09SD030006
09SD040006
09SD050006

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not available..
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 6-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil(1)	Surface Soil	Entire Site	Maintenance Workers	Adult	Ingestion	On-site	Quant(2)	NSWC Crane is an active facility and maintenance activities such as groundskeeping, may be performed at the site.
						Dermal	On-site	Quant	NSWC Crane is an active facility and maintenance activities such as groundskeeping, may be performed at the site.
				Trespassers	Adolescent	Ingestion	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
						Dermal	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
					Adult	Ingestion	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
						Dermal	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
		Air	Vapors and Particulates in Air - Entire Site	Maintenance Workers and Trespassers	Adult and Adolescent	Inhalation	On-site	Qual(3)	Exposure is evaluated qualitatively by a comparison of site data to U.S. EPA generic SSLs(4) for transfers from soil to air.
	Ground Water	Ground Water/Air	Surficial Aquifer	Maintenance Workers and Trespassers	Adult and Adolescent	Ingestion	On-site	None	Direct contact with groundwater does not occur under current land use. Shallow groundwater is not expected to be used as a domestic water supply.
						Dermal	On-site	None	Direct contact with groundwater does not occur under current land use. Shallow groundwater is not expected to be used as a domestic water supply.
						Inhalation	On-site	None	Direct contact with groundwater does not occur under current land use. Shallow groundwater is not expected to be used as a domestic water supply.
	Surface Water	Surface Water	On-site Streams, Ponded Water and Draingeways	Maintenance Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
						Dermal	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Trespassers	Adolescent	Ingestion	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
						Dermal	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
					Adult	Ingestion	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
						Dermal	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
		Air	On-site Streams, Ponded Water and Draingeways	Maintenance Workers and Trespassers	Adult and Adolescent	Inhalation	On-site	None	Minimal exposure to vapors emitted from surface water is anticipated (i.e., so low that it is not worth quantifying).

TABLE 6-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Sediment	Sediment	On-site Streams, Ponded Water and Draingeways	Maintenance Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
						Dermal	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Trespasser	Adolescent	Ingestion	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
						Dermal	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
					Adult	Ingestion	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
						Dermal	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
		Air	Vapors and Particulates in Air - Entire Site	Maintenance Workers and Trespassers	Adult and Adolescent	Inhalation	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
Future	Surface/ Subsurface Soil (5)	Surface/ Subsurface Soil	Entire Site	Excavation/Construction Workers	Adult	Ingestion	On-site	Quant	Excavation/construction activities may occur at the site in the future.
						Dermal	On-site	Quant	Excavation/construction activities may occur at the site in the future.
		Air	Vapors and Particulates in Air - Entire Site	Excavation/Construction Workers	Adult	Inhalation	On-site	Qual	Exposure is evaluated qualitatively by a comparison of site data to U.S. EPA generic SSLs for transfers from soil to air.
	Surface Soil	Surface Soil	Entire Site	Occupational Workers	Adult	Ingestion	On-site	Quant	Although the site is currently not in use, it could be used in the future for industrial purposes.
						Dermal	On-site	Quant	Although the site is currently not in use, it could be used in the future for industrial purposes.
				Recreational Users	Adult	Ingestion	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
						Dermal	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
				Residents	Child and Adult	Ingestion	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
		Air	Vapors and Particulates in Air - Entire Site	Occupational Workers, Recreational Users, and Residents	Child and Adult	Inhalation	On-site	Qual	Exposure is evaluated qualitatively by a comparison of site data to U.S. EPA generic SSLs for transfers from soil to air.
	Ground Water	Ground Water	Surficial Aquifer	Excavation/Construction Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
						Dermal	On-site	Quant	Excavation/construction activities may occur at the site and workers may be exposed by direct contact with groundwater.
				Occupational Workers	Adult	Ingestion	On-site	None	Direct contact with groundwater is not expected to occur for future workers.
						Dermal	On-site	None	Direct contact with groundwater is not expected to occur for future workers.

TABLE 6-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future		Ground Water		Recreational Users	Adult	Ingestion	On-site	None	Direct contact with groundwater is not expected to occur for future recreational users.
						Dermal	On-site	None	Direct contact with groundwater is not expected to occur for future recreational users.
				Residents	Child and Adult	Ingestion	On-site	Quant	Although it is unlikely that shallow ground water at the site would be used as a domestic water supply, this scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although it is unlikely that shallow ground water at the site would be used as a domestic water supply, this scenario is included to aid in future risk management decisions.
		Air	Vapors	Excavation/Construction/ Occupational Workers and Recreational Users	Adult	Inhalation	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Residents	Child and Adult	Inhalation	On-site	Quant	Although it is unlikely that shallow groundwater at the site would be used as a domestic water supply, this scenario is included to aid in future risk management decisions.
	Surface Water	Surface Water	On-site Streams, Ponded Water and Draingeways	Excavation/Construction and Occupational Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
						Dermal	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Recreational Users	Adult	Ingestion	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
						Dermal	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
				Residents	Child and Adult	Ingestion	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
		Air	On-site Streams, Ponded Water and Draingeways	Excavation/Constuction/Occupational Workers, Recreational Users, and Residents	Child and Adult	Inhalation	On-site	None	Minimal exposure to vapors emitted from surface water is anticipated (i.e., so low that it is not worth quantifying).
	Sediment	Sediment	On-site Streams, Ponded Water and Draingeways	Excavation/Construction and Occupational Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
						Dermal	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Recreational Users	Adult	Ingestion	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
						Dermal	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
				Residents	Adult and Child	Ingestion	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
		Air	On-site Streams, Ponded Water and Draingeways	Excavation/Constuction/Occupational Workers, Recreational Users, and Residents	Child and Adult	Inhalation	On-site	None	Minimal exposure to vapors emitted from surface water is anticipated (i.e., so low that it is not worth quantifying).

TABLE 6-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway

Footnotes:
1 Surface soil is defined as soil collected from 0 to 2 feet below ground surface (bgs).
2 Quantitative.
3 Qualitative.
4 Soil Screening Levels (U.S. EPA, May 1996).
5 Surface/subsurface soil is defined as soil collected from 0 to 10 feet bgs; no exposure to soil at depths below 10 feet bgs is anticipated.

TABLE 6-20

EXPOSURE POINT CONCENTRATIONS (EPCs) FOR COPCs
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Chemical of Potential Concern	Exposure Point Concentration				
	Surface Soil[1]	Surface/ Subsurface Soil[1]	Surface Water[2]	Sediment[2]	Groundwater[1]
	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)
1,1-DICHLOROETHENE	NA[4]	NA	NA	NA	0.0058
CIS-1,2-DICHLOROETHENE	NA	NA	NA	NA	0.13[3]
METHYLENE CHLORIDE	0.0053	0.0038	NA	NA	0.0086
TETRACHLOROETHENE	NA	0.0018	NA	NA	NA
TRICHLOROETHENE	NA	0.0025	NA	NA	0.037
2-METHYLNAPHTHALENE	1.02	0.038	NA	NA	NA
BENZO(A)ANTHRACENE	0.15[3]	0.025	NA	NA	NA
BENZO(A)PYRENE	0.13[3]	0.023	NA	NA	NA
NAPHTHALENE	0.36	0.025	NA	NA	NA
DIELDRIN	NA	NA	NA	NA	0.000014
AROCLOR-1248	NA	NA	NA	0.38	NA
AROCLOR-1254	NA	0.039	NA	NA	NA
PENTACHLOROPHENOL	0.0024	0.00093	NA	NA	NA
ALUMINUM	NA	9650	NA	10800	0.35
ANTIMONY	1.09	0.88	0.0016	NA	NA
ARSENIC	NA	NA	NA	6.1	0.0028
BARIUM	NA	83.6	NA	NA	0.23
BERYLLIUM	NA	NA	NA	NA	0.0012
CHROMIUM	NA	12.7	NA	NA	NA
IRON	NA	20670	NA	18600	37.3[3]
MANGANESE	NA	NA	NA	1300	7.92[3]
NICKEL	NA	NA	NA	NA	0.26

1 The exposure concentration is the 95% upper confidence limit (UCL) based on distribution of the data set (best fit of normal or lognormal), unless otherwise noted.
2 Because of the limited number of samples (i.e., less than 10 samples), the exposure concentration is set at the maximum detected concentration.
3 Maximum detected concentration is used because the UCL exceeeded the maximum.
4 NA - Not applicable. Chemical is not a chemical of potential concern for this medium.

TABLE 6-21

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURE
SWMU 9 - PESTICIDE CONTROL/5-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Exposure Route	Construction Worker	Maintenance Worker	Occupational Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
HAZARD INDEX							
Ingestion of Groundwater	NA	NA	NA	NA	NA	1.2E+01	4.2E+-01
Dermal Contact with Groundwater	6.0E-01	NA	NA	NA	NA	1.3E+00	3.8E+00
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	NA	1.0E-01	4.7E-01
Incidental Ingestion of Surface Soil	NA	2.6E-04	2.7E-03	5.7E-04	4.6E-04	3.8E-03	3.6E-02
Dermal Contact with Surface Soil	NA	1.5E-06	1.5E-05	2.0E-06	3.0E-06	1.3E-05	6.1E-05
Incidental Ingestion of Surface/Subsurface Soil	1.5E-01	NA	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	2.8E-03	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	NA	1.6E-03	2.7E-04	1.1E-02	1.0E-02
Dermal Contact with Surface Water	NA	NA	NA	2.0E-03	6.8E-04	1.3E-02	1.4E-02
Incidental Ingestion of Sediment	NA	NA	NA	1.6E-02	1.3E-02	1.1E-01	1.0E+00
Dermal Contact with Sediment	NA	NA	NA	1.1E-02	7.7E-04	3.4E-03	1.6E-02
Total Hazard:	**7.5E-01**	**2.6E-04**	**2.7E-03**	**3.2E-02**	**1.6E-02**	**1.4E+01**	**4.7E+01**

TABLE 6-21

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURE
SWMU 9 - PESTICIDE CONTROL/5-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

INCREMENTAL CANCER RISK

Exposure Route	Construction Worker	Maintenance Worker	Occupational Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
Ingestion of Groundwater	NA	NA	NA	NA	NA	7.9E-05	6.9E-05
Dermal Contact with Groundwater	8.4E-08	NA	NA	NA	NA	7.1E-06	4.1E-06
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	NA	3.4E-06	4.0E-06
Incidental Ingestion of Surface Soil	NA	3.6E-08	3.7E-07	9.2E-08	2.8E-08	5.0E-07	1.2E-06
Dermal Contact with Surface Soil	NA	3.0E-08	3.2E-07	4.9E-08	2.7E-08	2.6E-07	3.0E-07
Incidental Ingestion of Surface/Subsurface Soil	1.1E-08	NA	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	5.1E-09	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	NA	NA	NA	NA	NA
Dermal Contact with Surface Water	NA	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Sediment	NA	NA	NA	8.6E-07	2.6E-07	4.7E-06	1.1E-05
Dermal Contact with Sediment	NA	NA	NA	3.0E-06	7.6E-08	7.3E-07	8.3E-07
Total Risk:	**1.0E-07**	**6.6E-08**	**6.9E-07**	**4.0E-06**	**3.9E-07**	**9.5E-05**	**9.0E-05**

NOTES
NA - Not applicable; exposure route is not applicable for this receptor.
Chemical-specific risks presented in Appendix G-3.

TABLE 6-22

CUMULATIVE RISK SUMMARY - CENTRAL TENDENCY EXPOSURE
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Exposure Route	Construction Worker	Maintenance Worker	Occupational Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
HAZARD INDEX							
Ingestion of Groundwater	NA	NA	NA	NA	NA	8.4E+00	1.9E+01
Dermal Contact with Groundwater	3.9E-01	NA	NA	NA		5.8E-01	1.3E+00
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	NA	3.7E-02	1.7E-01
Incidental Ingestion of Surface Soil	NA	6.5E-05	1.2E-03	1.4E-04	1.2E-04	1.9E-03	1.2E-02
Dermal Contact with Surface Soil	NA	7.4E-08	1.3E-06	1.2E-07	2.4E-07	1.6E-06	7.1E-06
Incidental Ingestion of Surface/Subsurface Soil	7.6E-02	NA	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	8.0E-04	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	NA	4.1E-04	6.6E-05	3.7E-03	3.4E-03
Dermal Contact with Surface Water	NA	NA	NA	4.9E-04	1.4E-04	4.4E-03	4.0E-03
Incidental Ingestion of Sediment	NA	NA	NA	4.1E-03	3.3E-03	3.7E-02	3.4E-01
Dermal Contact with Sediment	NA	NA	NA	1.1E-03	6.3E-05	2.8E-04	1.8E-03
Total Hazard:	**4.7E-01**	**6.6E-05**	**1.2E-03**	**6.3E-03**	**3.7E-03**	**9.1E+00**	**2.0E+01**

TABLE 6-22

CUMULATIVE RISK SUMMARY - CENTRAL TENDENCY EXPOSURE
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

INCREMENTAL CANCER RISK

Exposure Route	Construction Worker	Maintenance Worker	Occupational Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
Ingestion of Groundwater	NA	NA	NA	NA	NA	1.6E-05	1.0E-05
Dermal Contact with Groundwater	6.0E-08	NA	NA	NA	NA	1.3E-06	7.5E-07
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	NA	3.7E-07	4.9E-07
Incidental Ingestion of Surface Soil	NA	3.2E-09	5.8E-08	6.9E-09	6.9E-09	7.3E-08	1.3E-07
Dermal Contact with Surface Soil	NA	5.5E-10	1.0E-08	9.0E-10	2.2E-09	9.4E-09	1.2E-08
Incidental Ingestion of Surface/Subsurface Soil	5.3E-09	NA	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	1.5E-09	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	NA				
Dermal Contact with Surface Water	NA	NA	NA				
Incidental Ingestion of Sediment	NA	NA	NA	6.5E-08	6.4E-08	4.5E-07	1.2E-06
Dermal Contact with Sediment	NA	NA	NA	9.0E-08	6.1E-09	1.7E-08	3.2E-08
Total Risk:	**6.7E-08**	**3.7E-09**	**6.8E-08**	**1.6E-07**	**8.0E-08**	**1.8E-05**	**1.3E-05**

NOTES
NA - Not applicable; exposure route is not applicable for this receptor.
Chemical-specific risks presented in Appendix G-3.

TABLE 6-23

SUMMARY OF CONCLUSIONS
SWMU 9 - PESTICIDE CONTROL/ R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Chemical of Concern[1]	Impact on Human Receptors	Comments
GROUND WATER		
1,1-Dichloroethene	Residential ILCR = 7.5E-5	Risks from volatile chlorinated organics were based on the hypothetical future residential use of ground water. Risks from cis-1,2-DCE (detected in three of 12 samples) were based on the maximum detected concentration, and 1,1-DCE was detected in only one sample and the concentration was less than U.S. EPA and IDEM MCLs.
cis-1,2-Dichloroethene	Adult resident HQ = 0.49, Child resident HQ = 1.8	
Trichloroethene	Adult resident HQ = 0.2, Child resident HQ = 0.66, Residential ILCR = 9.4E-6	
Dieldrin	Residential ILCR = 6.3E-6	Dieldrin was detected in 1 of 12 unfiltered ground water samples with the maximum concentration (0.03 ug/L) less than the IDEM default closure level for ground water (0.053 ug/L). Risks calculated for dieldrin are based on the hypothetical future residential use of ground water.
Arsenic	Adult resident HQ = 0.26, Child resident HQ = 0.89, Residential ILCR = 7.4E-5	Risks for arsenic are based on the hypothetical future residential use of ground water. The maximum concentration in ground water (4.6 ug/L) is less than the current (50 ug/L) and recently proposed (10 ug/L) MCLs. In addition, the concentrations of arsenic in ground water samples are similar to the concentrations in the upgradient well.
Iron	Adult resident HQ = 1.7, Child resident HQ = 6.0	Risks for iron are based on the hypothetical future residential use of ground water. Risks calculated for iron are not based on adverse health effects but rather on recommended daily allowances.
Manganese	Adult resident HQ = 10, Child resident HQ = 35	Risks for manganese are based on the hypothetical future residential use of ground water and assume exposure to the maximum detected concentration.
Nickel	Adult resident HQ = 0.36, Child resident HQ = 1.3	Risks for nickel are based on the hypothetical future residential use of ground water. Only the risk for the future child resident slightly exceeds unity. All nickel concentrations in ground water are less than the IDEM closure level for Class I ground water.

TABLE 6-23

SUMMARY OF CONCLUSIONS
SWMU 9 - PESTICIDE CONTROL/ R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Chemical of Concern[1]	Impact on Human Receptors	Comments
SEDIMENT		
Arsenic	Recreational User ILCR = 3.0E-6, Child resdient HQ = 0.26, Residential ILCR = 1.5E-5	Risks (>1.0E-6) for arsenic in sediment are based on future land use scenarios. Although the maximum concentration (6.1 mg/kg) exceeded the concentration in the upgradient sample, the concentrations of arsenic in sediment are within naturally occurring levels in soil at the Base. Risks calculated for residnetial receptors are based on very conservative exposure assumptions. Risks from exposure to sediment are less than or within the U.S. EPA's target risk range for all receptors.
Iron	Child resident HQ = 0.41	Risks for exposure to iron in sediment are based on the hypothetical future residential land use and conservative exposure assumptions but do not pose a risk under current land use. Risks calculated for iron are not based on adverse health effects but rather on recommended daily allowances.
Manganese	Child resident HQ = 0.24	Risks for exposure to manganese in sediment are based on the hypothetical future residential land use and conservative exposure assumptions but do not pose a risk under current land use.

HQ Hazard Quotient.
ILCR Incremental lifetime cancer risk
[1] Any carcinogenic chemical with a ILCR of greater than 1.0E-6 or a noncarcinogenic chemical contributing to target organ hazard indices (HI) greater than 1.0.

TABLE 6-24

ECOLOGICAL RISK SCREENING - SURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Site Above Background Concentration?	Surface Soil COPC Screening Level (3)	Ecological Effects Quotient (4)	COPC Flag (5)	Rationale for Contaminant Deletion or Selection(5)
Volatiles (mg/kg)										
METHYLENE CHLORIDE	5/11	0.004 J	0.006 J	09SB080102, 09SB090102	0.0032	--	4.1	0.001	No	BSL
Semi-Volatiles (mg/kg)										
2-METHYLNAPHTHALENE	2/11	0.04	1.8	09SB090002	0.17	--	3.2	0.556	No	BSL
ACENAPHTHENE	1/11	0.02	0.02	09SB030002	0.0055	--	682	0.00003	No	BSL
ACENAPHTHYLENE	1/11	0.018	0.018	09SB030002	0.0053	--	682	0.00003	No	BSL
ANTHRACENE	1/11	0.052	0.052	09SB030002	0.0084	--	1480	0.00004	No	BSL
BENZO(A)ANTHRACENE	4/11	0.018	0.15	09SB030002	0.032	--	5.2	0.029	No	BSL
BENZO(A)PYRENE	4/11	0.022 J	0.13	09SB030002	0.028	--	1.5	0.086	No	BSL
BENZO(B)FLUORANTHENE	5/11	0.009	0.12	09SB030002	0.029	--	59.8	0.002	No	BSL
BENZO(G,H,I)PERYLENE	5/11	0.009	0.057	09SB030002	0.017	--	119	0.0005	No	BSL
BENZO(K)FLUORANTHENE	4/11	0.018 J	0.11 J	09SB030002	0.023	--	1480	0.0001	No	BSL
CHRYSENE	5/11	0.01	0.14	09SB030002	0.034	--	4.7	0.030	No	BSL
DI-N-BUTYL PHTHALATE	1/11	1.2	1.2	09SB020002	0.30	--	0.15	8.01	Yes	ASL
DIBENZO(A,H)ANTHRACENE	3/11	0.01 J	0.029	09SB030002	0.0078	--	18.4	0.002	No	BSL
FLUORANTHENE	5/11	0.008	0.3 J	09SB030002	0.053	--	122	0.002	No	BSL
FLUORENE	1/11	0.029	0.029	09SB030002	0.0063	--	122	0.0002	No	BSL
INDENO(1,2,3-CD)PYRENE	4/11	0.014 J	0.058	09SB030002	0.014	--	109	0.001	No	BSL
NAPHTHALENE	2/11	0.03	0.93	09SB090002	0.091	--	0.10	9.36	Yes	ASL
PHENANTHRENE	4/11	0.013	0.63	09SB090002	0.093	--	45.7	0.014	No	BSL
PYRENE	5/11	0.013	0.23 J	09SB030002	0.050	--	78.5	0.003	No	BSL
Pesticides (mg/kg)										
4,4'-DDT	1/11	0.0047	0.0047	09SB090002	0.002	--	0.018	0.269	No	BSL
METHOXYCHLOR	1/11	0.025 J	0.025 J	09SB090002	0.012	--	0.020	1.26	Yes	ASL
Herbicides (mg/kg)										
2,4-D	1/6	0.02 J	0.02 J	09SB040002	0.005	--	0.027	0.734	No	BSL
DINOSEB	1/9	0.014 J	0.014 J	09SB080002	0.003	--	0.022	0.642	No	BSL
PENTACHLOROPHENOL	3/9	0.0012 J	0.0035	09SB020002	0.001	---	0.119	0.029	No	BSL
Inorganics (mg/kg)										
ALUMINUM	11/11	5040	12900	09SB080002	9085	NO	NA	NA	No	BKG
ANTIMONY	2/11	0.97	3.1 J	09SB060002	0.75	YES	0.142	21.8	Yes	ASL
ARSENIC	11/11	2.9 J	9.6 J	09SB090002	6.0	NO	5.7	1.7	No	BKG
BARIUM	11/11	49.6 J	106 J	09SB090002	83.1	NO	1.04	102	No	BKG
CADMIUM	1/11	0.96 J	0.96 J	09SB100002	0.50	NO	0.002	432	No	BKG
CALCIUM	11/11	843 J	175000 J	09SB110002	46305	YES	NA	NA	No	NT
CHROMIUM	11/11	7.6 J	13.7 J	09SB080002	11.1	NO	0.4	34.3	No	BKG
COBALT	11/11	4.8 J	23	09SB040002	10.5	NO	0.140	164	No	BKG
COPPER	11/11	7.6 J	20.1 J	09SB100002	12.0	YES	3.0	6.8	Yes	ASL
IRON	11/11	8840	20100	09SB080002	15804	NO	NA	NA	No	BKG
LEAD	11/11	8.6 J	34.9 J	09SB100002	18.9	YES	0.054	650	Yes	ASL
MAGNESIUM	11/11	731 J	32500 J	09SB110002	5569	YES	NA	NA	No	NT
MANGANESE	11/11	135 J	1060 J	09SB040002	577	NO	NA	NA	No	BKG
MERCURY	5/11	0.04	0.06	09SB040002, 09SB090002	0.04	NO	0.073	0.82	No	BSL, BKG

TABLE 6-24

ECOLOGICAL RISK SCREENING - SURFACE SOIL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Site Above Background Concentration?	Surface Soil COPC Screening Level (3)	Ecological Effects Quotient (4)	COPC Flag (5)	Rationale for Contaminant Deletion or Selection(5)
NICKEL	11/11	9.5 J	18.3 J	09SB100002	13.3	NO	13.6	1.3	No	BKG
POTASSIUM	6/11	464 J	618 J	09SB080002	385	NO	NA	NA	No	NT, BKG
VANADIUM	11/11	14.5 J	29.3 J	09SB090002	21.5	NO	1.6	18.4	No	BKG
ZINC	11/11	30.3 J	120 J	09SB060002	51.8	YES	6.6	18.1	Yes	ASL
Miscellaneous Parameters										
CATION EXCHANGE CAPACITY (MEQ/100 g)	3/3	8.4 J	11 J	09SB040002	9.7	---	NA	NA	No	NT
pH (S.U.)	3/3	6.9 J	8 J	09SB070002	7.4	---	NA	NA	No	NT
TOTAL ORGANIC CARBON (mg/kg)	3/3	5700	8500	09SB040002	6867	---	NA	NA	No	NT

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.
The table only includes parameters that were detected in downgradient samples (if applicable).

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 As presented in Table 3-14.
4 Refer to Section 3.4 for ecological effects quotient calculation.

Definitions:
COPC = Chemical of potential concern.
NA = Not available.

5 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.

For Elimination as a COPC:
BKG = Below site background level.
BSL = Below COPC screening level.
NT = Nontoxic.

TABLE 6-25

ECOLOGICAL RISK SCREENING - SEDIMENT
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Dectection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Upgradient Sample Concentration(3)	Sediment COPC Screening Level (4)	Ecological Effects Quotient (5)	COPC Flag (6)	Rationale for Contaminant Deletion or Selection(6)
Volatiles (mg/kg)										
METHYLENE CHLORIDE	2/4	0.004 J	0.004 J	09SD030006, 09SD040006	0.003	0.008 J	1.3	0.003	No	BSL
Semi-Volatiles (mg/kg)										
FLUORANTHENE	1/4	0.01	0.01	09SD030006	0.006	0.013	0.111	0.090	No	BSL
Pesticides (mg/kg)										
AROCLOR-1248	1/4	0.38 J	0.38 J	09SD030006	0.111	0.053 U	0.034	11.1	Yes	ASL
Inorganics (mg/kg)										
ALUMINUM	4/4	5470 J	10800 J	09SD050006	8215	7600 J	NA	NA	Yes	NTX
ANTIMONY	1/4	1.3 J	1.3 J	09SD020006	0.69	1.2 U	NA	NA	Yes	NTX
ARSENIC	4/4	0.77	6.1	09SD030006	4.2	3.7	5.9	1.03	Yes	ASL
BARIUM	4/4	39.3	103	09SD030006	65.6	78.1	NA	NA	Yes	NTX
CALCIUM	4/4	786 J	1470 J	09SD030006	1099	2120 J	NA	NA	No	NT, BKG
CHROMIUM	4/4	11.1	13	09SD050006	11.9	8.7	26	0.50	No	BSL
COBALT	4/4	4.8	14.5	09SD040006	9.4	9.2	50	0.290	No	BSL
COPPER	4/4	9	27.7	09SD050006	14.0	16.0	16	1.73	Yes	ASL
IRON	4/4	15700 J	18600 J	09SD030006	16750	9620 J	NA	NA	Yes	NTX
LEAD	4/4	6.6 J	22.7 J	09SD030006	13.5	22.1 J	31	0.732	No	BSL
MAGNESIUM	4/4	597 J	1820 J	09SD050006	1157	1290 J	NA	NA	No	NT
MANGANESE	4/4	86.8	1300	09SD030006	714	350	NA	NA	Yes	NTX
NICKEL	4/4	7.4	11.6	09SD040006	9.9	12.2	16	0.725	No	BSL, BKG
POTASSIUM	1/4	913 J	913 J	09SD050006	392	589 UJ	NA	NA	No	NT
VANADIUM	4/4	12.2	21.2	09SD030006	17.5	15.2	NA	NA	Yes	NTX
ZINC	4/4	27.7	95.3	09SD030006	57.2	40.9	120	0.794	No	BSL
Miscellaneous Parameters (mg/kg)										
TOTAL ORGANIC CARBON	4/4	1600	14000	09SD040006	7175	38000	NA	NA	No	NT

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.
The table only includes paramters that were detected in downgradient samples (if applicable).

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 Location of upgradient sample was 09SD010006
4 As presented in Table 3-14.
5 Refer to Section 3.4 for ecological effects quotient calculation.

Definitions:
COPC = Chemical of potential concern.
NA = Not available.

6 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.

For Elimination as a COPC:
BKG = Below site background level.
BSL = Below COPC screening level.
NT = Nontoxic.

Associated Samples
09SD010006
09SD020006
09SD030006
09SD040006
09SD050006

TABLE 6-26

ECOLOGICAL RISK SCREENING - SURFACE WATER
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection [1]	Minimum Concentration [1]	Maximum Concentration [1][2]	Location of Maximum Concentration	Average of All Results	Upgradient Sample Concentration[3]	Surface Water COPC Screening Level[4]	Ecological Effects Quotient [5]	COPC Flag [6]	Rationale for Contaminant Deletion or Selection[6]
Herbicides (µg/L)										
2,4-D	1/4	0.18	0.18	09SW0201	0.075	0.080 U	NA	NA	Yes	NTX
Inorganics (µg/L)										
ALUMINUM	2/4	220 J	245 J	09SW0201	166	5990 J	NA	NA	No	BKG
ANTIMONY	1/4	1.6	1.6	09SW0501	0.78	1.0 U	31	0.05	No	BSL
ARSENIC	4/4	0.41 J	1.9 J	09SW0501	0.89	4.6 J	53	0.04	No	BSL, BKG
BARIUM	4/4	37.3	72.5	09SW0501	53	173	5000	0.01	No	BSL, BKG
CALCIUM	4/4	17600	57300	09SW0501	41625	34800	NA	NA	No	NT
COBALT	1/4	5.5	5.5	09SW0501	2.5	9.8	5	1.1	No	BKG
COPPER	1/4	12.4	12.4	09SW0501	3.9	18.5	5	2.5	No	BKG
IRON	4/4	288 J	1830 J	09SW0501	751	8390 J	NA	NA	No	BKG
LEAD	1/4	3.6	3.6	09SW0501	1.3	21.9	1	2.8	No	BKG
MAGNESIUM	4/4	5960 J	15000 J	09SW0201	9315	15400 J	NA	NA	No	NT, BKG
MANGANESE	4/4	57.6	583	09SW0201	289	637	NA	NA	No	NTX, BKG
POTASSIUM	1/4	5310 J	5310 J	09SW0501	3203	5000 U	NA	NA	No	NT
SODIUM	4/4	12600	175000	09SW0501	60625	36000	NA	NA	No	NT
VANADIUM	1/4	3.1	3.1	09SW0501	1.5	14.3	19	0.16	No	BSL, BKG
ZINC	1/4	11.9	11.9	09SW0501	6.7	50.4	58.9	0.20	No	BSL, BKG
Filtered Inorganics (µg/L)										
ANTIMONY	1/4	1.6	1.6	09SW0501-F	0.78	1.0 U	31	0.05	No	BSL
ARSENIC	4/4	0.27 J	2.3 J	09SW0501-F	0.92	1.1 J	53	0.04	No	BSL
BARIUM	4/4	33.2	71	09SW0501-F	50	94.9	5000	0.01	No	BSL, BKG
CALCIUM	4/4	17800	57100	09SW0501-F	41200	40300	NA	NA	No	NT
COBALT	1/4	5.1	5.1	09SW0501-F	2.4	3.0 U	5	1.02	Yes	ASL
COPPER	1/4	7.4	7.4	09SW0501-F	2.6	2.0 U	5	1.48	Yes	ASL
IRON	3/4	145 J	1460 J	09SW0501-F	467	138 J	NA	NA	Yes	NTX
LEAD	1/4	2.3	2.3	09SW0501-F	0.95	1.0 U	1	1.77	Yes	ASL
MAGNESIUM	4/4	6210 J	14100 J	09SW0201-F	9218	17800 J	NA	NA	No	NT, BKG
MANGANESE	4/4	18	532	09SW0201-F	266	239	NA	NA	Yes	NTX
POTASSIUM	1/4	5390 J	5390 J	09SW0501-F	3223	5000 U	NA	NA	No	NT
SODIUM	4/4	12700	182000	09SW0501-F	62975	43200	NA	NA	No	NT
VANADIUM	1/4	3.8	3.8	09SW0501-F	1.7	2.0 U	19	0.20	No	BSL
ZINC	1/4	10.2	10.2	09SW0501-F	6.3	10.0 U	58.9	0.17	No	BSL
Miscellaneous Parameters (µg/L)										
HARDNESS	4/4	70000	180000	09SW0501	142500	150000	NA	NA	No	NT
TOTAL SUSPENDED SOLIDS	3/4	3000	640000	09SW0401	132000	640000	NA	NA	No	NT

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.
The table only includes parameters that were detected in downgradient samples (if applicable).

Footnotes:

1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 Location of upgradient sample was 09SW0101
4 As presented in Table 3-15.
5 Refer to Section 3.4 for ecological effects quotient calculation.

Definitions:

COPC = Chemical of potential concern.
NA = Not available.

6 Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.

For Elimination as a COPC:
BKG = Below site background level.
BSL = Below COPC screening level.
NT = Nontoxic.

TABLE 6-27

CHEMICALS OF POTENTIAL CONCERN RETAINED FOR FOOD-CHAIN MODELING
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE
CRANE, INDIANA

Parameters	Media		
	Surface Water	Sediment	Surface Soil
PCBs			
Aroclor-1248		X	
Pesticides			
Methoxychlor			X
Herbicides			
2,4-D	X		
Inorganics			
Arsenic		X	
Copper	X	X	X
Lead	X		X
Zinc			X

COPCs retained in surface water and sediment were used to evaluate potential risk to piscivorous receptors.

COPCs retained in surface soil were used to evaluate potential risk to terrestrial wildlife.

TABLE 6-28

STEP 3A EVALUATION FOR RISKS TO PLANTS AND INVERTEBRATES
SURFACE SOIL COPCs
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Screening Level (mg/kg)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation						Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						Alternate Benchmarks					Other Step 3a Factors Considered in Evaluation[4]		
						Eco-SSL		Canadian SQG[3]	ORNL Benchmarks[3]				
						Plant	Earthworm		Plant	Earthworm			
Semi-Volatiles													
Di-N-Butyl Phthalate	1/11	1.2	0.15	8.01	1	NA	NA	NA	200	NA	-Maximum concentration less than ORNL plant benchmark. -Maximum concentration less than earthworm values reported for dimethylphthalate (200 mg/kg). -Only detected in one sample at site; contamination is not widespread across SWMU 9; contamination limited to small area. -Location of maximum detection is covered by gravel so there is no habitat for earthworms or plants at this location.	Acceptable	No
Naphthalene	2/11	0.93	0.10	9.36	1	NA	NA	0.6	NA	NA	-Only maximum concentration is greater than SQG; maximum does not exceed study LOEC of 3 mg/kg. -Naphthalene not detected in samples nearest maximum concentration; maximum is likely isolated. -Location of maximum detection is mowed grass and not high quality ecological habitat.	Acceptable	No
Pesticides													
Methoxychlor	1/11	0.025	0.020	1.26	1	NA	NA	NA	NA	NA	-Only detected in one sample at site; contamination is not widespread across SWMU 9; contamination limited to small area. -Location of maximum detection is mowed grass and not high quality ecological habitat.	Acceptable	No
Inorganics													
Antimony	2/11	3.1	0.142	21.8	2	NA	78	NA	5	NA	-Maximum concentration less than alternate benchmarks for plants and invertebrates.	Acceptable	No
Copper	11/11	20.1	2.96	6.8	11	NA	NA	63	100	60	-Maximum concentration less than Canadian SQG. -Concentrations (7.6 to 20.1 mg/kg) are similar to background soil data range (5.4 to 17.1 mg/kg).	Acceptable	No
Lead	11/11	34.9	0.054	650	11	115	1,700	NA	NA	NA	-Maximum concentration less than Eco-SSLs. -Concentrations (8.6 to 34.9 mg/kg) are similar to background soil data range (9.4 to 21.5 mg/kg).	Acceptable	No
Zinc	11/11	120	6.62	18.1	11	NA	NA	200	NA	NA	-Maximum concentration less than Canadian SQG.	Acceptable	No

Footnotes:
1 Maximum EEQ = Maximum detection divided by the screening level.
2 Number of samples with concentrations greater than the screening level.
3 ORNL benchmarks were used only in the absence of the Eco-SSL and Canadian SQG.
4 See Section 6.7.6.1.1 for a more detailed Step 3a evaluation.

EEQ = Ecological Effects Quotient
NA = Not Available or Not Applicable
SQG = Soil Quality Guideline
Eco-SSL = US EPA Ecological Soil Screening Level
ORNL = Oak Ridge National Laboratory

TABLE 6-29

STEP 3A EVALUATION FOR RISKS TO BENTHIC ORGANISMS
SEDIMENT COPCs
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Region V EDQLs (mg/kg)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation						Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						Alternate Benchmarks					Other Step 3a Factors Considered in Evaluation[3]		
						Consensus-based TEC	TEL	ER-L	Canadian LEL	AET			
PCBs													
Aroclor-1248	1/4	0.38	0.034	11.1	1	0.0598	NA	NA	NA	NA	-Maximum concentration exceeds TEC but is less than the PEC (0.676 mg/kg). -Only detected in one sample at site; contamination is not widespread across SWMU 9; contamination limited to small area, which is supported by the fact that Aroclor-1248 was not detected in surface soil. -Marginal (if any) aquatic habitat at location of maximum detection.	Acceptable	No
Inorganics													
Aluminum	4/4	10,800	NA	NA	NA	NA	25,500	NA	NA	NA	-Maximum concentration is less than the TEL.	Acceptable	No
Antimony	1/4	1.3	NA	NA	NA	NA	NA	2	NA	NA	-Maximum concentration is less than the ER-L.	Acceptable	No
Arsenic	4/4	6.1	5.9	1.03	1	9.79	NA	NA	NA	NA	-Maximum concentration is less than the TEC.	Acceptable	No
Barium	4/4	103	NA	NA	NA	NA	NA	NA	NA	48	-Maximum concentration is greater than the AET; however upgradient sediment concentration is also greater than AET -Marginal (if any) aquatic habitat at location of maximum detection. -Site sediment concentrations (39.3 to 103 mg/kg) are within the soil background range (24.8 to 155 mg/kg).	Acceptable	No
Copper	4/4	27.7	16	1.73	1	31.6	NA	NA	NA	NA	-Maximum concentration is less than the TEC.	Acceptable	No
Iron	4/4	18,600	NA	NA	NA	NA	NA	NA	20,000	NA	-Maximum concentration is less than the LEL.	Acceptable	No
Manganese	4/4	1,300	NA	NA	NA	NA	NA	NA	460	NA	-Two greatest detections exceed the LEL and SEL (1,100 mg/kg); other two detections are less than the LEL. -Site sediment concentrations (86.8 to 1,300 mg/kg) are within the soil background range (23.2 to 3,040 mg/kg). -Marginal (if any) aquatic habitat at location of maximum detection.	Acceptable	No
Vanadium	4/4	21.2	NA	NA	NA	NA	NA	NA	NA	57	-Maximum concentration is less than the AET. -Most detected concentrations were less than the upgradient sediment location and maximum site concentration was only slightly greater than the upgradient concentration (15.2 mg/kg). -Site sediment concentrations (12.2 to 21.2 mg/kg) are within the soil background range (14.1 to 48.5 mg/kg).	Acceptable	No

Footnotes:
1 - Maximum EEQ = Maximum detection divided by the screening level
2 - Number of samples with concentrations greater than the screening level
3 - See section 6.7.6.1.2 for a more detailed Step 3a evaluation

EEQ - Ecological Effects Quotient
NA - Not available or not applicable
COPC = Chemical of Potential Concern
AET = Apparent Effects Threshold
ER-L = Effects Range-Low
LEL = Lowest Effects Level
PEC = Probable Effects Concentration
TEC = Threshold Effects Concentration
TEL = Threshold Effects Level
SEL = Severe Effects Level

TABLE 6-30

STEP 3A EVALUATION FOR RISKS TO AQUATIC ORGANISMS
SURFACE WATER COPCs
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (ug/L)	Screening Level (ug/L)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation				Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						AWQC Chronic	ESL	ORNL Aquatic	Other Step 3a Factors Considered in Evaluation[3]		
Herbicides											
2,4-D	1/4	0.18	NA	NA	NA	NA	220	NA	-Maximum concentration is less than new ESL.	Acceptable	No
Filtered Inorganics											
Cobalt	1/4	5.1	5	1.02	5	NA	24	NA	-Maximum concentration is less than new ESL.	Acceptable	No
Copper	1/4	7.4	5	1.48	5	14.8[4]	NA	NA	-Maximum concentration is less than AWQC.	Acceptable	No
Iron	3/4	1,460	NA	NA	NA	1,000	NA	NA	-Only maximum concentration is greater than AWQC -Poor aquatic habitat at location of maximum concentration.	Acceptable	No
Lead	1/4	2.3	1	1.77	1	4.7[4]	NA	NA	-Maximum concentration is less than AWQC.	Acceptable	No
Manganese	4/4	532	NA	NA	NA	NA	NA	120	-Maximum concentration is greater than the ORNL aquatic value but is less than the tolerance value range (1.5 to 1,000 mg/kg) reported in the Gold Book. -Poor aquatic habitat at location of maximum concentration.	Acceptable	No

Footnotes:
1 - Maximum EEQ = Maximum detection divided by the screening level.
2 - Number of samples with concentrations greater than the screening level.
3 - See section 6.7.6.1.3 for a more detailed Step 3a evaluation.
4 - Calculated using hardness concentration of 180 mg/L in sample 09SW0501-F.

EEQ - Ecological Effects Quotient
NA - Not available or not applicable
AWQC = Ambient Water Quality Criteria
EDQL = Environmental Data Quality Level
LCV = Lowest Chronic Value
ORNL = Oak Ridge National Laboratory

TABLE 6-31

TERRESTRIAL WILDLIFE MODEL-MAXIMUM EEQS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
INSECTIVOROUS/HERBIVOROUS RECEPTORS
NSWC CRANE, INDIANA

Parameter	Meadow Vole EEQ_{NOAEL}	Meadow Vole EEQ_{LOAEL}	Short-Tailed Shrew EEQ_{NOAEL}	Short-Tailed Shrew EEQ_{LOAEL}	American Robin EEQ_{NOAEL}	American Robin EEQ_{LOAEL}	N. Bobwhite Quail EEQ_{NOAEL}	N. Bobwhite Quail EEQ_{LOAEL}
Pesticides								
Methoxychlor	6.8E-06	3.4E-06	2.2E-04	1.1E-04				
Inorganics								
Copper	3.9E-03	3.0E-03	9.2E-03	7.1E-03	1.7E-01	1.3E-01	8.2E-03	6.2E-03
Lead	2.1E-02	2.1E-03	6.5E-02	6.5E-03	1.2E+01	1.2E+00	4.8E-01	4.8E-02
Zinc	1.0E-02	5.0E-03	5.2E-02	2.6E-02	1.5E+01	1.7E+00	2.8E-01	3.2E-02

Notes:
- Blank spaces indicate that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- Cells are shaded if the EEQ is greater than 1.0

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration

TABLE 6-32

TERRESTRIAL WILDLIFE MODEL - AVERAGE EEQS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
INSECTIVOROUS/HERBIVOROUS RECEPTORS
NSWC CRANE, INDIANA

Parameter	American Robin EEQ_{NOAEL}	American Robin EEQ_{LOAEL}
Inorganics		
Lead	3.0E+00	3.0E-01
Zinc	2.7E+00	2.9E-01

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicate that an EEQ could not be calculated because a NOAEL or LOAEL was not available.
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations.

EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

TABLE 6-33

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-MAXIMUM CONCENTRATIONS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
PISCIVOROUS RECEPTORS
NSWC CRANE, INDIANA

Parameter	Raccoon NOAEL	Raccoon LOAEL	Belted Kingfisher NOAEL	Belted Kingfisher LOAEL
PCBs				
AROCLOR-1248	1.9E+02	1.9E+01	1.1E+01	1.1E+00
Herbicides				
2,4-D	1.3E+02	2.5E+01		
Inorganics				
ARSENIC	4.8E+03	4.8E+02	7.7E-02	2.6E-02
COPPER	7.1E+00	5.5E+00	1.8E-02	1.4E-02
LEAD	2.4E+01	2.4E+00	6.2E-01	6.2E-02

Notes:

- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum inpu parameters, and were detected above background concentrations.

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

TABLE 6-34

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-AVERAGE CONCENTRATIONS
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
PISCIVOROUS RECEPTORS
NSWC CRANE, INDIANA

Parameter	Raccoon NOAEL	Raccoon LOAEL	Belted Kingfisher NOAEL	Belted Kingfisher LOAEL
Pesticides				
AROCLOR-1248	2.8E+01	2.8E+00	2.6E+00	2.6E-01
Herbicides				
2,4-D	1.2E-04	2.4E-05		
Inorganics				
ARSENIC	1.6E+03	1.6E+02	4.3E-02	1.4E-02
COPPER	1.8E+00	1.4E+00	7.5E-03	5.7E-03
LEAD	7.0E+00	7.0E-01	3.0E-01	3.0E-02

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

TABLE 6-35

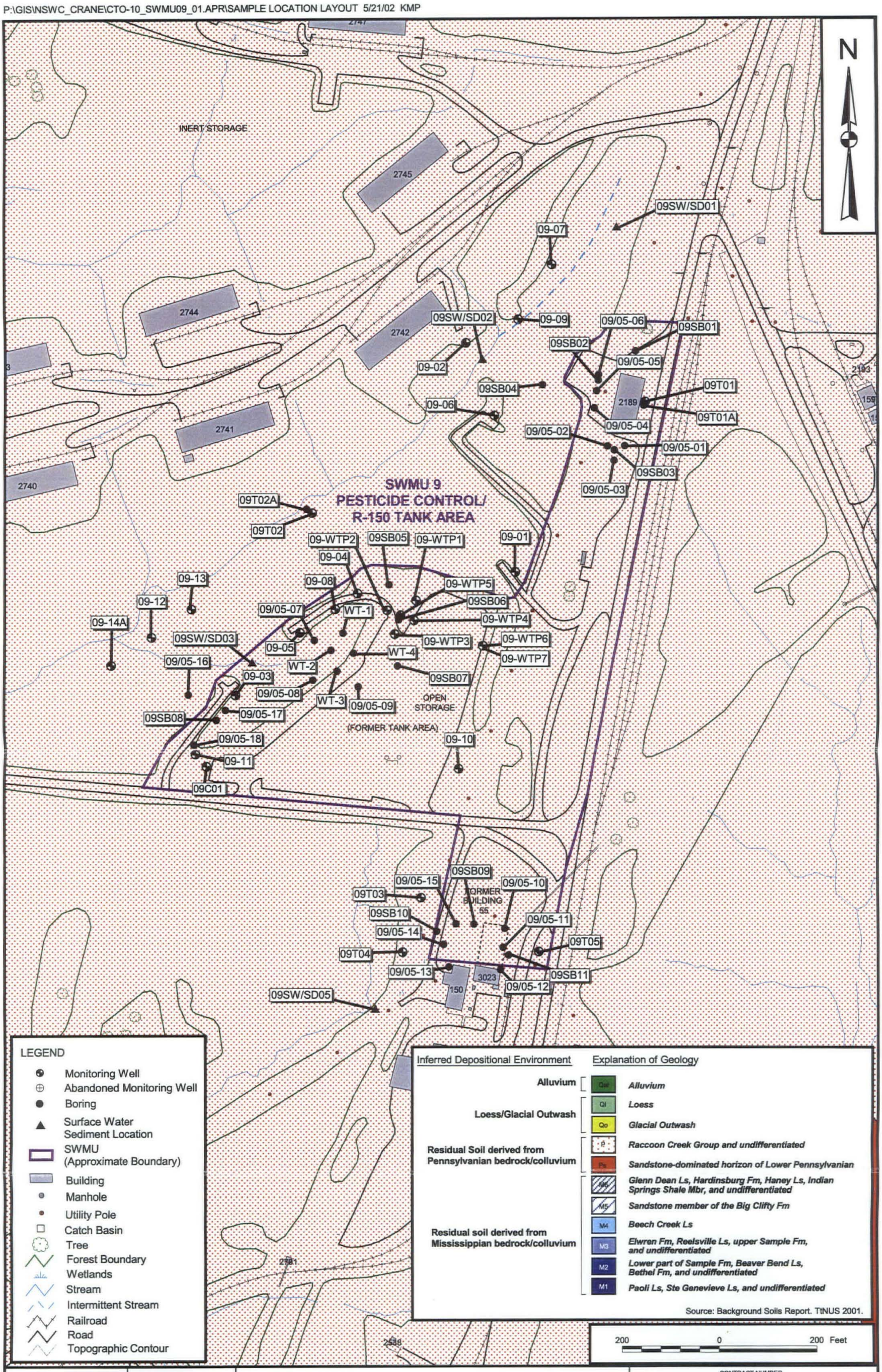
STEP 3A EVALUATION FOR RISKS TO WILDLIFE
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection[1]	Maximum Detected Concentration (mg/kg)[1]	Average Concentration (mg/kg)[1]	EEQs Using Average Exposure Values				Basis of Wildlife Toxicity Reference Value	Other Step 3a Factors Considered in Evaluation[2]	Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
				NOAEL		LOAEL					
				EEQ > 1.0	Species	EEQ > 1.0	Species				
Insectivorous/Herbivorous Wildlife											
Methoxychlor	1/11	0.025	0.012	None	NA	None	NA	NA	NA	Acceptable	No
Copper	11/11	20.1	12	None	NA	None	NA	NA	NA	Acceptable	No
Lead	11/11	34.9	18.9	3.0	Robin	None	NA	Reproduction not impaired at 10 mg/kg (NOAEL).	-LOAEL EEQ was less than 1.0 after refinement.	Acceptable	No
Zinc	11/11	120	51.8	2.7	Robin	None	NA	Egg hatchability <20% of controls (LOAEL).	-LOAEL EEQ was less than 1.0 after refinement.	Acceptable	No
Piscivorous Wildlife											
2,4-D[3]	1/4	0.18	0.075	None	NA	None	NA	NA	NA	Acceptable	No
Aroclor-1248	1/4	0.38	0.11	28	Raccoon	2.8	Raccoon	Pregnancy and live birth rates were reduced by 2.5 mg/kg in rhesus monkey; TRVs adjusted for raccoon body weight difference.	-Poor aquatic habitat; very unlikely that raccoons will obtain significant amount of food from SWMU 9 because the home range of the raccoon is large (greater than 250 acres). -Detected concentrations (of arsenic) are within background data set; only copper and lead were greater than the background concentrations. -The LOAEL EEQ is only slightly greater than 1.0 for copper and less than 1.0 for lead after the refinement. -There are no sediment to fish BASFs, so a BAF of 1.0 was used. A BAF of 1.0 is conservative because it assumes tissue concentrations are equal to sediment concentrations. -Body weight scaling may be overly conservative.	Acceptable	No
Arsenic	4/4	6.1	4.2	1,600	Raccoon	160	Raccoon	Declining litter sizes over multiple mice generations (LOAEL); TRVs adjusted for raccoon body weight difference.		Acceptable	No
Copper	4/4	27.7	14	1.8	Raccoon	1.4	Raccoon	Kit survivorship in mink was not affected at 25 mg/kg (NOAEL); TRVs adjusted for raccoon body weight difference.		Acceptable	No
Lead	4/4	22.7	13.5	7.0	Raccoon	None	NA	Number of pregnancies, live births, and other reproductive indices in rats were not affected at 100 mg/kg; TRVs adjusted for raccoon body weight difference.		Acceptable	No

Footnotes:
1 - These columns present the Frequency of Detection and concentrations for soil (for insectivorous/herbivorous wildlife) or sediment (for piscivorous wildlife).
2 - See Section 6.7.6.2 for a more detailed Step 3a evaluation.
3 - 2,4-D was detected in surface water only.

EEQ - Ecological Effects Quotient
NA - Not available or not applicable
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level

P:\GIS\NSWC_CRANE\CTO-10_SWMU09_01.APR\SAMPLE LOCATION LAYOUT 5/21/02 KMP



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CHECKED BY	DATE		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 6 - 1 / REV 0

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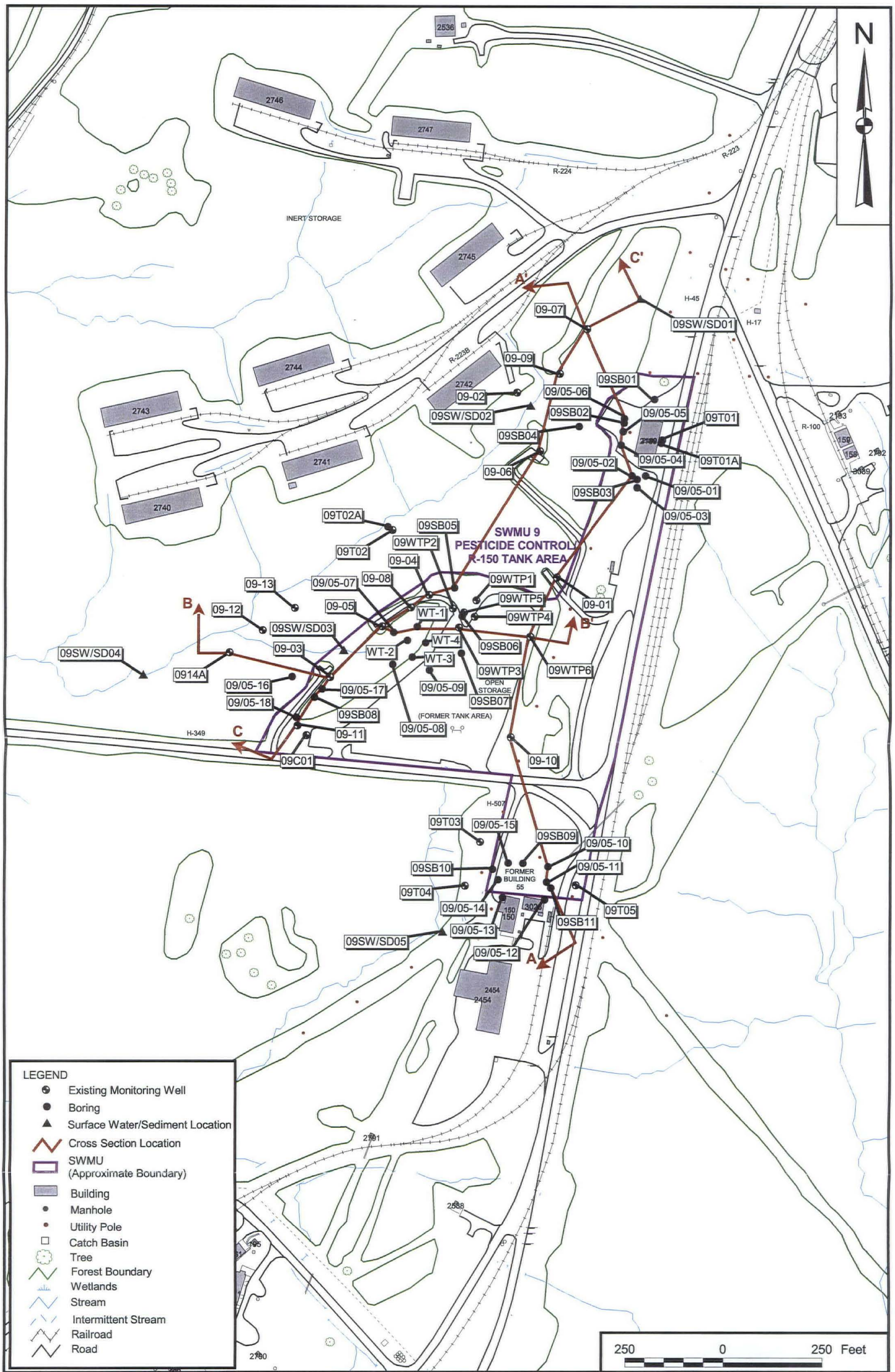

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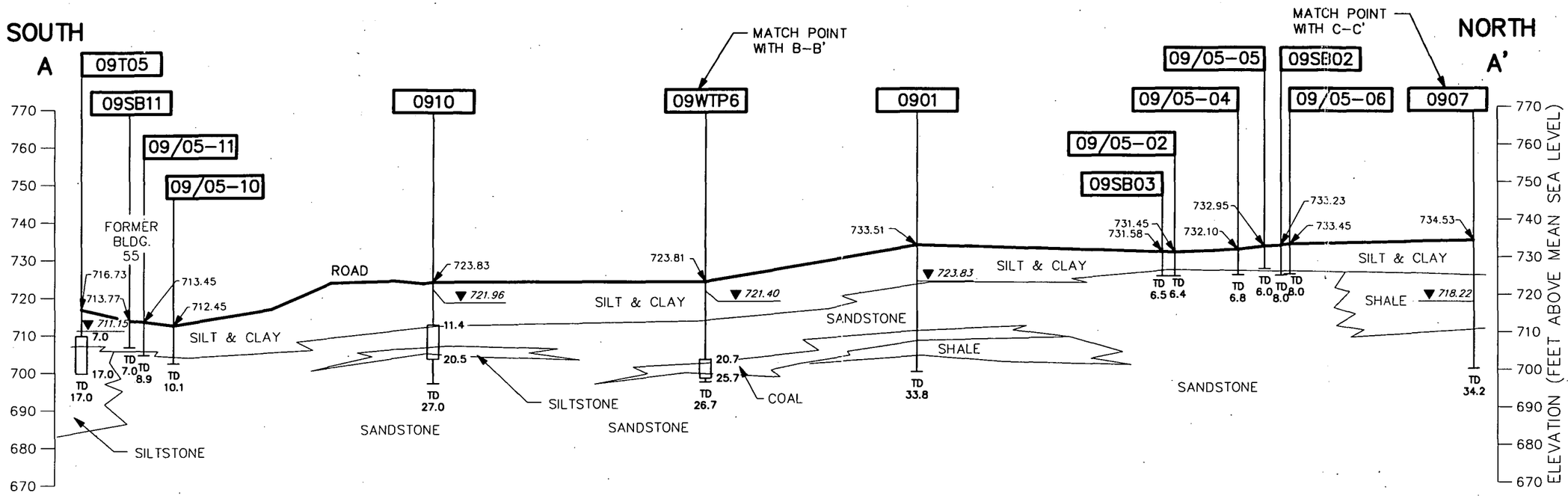
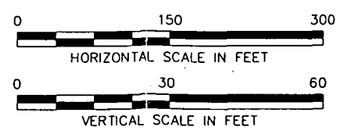
CHECKED BY	DATE		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 6 - 2 REV 0





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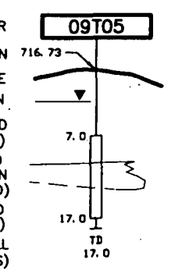

CONTRACT NO. 7141

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 6-3

REV. 0

GEOLOGIC CROSS SECTION A-A'
SWMU 9 - PESTICIDE CONTROL
R-150 TANK AREA
NSWC CRANE, INDIANA

DEPARTMENT OF THE NAVY * SOUTHERN DIV FACILITIES ENGINEERING COMD

DRAWN BY HJB DATE 5/7/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

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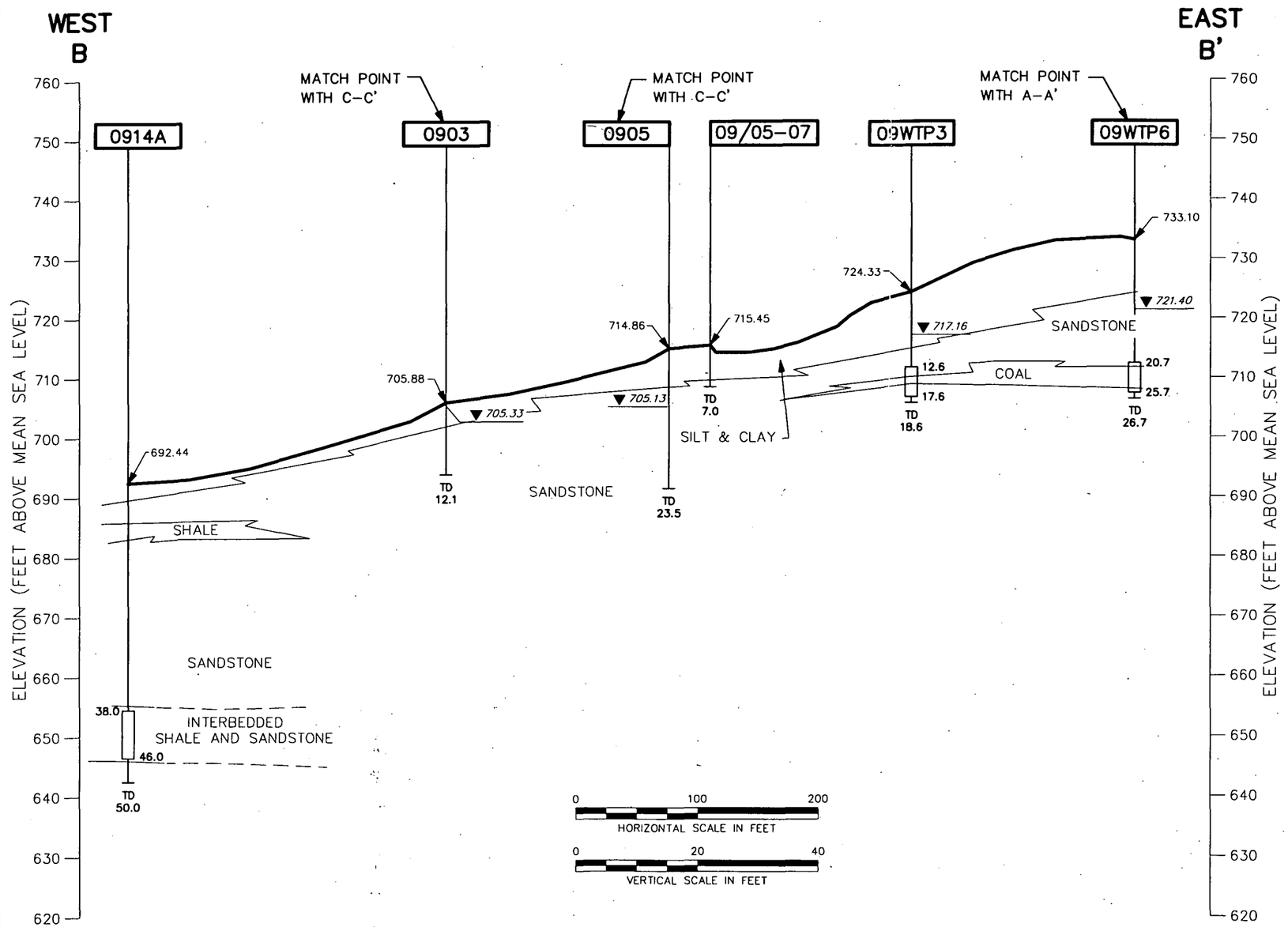

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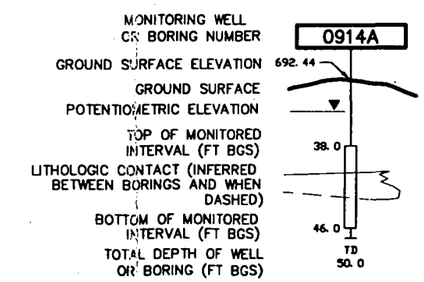

CONTRACT NO. 7141

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DRAWING NO. FIGURE 6-4

REV. 0

GEOLOGIC CROSS SECTION B-B'
SWMU 9 - PESTICIDE CONTROL
R-150 TANK AREA
NSWC CRANE, INDIANA

DRAWN BY HJB DATE 5/7/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

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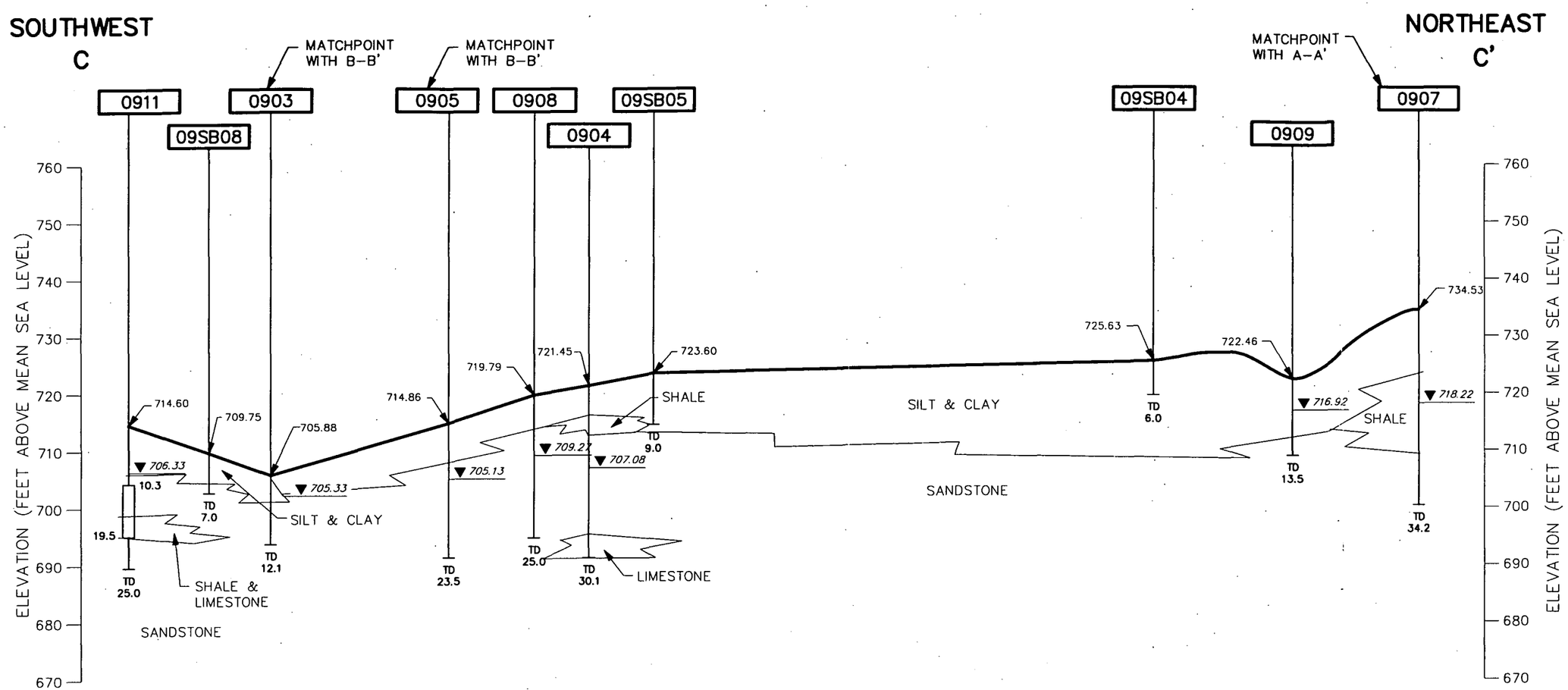

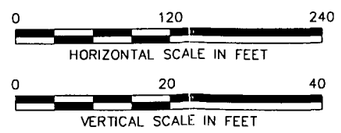

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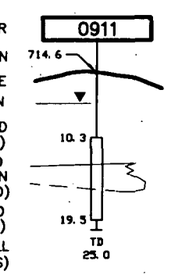

CONTRACT NO. 7141

APPROVED BY DATE

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DRAWING NO. FIGURE 6-5

REV. 0

GEOLOGIC CROSS SECTION C-C'
SWMU 9 – PESTICIDE CONTROL
R-150 TANK AREA
NSWC CRANE, INDIANA

DEPARTMENT OF THE NAVY ★ SOUTHERN DIV. ENGINEERING COMD. ★

DRAWN BY HJB DATE 5/8/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

FORM CADD NO. SDIV_BV.DWG - REV 0 - 1/20/98

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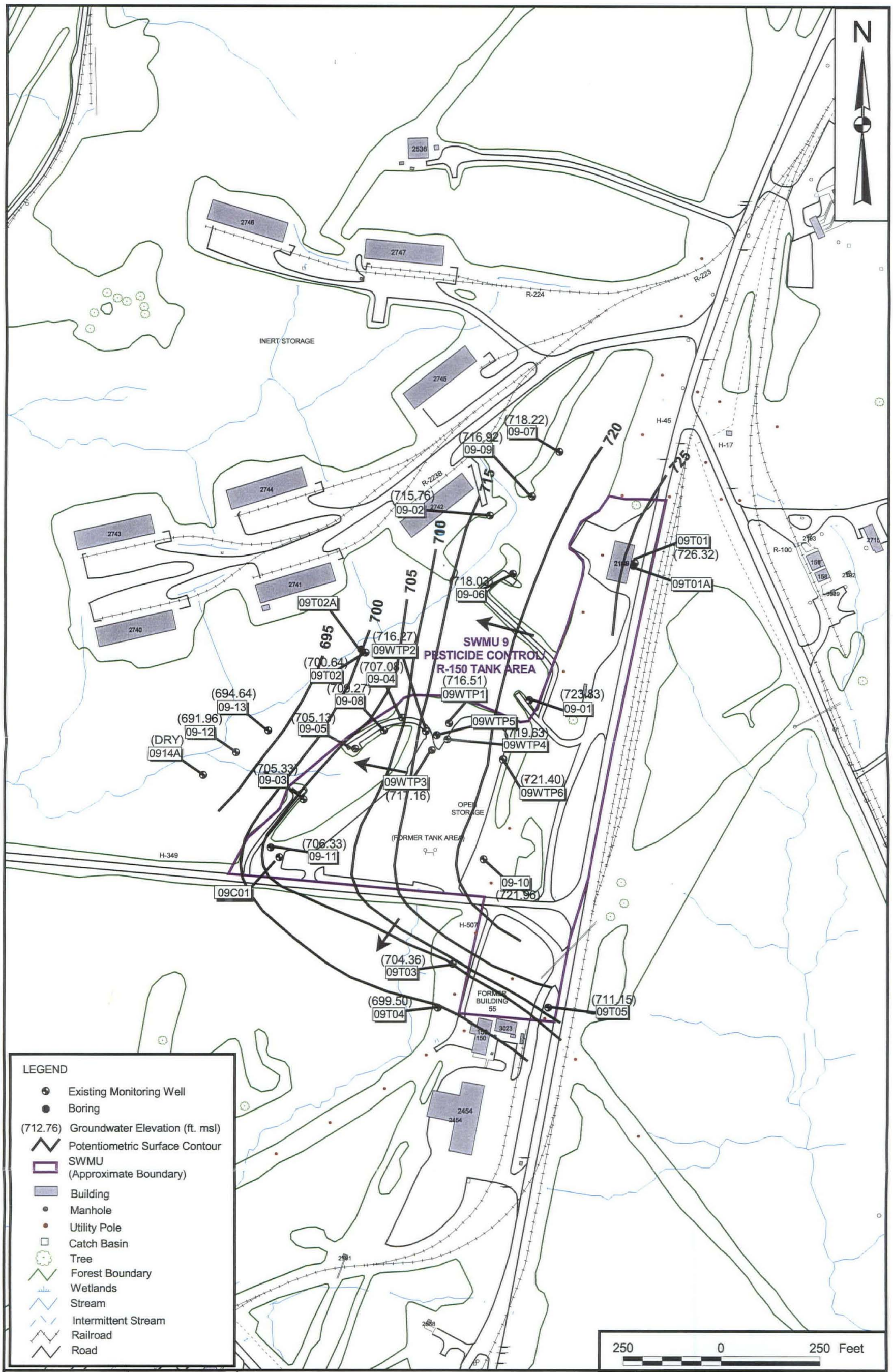

LEGEND

- Existing Monitoring Well
- Boring
- (712.76) Groundwater Elevation (ft. msl)
- Potentiometric Surface Contour
- SWMU (Approximate Boundary)
- Building
- Manhole
- Utility Pole
- Catch Basin
- Tree
- Forest Boundary
- Wetlands
- Stream
- Intermittent Stream
- Railroad
- Road

DRAWN BY K. PEILA	DATE 5/21/02	POTENTIOMETRIC SURFACE MAP (1-10-01) SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA NSWC CRANE, INDIANA	CONTRACT NUMBER 7141
CHECKED BY	DATE		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 6 - 6 / REV 0

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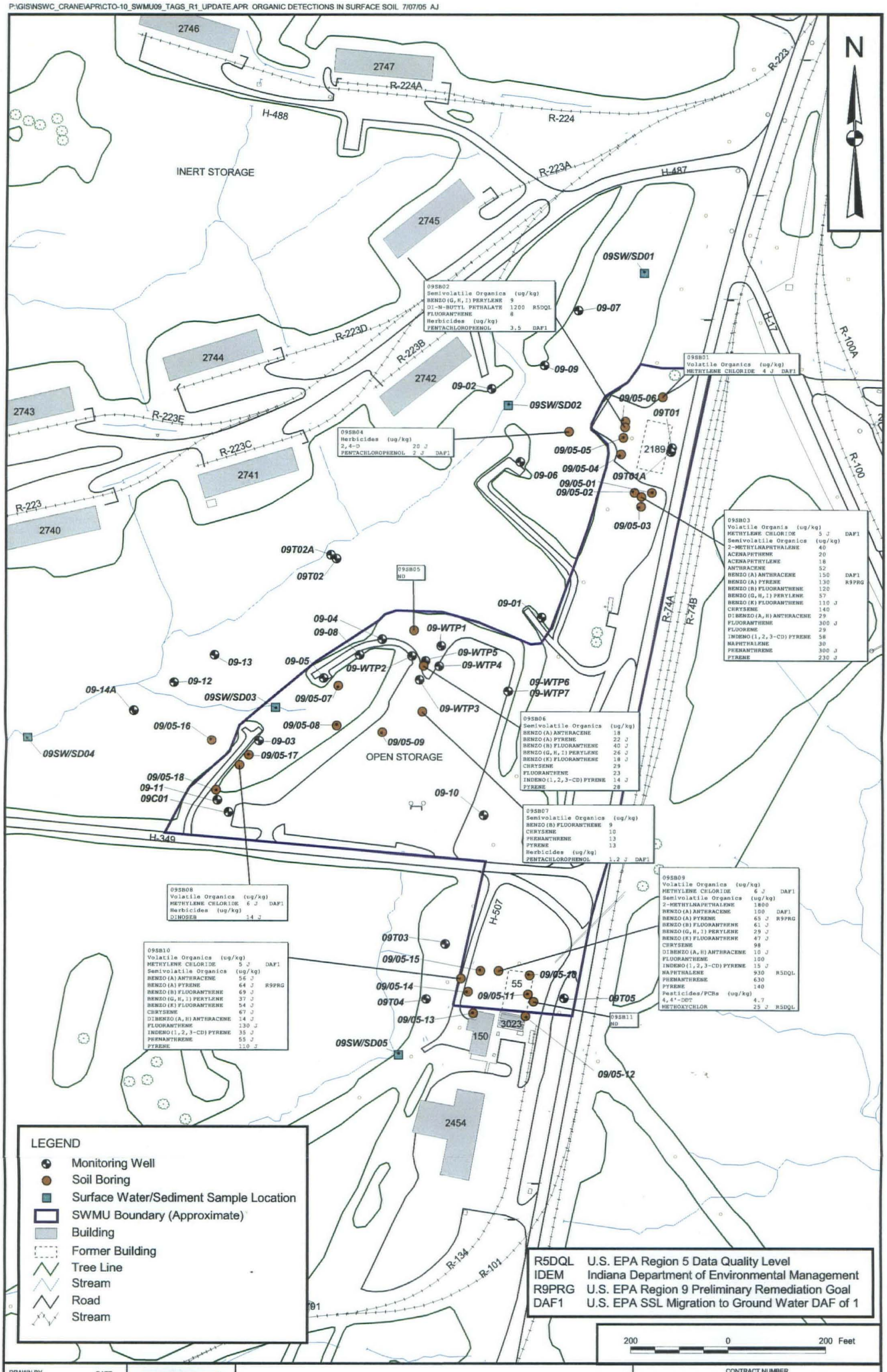

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K. PEILA	5/21/02
CHECKED BY	DATE
T. JOHNSTON	7/15/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

ORGANIC DETECTIONS IN SURFACE SOIL

SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA

NSWC CRANE

CRANE, INDIANA

CONTRACT NUMBER	
N4267	
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APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 6 - 7	1

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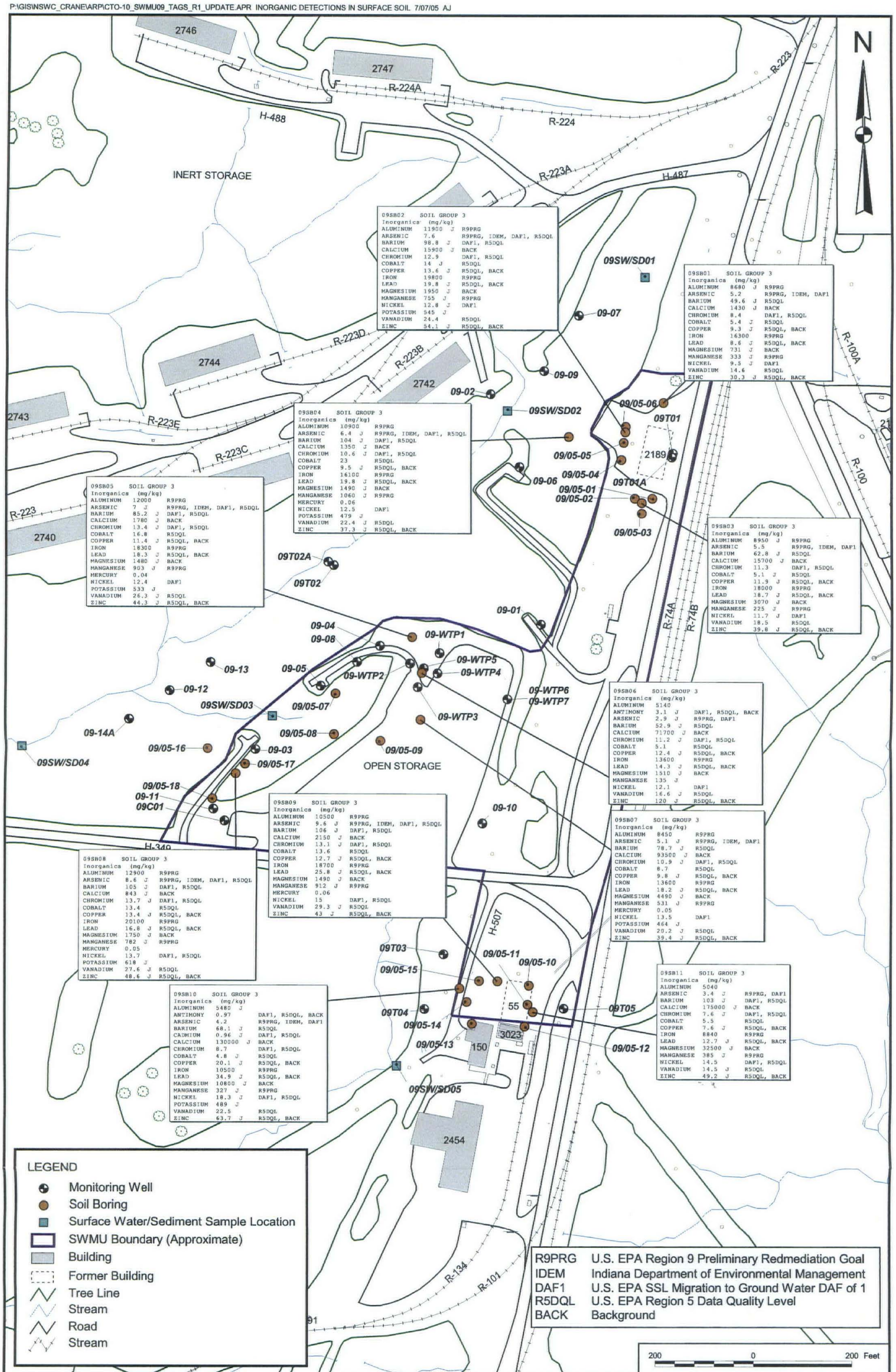

DRAWN BY	DATE
K. PEILA	5/21/02
CHECKED BY	DATE
T. JOHNSTON	7/15/05
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

INORGANIC DETECTIONS IN SURFACE SOIL

SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA

NSWC CRANE

CRANE, INDIANA

CONTRACT NUMBER N4267	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 6 - 8	REV 1

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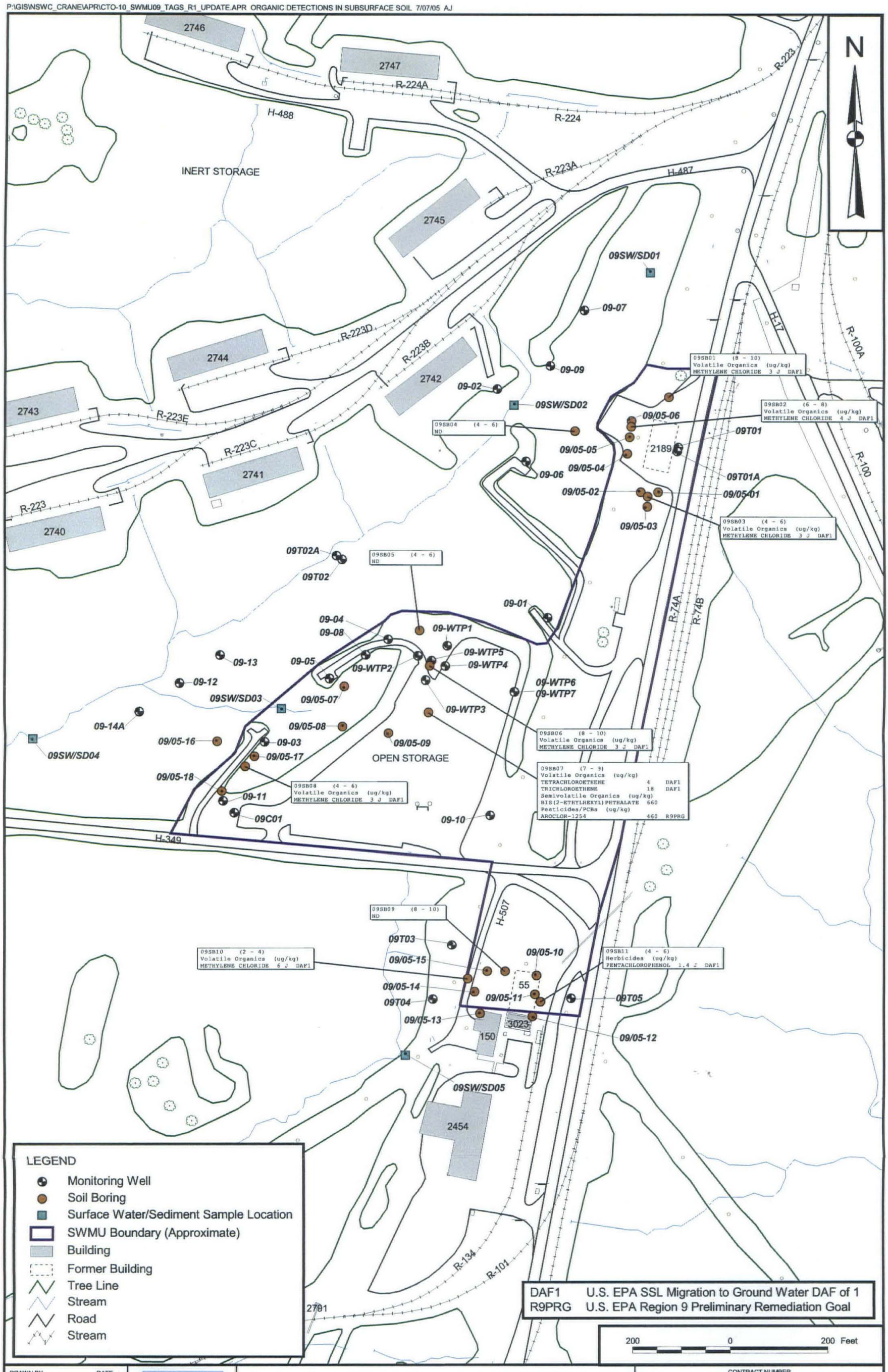

DRAWN BY	DATE
K. PEILA	5/21/02
CHECKED BY	DATE
T. JOHNSTON	7/15/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

ORGANIC DETECTIONS IN SUBSURFACE SOIL

SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA

NSWC CRANE

CRANE, INDIANA

CONTRACT NUMBER	
N4267	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 6 - 9	1

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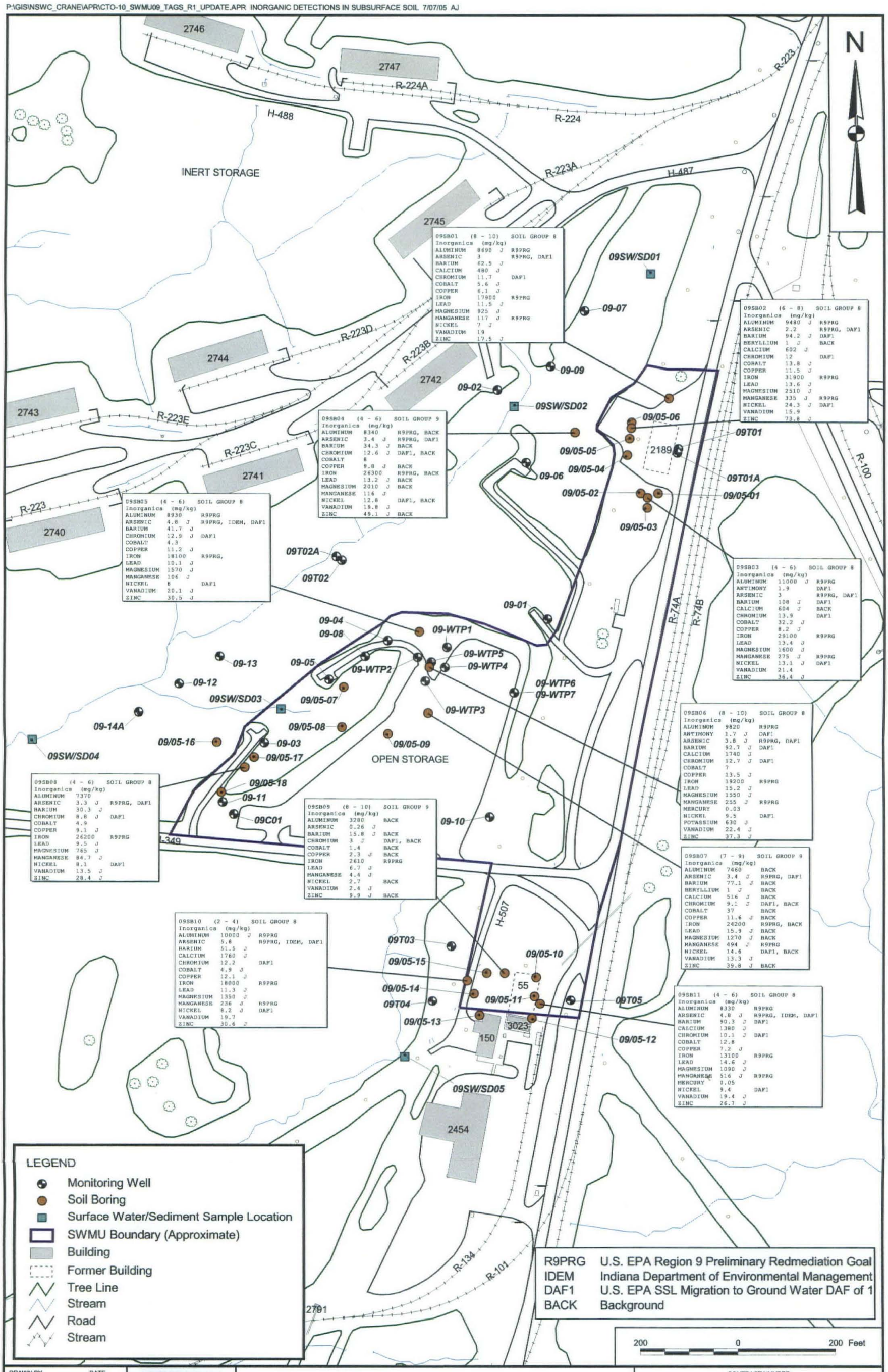

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K. PEILA	5/21/02
CHECKED BY	DATE
T. JOHNSTON	7/15/05
COST/SCHEDULE-AREA	
SCALE	AS NOTED

NAVFAC

INORGANIC DETECTIONS IN SUBSURFACE SOIL

SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA

NSWC CRANE

CRANE, INDIANA

CONTRACT NUMBER	
N4267	
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DRAWING NO. FIGURE 6 - 10	REV 1

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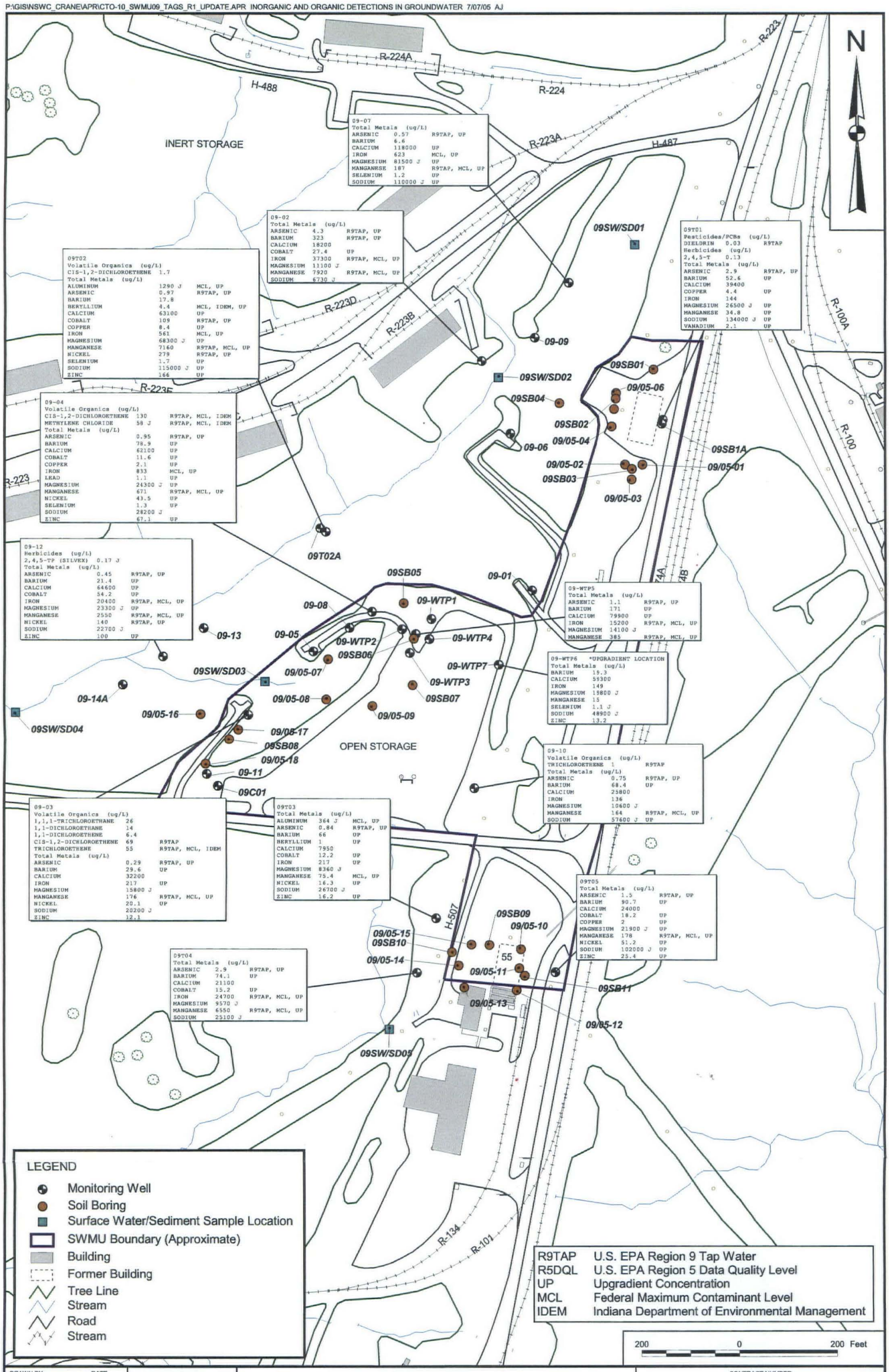

DRAWN BY	DATE
K. PEILA	5/21/02
CHECKED BY	DATE
T. JOHNSTON	7/15/05
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

INORGANIC AND ORGANIC DETECTIONS IN GROUND WATER

SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA

NSWC CRANE

CRANE, INDIANA

CONTRACT NUMBER N4267	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 6 - 11	REV 1

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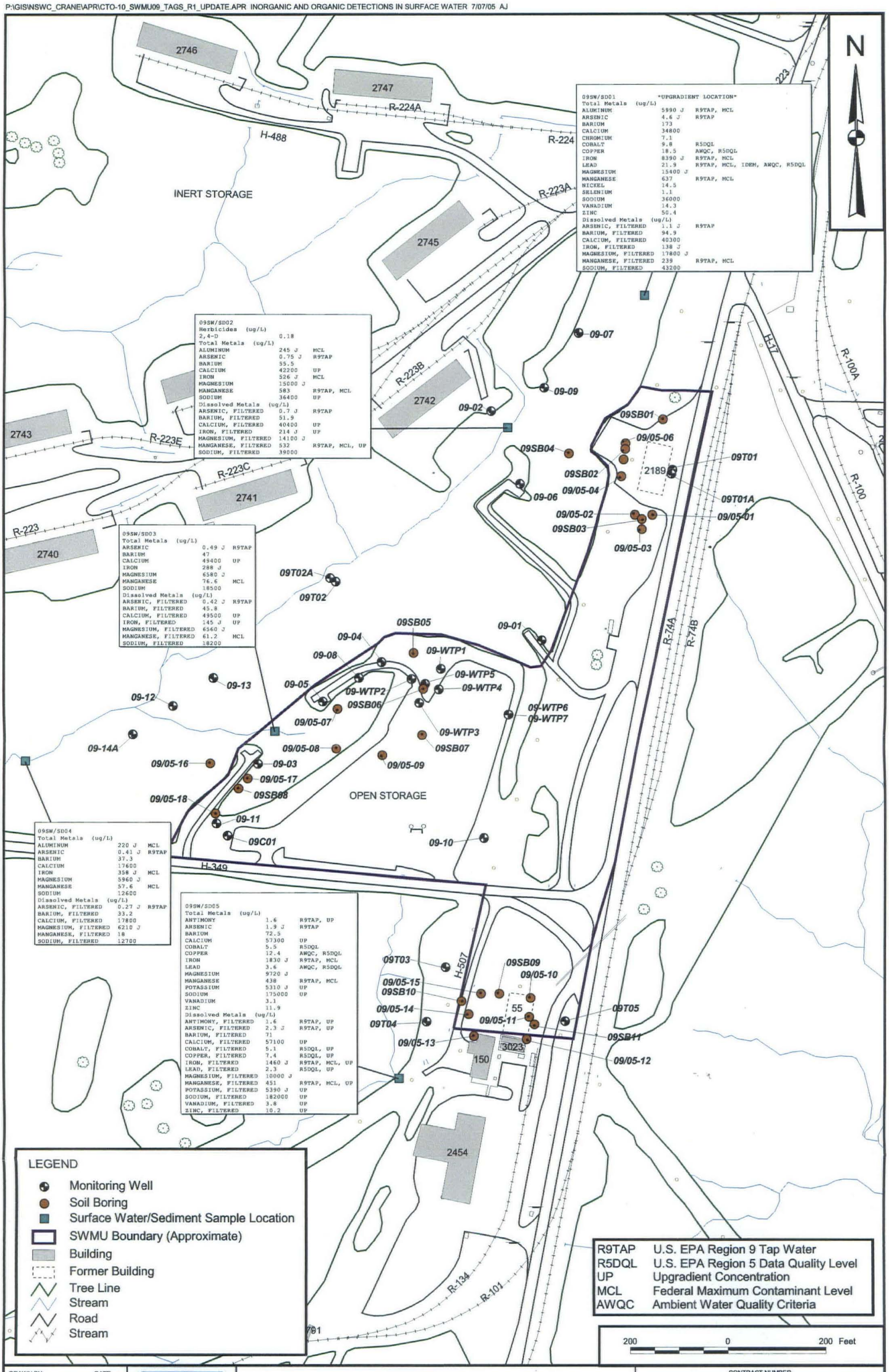

DRAWN BY	DATE
K. PEILA	5/21/02
CHECKED BY	DATE
T. JOHNSTON	7/15/05
COST/SCHEDULE-AREA	
SCALE	AS NOTED

NAVFAC

INORGANIC AND ORGANIC DETECTIONS IN SURFACE WATER

SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA

NSWC CRANE

CRANE, INDIANA

CONTRACT NUMBER	
N4267	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 6 - 12	REV 1

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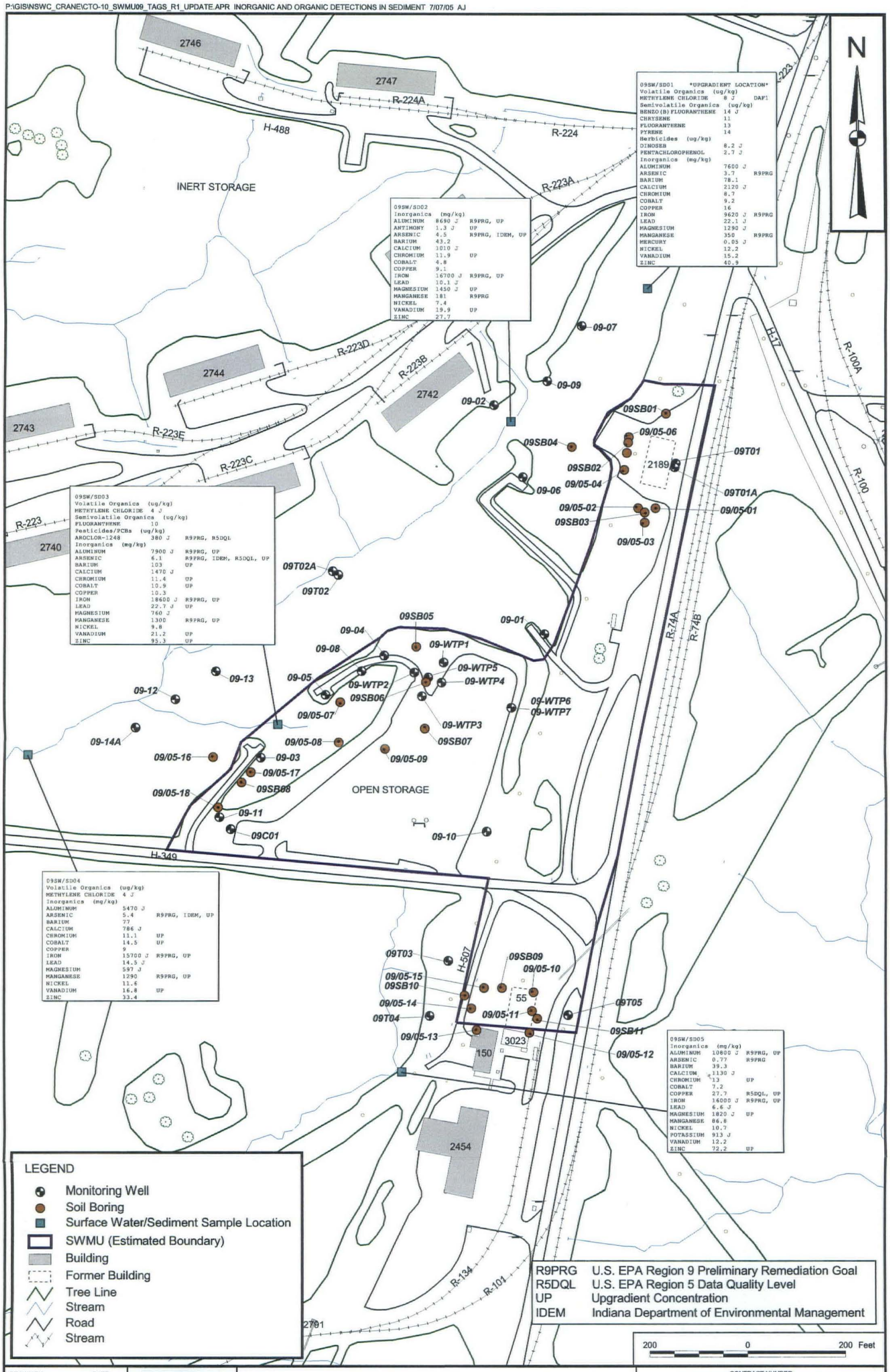


DRAWN BY	DATE
K. PEILA	5/21/02
CHECKED BY	DATE
T. JOHNSTON	7/15/05
COST/SCHEDULE-AREA	
SCALE	AS NOTED

NAVFAC

INORGANIC AND ORGANIC DETECTIONS IN SEDIMENT

SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA

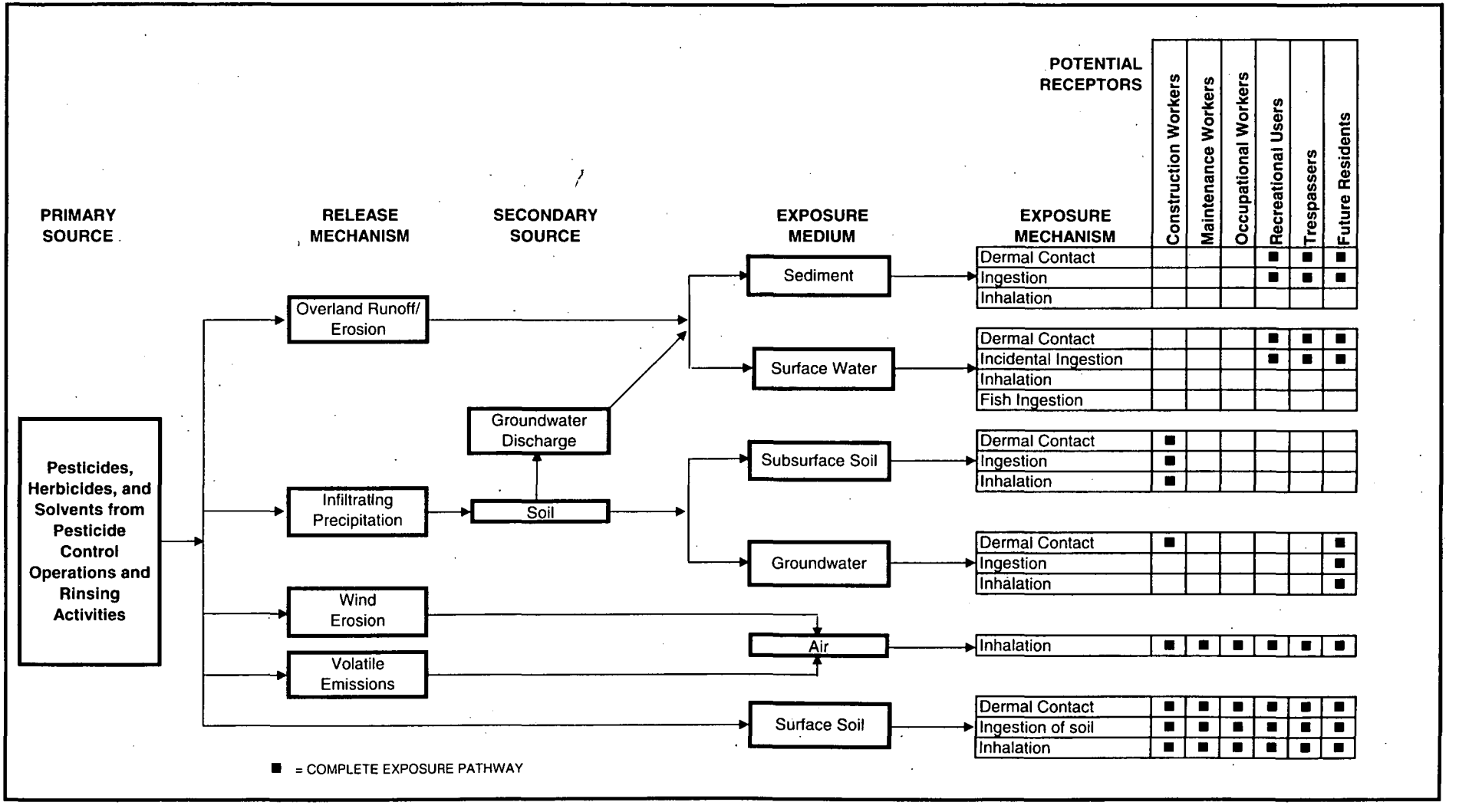
NSWC CRANE

CRANE, INDIANA

CONTRACT NUMBER	
N4267	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 6 - 13	1

FIGURE 6-14

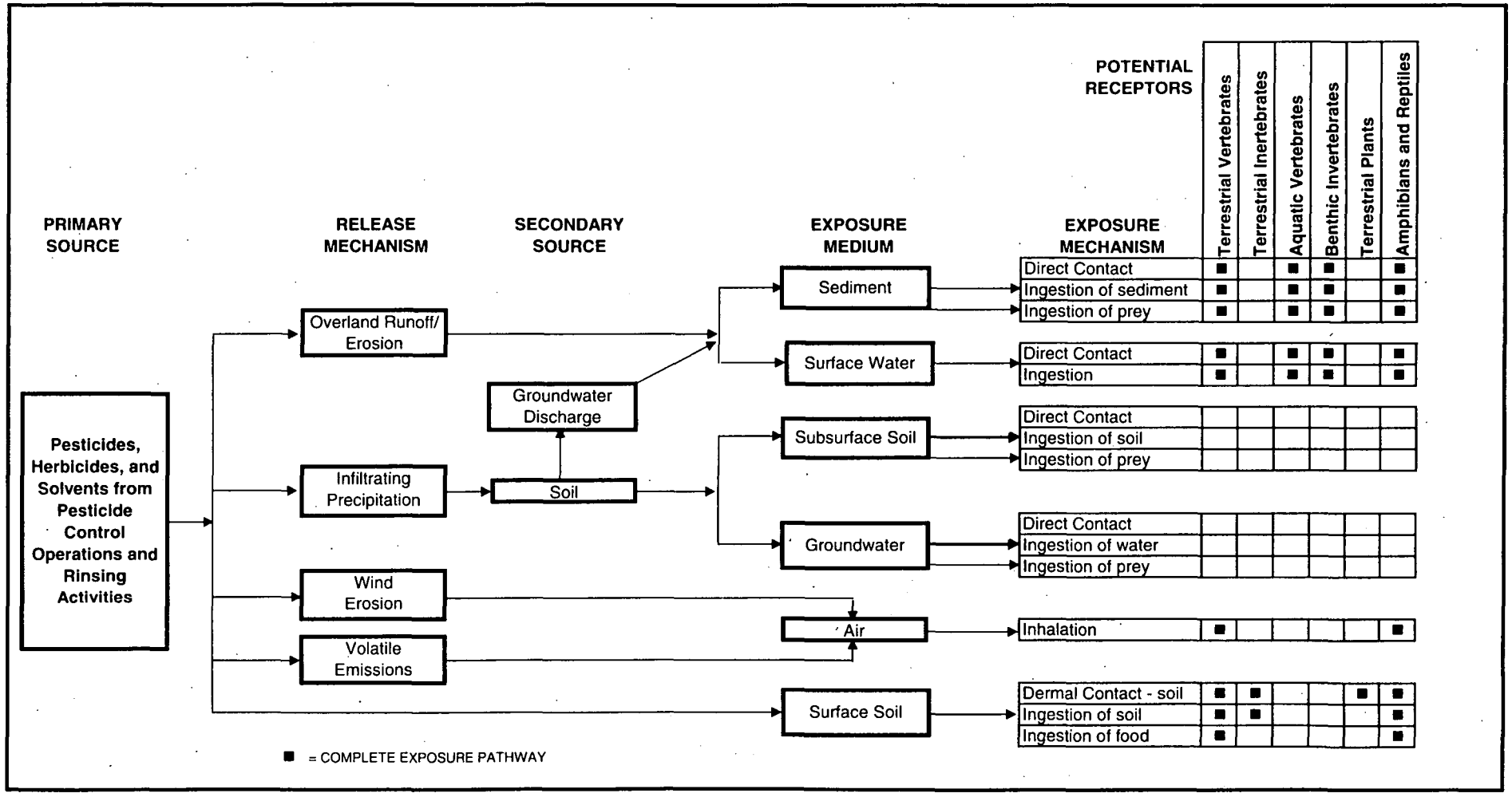
HUMAN HEALTH CONCEPTUAL SITE MODEL
SWMU 9 - PESTICIDE CONTROL / R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA



Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

FIGURE 6-15

ECOLOGICAL CONCEPTUAL SITE MODEL
SWMU 9 - PESTICIDE CONTROL/R-150 TANK AREA
NSWC CRANE, CRANE, INDIANA



Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

7.0 SWMU 10

This section describes the SWMU 10 (Rockeye) site investigation, physical characterization, nature and extent of contamination, human and ecological risk assessments, and conclusions. References are provided to other sections of the RFI report for relevant background information and general data evaluation procedures.

7.1 BACKGROUND

Section 1.4.4 contains a description of Rockeye. Section 1.5.4 contains a discussion of historical data collection activities. Section 1.6.3 summarizes information on constituents found in environmental media that may be attributable to historical operations at SWMU 10. These constituents of concern were used as the basis for the SWMU 10 site investigation described in this section.

7.2 SITE INVESTIGATION

The primary objective of the field investigation was to collect field and laboratory data needed to evaluate the potential risks for human and ecological receptors. Figure 7-1 includes the sample locations. Table 7-1 summarizes the sampling and analysis for SWMU 10, Rockeye.

As depicted on Table 7-1, environmental samples collected from the site were analyzed for a various field and laboratory parameters. Field parameters were collected for ground water and surface water samples. Typical water-quality indicator parameters, such as turbidity, pH, dissolved oxygen, specific conductance, oxidation reduction potential, and temperature, were collected for these samples. Soil samples collected at the site were screened for VOCs using monitoring equipment (PID) and visually observed for signs of staining or saturation.

All soil, sediment, ground water, and surface water samples collected at Rockeye were analyzed for explosives, TAL metals plus tin, and cyanide. Selected ground water samples were analyzed for Appendix IX VOAs and SVOAs. Filtered surface water samples were analyzed only for dissolved metals. Surface water samples also were also analyzed for, hardness, and TSS, and sediment samples were analyzed for TOC to assist in assessing the potential risks for ecological receptors. Additionally, soil characteristic parameters (CEC, pH, and TOC) were collected to determine the likelihood of the potential fate and transport of contaminants at the site (and the potential for risks outside the site boundaries). Low flow sampling techniques were used to collect ground water samples to minimize turbidity to less than 10 NTU. A filtered sample was collected at one location. The turbidity was greater than 10 NTU.

As noted previously, Figure 7-1 illustrates the sampling locations for the field investigation at Rockeye. The rationale for the collection of these samples is as follows:

- Surface/subsurface soils (20 samples): To assess the potential risks associated with residual soil contamination at SWMU 10, 10 soil borings were installed at the site. Eight of the soil borings (10SB01 through 10SB08) focused on the sumps and discharge areas around the five main buildings of the facility. One boring (10SB09) was placed to evaluate soil conditions in an area where "pink water" discharges pooled. A boring (10SB10) was placed near Building 2726C because it is historically documented that a chlorination tank for the now incapacitated sewage treatment plant was present in this area. One surface and one subsurface sample (for a total of 20) were collected from each soil boring. Surface soil samples were collected from a depth of 0 to 2 feet bgs. Subsurface intervals (2 to 10 feet bgs) were screened and selected based on the presence of organic contamination (highest PID readings), staining, or saturation. Random subsurface intervals were selected if screening indicators were absent. One soil sample collected at 10SB03 was analyzed for SVOCs. All soil samples were analyzed for inorganics and explosives.

  Ground water (20 samples): Twenty ground water samples were collected from existing single or cluster wells at the site to assess the potential risks associated with the migration of soil constituents to ground water. No new monitoring wells were installed during this field effort. The list of monitoring wells sampled are included on Table 7-1. Ground water samples from four wells (10-03, 10C52, 10C41, 10C41P3) were collected to evaluate water quality upgradient of Rockeye. These four wells were analyzed for VOCs, SVOCs, inorganics, and explosives. "Ultimately, ground water elevations would show that only well 10C52 was a suitable upgradient well, and only for the Lower Pennsylvanian aquifer. No suitable upgradient samples were collected for other water bearing units." Two cohorts (10C31 and 10C31P3) of one well cluster characterize ground water affected by the central active area of the production facility between Buildings 2734 and 2731. These two wells were also analyzed for VOCs, SVOCs, inorganics, and explosives. During the RFI studies, wells 10-17 and 10C55, which are downgradient of the active area of the site, consistently showed the highest concentrations of explosives. Impacts to ground water north (downgradient) of the site were determined by sampling monitoring wells 10C33, 10C33P2, 10C55, 10C55P2, 10-17, and 10C57. Of these wells, only 10C55 and 10C55P2 were analyzed for VOCs and SVOCs. All six downgradient wells were analyzed for inorganics and explosives. The connection of ground water and surface water at Sulphur Creek was evaluated by measuring the quality of ground water in well 10-02, which is located approximately 1,500 feet east of the site. Samples were collected from wells 10C35 and 10C35P2 to evaluate the ground water migration northwest of Rockeye. Two cohorts (10C37 and

10C37P3) of one well cluster were sampled to assess ground water migration west of the site. One monitoring well, 10-16, was used to assess ground water quality east of the site. Ground water wells used to measure round water quality or migration were analyzed for inorganics and explosives. Two wells (10C26 and 10C26P3) located in the south-central area of the site near Building 2726C were sampled. The samples were analyzed for only VOCs and SVOCs to determine the impact on surface water quality from an historical solvent tank.

- Surface Water and Sediment (12 samples): To determine the potential risks associated with migration (ground water discharge and surface runoff) of ground water and soil chemicals to surface water and sediment, collocated surface water and sediment samples were collected from 12 off-site locations. Prior to 1978, explosive-contaminated wastewater collected in sumps on the northern side of Buildings 2734 and 2731 and was released to several drainageways that lead to various tributaries and/or creeks. Samples from six stations (10SW/SD01, 10SW/SD02, 10SW/SD03, 10SW/SD04, 10SW/SD05, 10SW/SD06) were used to evaluate contributions of affected runoff from the northern and eastern drainageways, which lead to a tributary of Sulphur Creek. 10SW/SD08 assessed impacts of runoff northwest of the site. West of the site, runoff from the Area A drainageway, which leads to a tributary of Furst Creek, was assessed by the collection of samples at two stations (10SW/SD09 and 10SW/SD10). Contributions from the southern side of the facility to Turkey Creek was determined by collecting samples at two stations (10SW/SD11 and 10SW/SD12) near drainageways. Samples from 10SW/SD07 were used to evaluate contributions of pink water discharge that pooled.

Section 2 contains details on field sampling procedures.

The data collected during the field investigation were used to assess potential risks for human and ecological receptors exposed to site media under current and/or future land use. A description of how the data obtained during the proposed field investigation were managed prior to use in the risk assessment is presented in Section 3.0. General methodologies and techniques used to calculate potential risks for the site are provided in Sections 3.3 for human health and 3.4 for ecological risk.

7.3 PHYSICAL CHARACTERISTICS

Rockeye is 10 acres in size and is located on a flattened ridge crest that separates Sulphur Creek and Boggs Creek in the north central portion of the Base. The SWMU is located on Highway 45, approximately 2 miles south of North Gate No. 1. The site map for SWMU 10, Rockeye is presented as Figure 7-1.

7.3.1 Topography/Hydrology

Rockeye is located on a topographic ridge with ground surface elevations at approximately 815 feet. The SWMU rests on a major north-south drainage divide. Drainage northeast of the divide ultimately flows toward Sulphur Creek and drainage southwest of the divide flows toward Turkey Creek. The ground surface elevation in the study area ranges from a low of 570 feet in the valley of Sulphur Creek located east of the SWMU to 860 feet along the topographic divide immediately south of the SWMU.

Several manmade drainage ditches are evident that convey stormwater away from the SWMU. These ditches typically run along the SWMU access roads, trending in a northwest-southeast pattern; and route surface water through culverts until exiting the SWMU. Flow in the ditches follows the regional surface water divide patterns as dictated by topography, and ultimately lead to streams that discharge into either Sulphur Creek or Turkey Creek.

7.3.2 Geology

An extensive geologic and hydrogeologic investigation of Rockeye was performed by the U.S. Army Corps of Engineers (U.S. ACE) and is detailed in a report titled "RCRA Facility Investigation, Phase III Ground Water Release Characterization, SWMU 10/15 Rockeye Facility, Naval Surface Warfare Center Crane, Indiana, 1998 (U.S. ACE, August 1998). That investigation included the drilling and installation of over 100 monitoring wells in multiple geologic and hydrogeologic units of interest. No monitoring wells were installed during the TtNUS investigation performed in 2001. A summary of the findings of the U.S. ACE investigation that focuses on those issues that are critical to this RFI is included in the remainder of this section. Figures contained in the U.S. ACE report have been reprinted in this document to support the discussion.

The U.S. ACE subsurface investigation focused primarily on the upper 150 feet of material beneath the SWMU, which included those units most likely to become impacted by SWMU activities. The majority of wells installed at this SWMU (all wells except five, see Figure 7-1 and Table 2-4) were installed above a continuous shale (defined as the basal shale) that was encountered in the Pennsylvanian bedrock at an approximate elevation of 725 amsl (see Figure 7-2). Five borings investigated the Mississippian bedrock below the Pennsylvanian basal shale.

The U.S. ACE investigation included the installation of wells in clusters and at solitary locations, and up to three hydrogeologic zones of interest were defined and investigated above the basal shale. Those units

were named the upper, middle, and lower aquifers; and were generally grouped based on having relatively similar well screen elevations and potentiometric surface elevations.

Rockeye is located on a high point overlying Pennsylvanian rocks that were modified by the cut and fill process for construction of the facility. Farther east, the area is dissected by Sulphur Creek, exposing Mississippian rocks in the stream valley. The subsurface materials encountered beneath Rockeye include fill, natural unconsolidated materials derived from the Pennsylvanian rocks, the Pennsylvanian bedrock, and Mississippian bedrock. A generalized hydrogeologic cross section is included in Figure 7-2 and more detailed cross sections are included in Appendix A.4.2.

Fill material exists in lowland areas that were regraded with surrounding natural. The fill exists predominantly in the eastern portion of the SWMU and is up to 13 feet thick (see cross section D-D' in Appendix A.4.2). The fill consists predominantly of silty clay. The fill directly overlies the natural unconsolidated materials in all areas, except in the vicinity of boring 10C26, where the fill directly overlies the bedrock.

Natural unconsolidated materials underlie the fill where present or are present at the ground surface in other areas. The natural unconsolidated materials, which consist of residual soils derived from the Pennsylvanian, are generally 10 feet thick and consist predominantly of clay. Residual soils derived from the Mississippian have also been mapped along the valley sides of Sulphur Creek, located east of the SWMU.

The bedrock units beneath Rockeye consist of the Pennsylvanian units and the underlying Mississippian units. The Pennsylvanian consists of alternating units of shale, sandstone, siltstone, and coal. The materials comprising the Pennsylvanian were found to be thin and laterally discontinuous, based on depositional environment; which prompted extensive mapping by the U.S. ACE. Ten depositional facies (defined as thin, laterally discontinuous units) were identified, mapped, and detailed in the U.S. ACE report.

Several of the sandstone facies mapped and identified by the U.S. ACE (massive, cross bedded, and ripple bedded sandstone facies) were found to dominate three identified channel sandstones. These channel sandstones were identified as sandstones A, B, and C (see Figure 7-3 for Isopach maps and Appendix A.4.2 for additional cross sections), and are labeled in order from the deepest "A" and, therefore oldest; to the shallowest "C" and youngest. These sandstones were identified as potentially excellent aquifer material. Sandstone "A" occupies the eastern two-thirds of the SWMU, sandstone "B" occupies

the north-central two-thirds of the SWMU, and sandstone "C" occupies the southeast corner of the SWMU.

An intermediate shale facies unit exists between the sandstone "A" and the overlying sandstone "B" and "C" units. The surface of the shale has been mapped and is shown on Figure 7-4. Of particular interest is the absence of shale in the northwest and northeast corners of the SWMU, as well as an isolated area in the western portion of the SWMU. The surface of the shale is also highest at the east side and southwest corners of the SWMU with an undulating slope to the north-northwest. The thickness of this shale is greatest in the southeast and southwest corners of the SWMU (greater than 20 feet thick, see Figure 7-5), and tapers to those areas where the shale is nonexistent.

A continuous basal shale exists within the Pennsylvanian bedrock underlying the SWMU. The basal shale is reported to range in thickness from 2 to 12 feet, and is defined as a persistent aquiclude by the U.S. ACE. The surface of this shale has also been mapped as shown on Figure 7-6. The shale is at its highest elevation in the eastern portion of the SWMU and follows an undulating slope toward the west, which is consistent with the reported westward regional dip of bedrock units in this area.

The Pennsylvanian bedrock units underlying the basal shale have not been extensively investigated. An unconformity forms the contact between the Pennsylvanian bedrock and the underlying Mississippian units. The Mississippian geologic units underlying the unconformity are from youngest to oldest, the Hardinsburg shale, Golconda/Haney Limestone, Indian Springs shale, Big Clifty Sandstone, Beech Creek Limestone, Elwren shale, Sample Formation, and Beaver Bend Limestone.

7.3.3 Hydrogeology

Three discrete aquifers were identified and monitored in the Pennsylvanian beneath Rockeye. Those aquifers were identified as the Upper, Middle, and Lower Aquifers. Monitoring wells were also installed into four other deeper geologic units in the Mississippian including the Golconda/Haney Limestone, Beech Creek Limestone, Big Clifty Sandstone, and Sample Formation.

Ground water is present in predominantly the bedrock beneath the SWMU; however, one well 10C55P2, encountered ground water in fill at a depth less than 10 feet. This well is located in a topographic low point at the SWMU. No ground water was found in the unconsolidated natural material at the site as it is relatively thin (generally 10 feet) and comprised primarily of clay.

The Upper Aquifer, which is the shallow aquifer at the site, generally follows topography and flows from topographic high points to low areas (Figure 7-7). The channel Sandstone C unit occupies a portion of the upper aquifer in the southeastern corner of the facility. Ground water in the upper aquifer appears to be unaffected by the presence of this unit. The Upper Aquifer is reported by U.S. ACE to drain vertically into the middle aquifer through Sandstone B, in the northeastern portion of the SWMU area. This belief is confirmed by comparison of potentiometric surface water elevations in middle aquifer wells that are more representative of the upper aquifer potentiometric surface, and the lack of shallow ground water at the expected depth where upper aquifer ground water should exist. Ground water in the Upper Aquifer flows at a gradient of about 0.04. A geometric mean of hydraulic conductivity values for this unit is 1.8×10^{-4} feet/second. A seepage velocity for the Upper Aquifer was calculated to be 4.5×10^{3} feet/year. Seepage velocity calculations are contained in Appendix B.1.

The middle aquifer is defined by U.S. ACE as the water-yielding unit above the intermediate shale at an elevation of 770 feet upwards to about 790 feet. This aquifer corresponds fairly well with the Sandstone B unit. Wells outside of the mapped extent of the Sandstone B unit are typically dry, or have potentiometric surface elevations that are more representative of the overlying upper aquifer, implying a hydraulic connection in these areas. The potentiometric surface contour map of the middle aquifer is included in Figure 7-8. Ground water in the middle Aquifer flows from the east and west to a trough, then in a southward direction at a gradient of 0.2. A geometric mean of hydraulic conductivity values for this unit is 1.59×10^{-4}. A seepage velocity for the Middle Aquifer was calculated to be 3.34×10^{3} feet/year. Seepage velocity calculations are contained in Appendix B.11.

The Lower Aquifer is defined as the water-yielding unit above the basal shale at an elevation of 725 feet, and underlying the intermediate shale at an elevation of 770 feet. This aquifer is defined to be extensive beneath the site, with varying ground water yield. Sandstone A occupies a portion of the lower aquifer. Wells installed in the lower aquifer outside of the limits of Sandstone A yielded similar potentiometric surface elevations as those wells located in Sandstone A, which supports a hydraulic connection across the entire lower aquifer. The potentiometric surface contour map of the lower aquifer is included in Figure 7-9. The potentiometric surface is highest in the southeast corner of the SWMU with ground water in this unit flowing toward the north and southwest, at a gradient of about 0.02. A geometric mean of hydraulic conductivity values for this unit is 6.08×10^{-4}. A seepage velocity for the lower Aquifer was calculated to be 1.28×10^{4} feet/year. Seepage velocity calculations are contained in Appendix B.11.

7.4 NATURE AND EXTENT OF CONTAMINATION

Soil (surface and subsurface), ground water, surface water, and sediment samples were collected from SWMU 10 and analyzed for the presence of site-related contamination during the investigation phase of this RFI. Based on analytical data obtained during this investigation, the nature and extent of contamination in the soil, ground water, surface water, and sediment at SWMU 10 are discussed on a matrix-specific basis in the following subsections.

Soil samples at each SWMU were classified according to the soil types defined in the NSWC Crane Basewide Soil Background Study (TtNUS, August 2000b). Each soil type is defined by the characteristics of soil parent material (depositional environment), depth (surface or subsurface), and grain size (sand, silt or clay). The soil types were gathered into soil groups that reflect different classifications of soil throughout NSWC Crane. SWMU 10 surface soils are classified as Group 3 and subsurface soils are classified as Groups 8 and 9. The following are descriptions of these soil types:

- Group 3 - Alluvial, Mississippian, and Pennsylvanian Surface Soil
- Group 8 - Pennsylvanian Subsurface Clay and Silt
- Group 9 - Pennsylvanian Subsurface Sand

Metal concentrations in each soil group from a given SWMU were compared to metal concentrations from the corresponding background soil group. These comparisons used the entire data set from the background study for a given soil group and all SWMU samples of the corresponding soil group. The outcome of each comparison was a classification of each metal at a given SWMU as being statistically determined to be either elevated or not elevated relative to background concentrations, unless data indicates that the contaminants (e.g., laboratory related) are from non-site related sources.

No background samples were collected for ground water, surface water, and sediment. However, one site-specific upgradient sample was collected for ground water. This upgradient sample is treated as background and a direct comparison to the upgradient value is discussed in the ground water section.

The SWMUs 4, 5, 9, and 10 work plan (TtNUS, August 2000a) provides a tabular summary and text discussing historical analytical results for SWMU 10 media. These data are not included in this nature and extent discussion because they were not used in the risk assessments. However, some discussion from the work plan as relevant is referenced in this nature and extent discussion for SWMU 10.

7.4.1 Surface Soil

As detailed in Table 7-1 and Section 7.2, 10 surface soil samples were collected to evaluate the nature and extent of contamination. All 10 surface soil samples were analyzed for Appendix IX explosives, TAL metals (plus tin), and cyanide. One surface soil sample was analyzed for Appendix IX SVOCs. Additionally, one surface soil samples was analyzed for CEC, pH, and TOC.

Table 7-2 presents a summary of the results reported for compounds detected in the surface soil samples collected from SWMU 10. Table 7-3 presents a summary of descriptive statistics for surface soil detections including range of detections, frequency of detection, location of maximum, and comparison to background. Appendix E.1.4 contains a copy of the entire analytical database for SWMU 10 surface soil. Figures 7-10 and 7-11 present a geographical depiction of organic and inorganic detections in surface soil, respectively. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R9PRG) on the tag at the affected sampling location shows this on the figures. If an inorganic chemical whose data set exceeded the surface soil background concentration was detected at a particular location, this is indicated with a "BACK" flag on the tag at all locations where soil from the same soil group was collected. If "BACK" does not appear on a tag it means that the chemical was detected at that location but the concentration of the chemical was less than the background concentration.

The area around sample location 10SB03 has recently been excavated to a depth of 10 feet and composted. The excavated area was backfilled with bioremediated soil and screened rock (i.e., represented on Tables 7-2 through 7-5 as sample 10SB030002-REM). The bioremediated soil (10SB030002-REM) was analyzed for HMX, RDX, and TNT, only. Because there is some uncertainty with regard to the chemical concentrations (i.e., SVOCs and metals) in the backfilled soil, results from the analysis of sample 10SB030002 (except for HMS, RDX, TNT) are used for nature and extent discussion.

Semivolatile Organic Compounds

Sample 10SB030002 (which has been excavated) was the only sample analyzed for SVOCs. Analysis of this sample yielded 13 PAHs. The concentrations of PAHs ranged from 110 µg/kg (anthracene) to 990 µg/kg [benzo(a)pyrene]. This sample was collected along the northern side of Building 2734 in the location of an air discharge vent. The horizontal extent of contamination cannot be defined because this was the only sample collected. The data agree with historical data collected in this area (TtNUS, August 2000a).

The soil area that was backfilled into this location (represented by sample 10SB030002-REM) was not analyzed for SVOCs. Therefore, the current nature and extent of possible SVOC contamination at this site cannot be evaluated.

Explosives

The explosive compounds 2-amino-4,6-dinitrotoluene, HMX, and RDX were detected in these surface soil samples. 2-Amino-4,6-Dintrotoluene was detected in sample 10SB090002 at a concentration of 0.53 mg/kg. HMX was detected in samples 10SB020002 (1.3 mg/kg), 10SB030002-REM (44.3 mg/kg), 10SB040002 (5.0 mg/kg), 10SB050002 (55 mg/kg), and 10SB070002 (4 mg/kg). RDX was detected in samples 10SB020002 (1.6 mg/kg) and 10SB030002-REM (0.71 mg/kg).

Sample 10SB010002 was collected near the northeastern corner of Building 2734 and contained no explosive compounds. Samples 10SB020002, 10SB030002-REM, and 10SB040002 were collected around the perimeter of Building 2734 and contained varying concentrations of explosive compounds. Samples 10SB050002 (northwestern corner) and 10SB060002 (northeastern corner) were collected on the northern side of Building 2731. Sample 10SB050002 contained HMX at a concentration of 55 mg/kg, and sample 10SB060002 did not yield any explosive compound detections. Samples 10SB070002 (northwest) and 10SB080002 (northeast) were collected on the northern side of Building 2728. Sample 10SB070002 contained HMX at a concentration of 4 mg/kg, and sample 10SB080002 did not yield any explosive compound detections. Sample 10SB090002 was collected at the location of the pink water discharge (located outside the northern SWMU boundary) and yielded 2-amino-4,6-dinitrotoluene at a concentration of 0.53 mg/kg. Sample 10SB100002 was collected at the location of the former solvent tank on the southern border of SWMU 10. No explosive compounds were detected at this location.

Metals

As shown in Table 7-3, 18 metals were detected in the surface soil samples. Antimony, selenium, silver, sodium, thallium, and tin were not detected in any of these surface soil samples. Of the 18 detected metals, calcium and magnesium were the only metals detected at concentrations statistically determined to be greater than background concentrations. Even though calcium and magnesium were the only metals detected above background, they are considered to be essential nutrients and will not be discussed any further. Since no other metals were detected above background, for surface soils, the metals concentrations detected in surface soil will not be discussed further.

As shown in Figure 7-11, metals are frequently detected but are not detected in an apparent spatial pattern. It is unlikely that these metals concentrations are related to site activities, as evidenced by no non-essential nutrient metal concentrations in excess of background concentrations. Additionally, concentrations of metals in surface soil are less than the most sensitive risk-based screening level (see HHRA Section 7.6.1).

Miscellaneous Parameters

Cyanide was analyzed in all ten surface soil samples. Cyanide was not detected in any surface soil sample. Only samples 10SB020002 and 10SB080002 were analyzed for TOC, CEC, and pH. TOC in sample 10SB020002 was 1,900 mg/kg and in sample 10SB080002 was 1,600 mg/kg. The CEC in sample 10SB020002 was 10 MEQ/100 g and in sample 10SB080002 was 1.5 MEQ/100 g. The pH in sample 10SB020002 was 8 and in sample 10SB080002 was 8.5, which are alkaline.

7.4.2 Subsurface Soil

As detailed in Table 7-1 and Section 7.2, 10 subsurface soil samples were collected at 10 locations to evaluate the nature and extent of contamination. All 10 subsurface soil samples were analyzed for explosives, TAL metals (plus tin), and cyanide. One surface soil sample was analyzed for Appendix IX SVOCs. Additionally, five subsurface soil samples were analyzed for CEC, pH, and TOC.

Table 7-4 presents a summary of the positive results reported for compounds detected in the subsurface soil samples collected from SWMU 10. Table 7-5 presents a summary of descriptive statistics for positive subsurface soil detections including range of detections, frequency of detection, location of maximum, and comparison to background. Because two different soil groups comprise subsurface soil at this SWMU, the table displays an exceedance of background concentrations if either soil group exceeded its respective background values. Figures described below indicate background exceedances for soil group-specific comparisons. Appendix E1.4 contains a copy of the entire analytical database for SWMU 10 subsurface soil. Figures 7-12 and 7-13 present a geographical depiction of organic and inorganic detections in subsurface soil, respectively. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R9PRG) on the tag at the affected sampling location shows this on the figures. If an inorganic chemical whose data set exceeded the subsurface soil background concentration was detected at a particular location, this is indicated with a "BACK" flag on the tag at all locations where subsurface soil from the same soil group was collected. If "BACK" does not appear on a tag it means that the chemical was detected at that location but the concentration of the chemical was less than the background concentration.

The area around sample location 10SB03 has recently been excavated to a depth of 10 feet and composted. The excavated area was backfilled with bioremediated soil and screened rock (i.e., represented on Tables 7-2 through 7-5 as sample 10SB030810-REM). The bioremediated soil (10SB030810-REM) was analyzed for HMX, RDX, and 2,4,6-trinitrotoluene, only. Because there is some uncertainty with regard to the chemical concentrations (i.e., SVOCs and metals) in the backfilled soil, results from the analysis of sample 10SB030810 (except for HMX, RDX, and TNT) are used for nature and extent discussion.

Semivolatile Organic Compounds

Sample 10SB030810 was the only subsurface soil sample analyzed for SVOCs. Analysis of this sample yielded the detection of acenaphthene and di-n-octyl phthalate. The concentration of acenaphthene was 11 µg/kg and the concentration of di-n-octyl phthalate was 1,400 µg/kg. This sample was collected along the northern side of Building 2734 in the location of an air discharge vent. The horizontal extent of PAH contamination cannot be defined since this was the only sample collected.

Explosives

The SWMU 10 subsurface soil data set prior to inclusion of sample 10SB030810-REM contained only HMX in one subsurface soil sample 10SB090204 at a concentration of 0.57 mg/kg. Boring 10SB09 was drilled at the location of the pink water discharge (located outside the northern SWMU boundary). HMX was not detected in the surface soil collected from this location; however, the compound 2-amino-4,6-dinitrotoluene (0.53 mg/kg) was detected. No other explosive compounds were detected in SWMU 10 subsurface soil samples other than in the bioremediated soil sample 10SB030810-REM.

Soil sample 10SB030810-REM contained 2,4,6-trinitrotoluene at a concentration of 0.53 mg/kg, HMX at a concentration of 44.3 mg/kg, and RDX at a concentration of 0.71 mg/kg.

Metals

As shown in Table 7-5, 17 metals were detected in the subsurface soil samples. Of these 17 metals, none of the detected metal concentrations were in excess of their respective background concentrations, except at location 10SB09. Beryllium, cadmium, selenium, silver, sodium, thallium, and tin were not detected in any of these subsurface soil samples. Three of the detected metals (calcium, potassium, and magnesium) are considered to be essential nutrients and will not be discussed any further.

One subsurface soil sample exhibited metal concentrations greater than the background concentrations. The few exceedances at all locations except 10SB09 were for the two essential nutrients, calcium, magnesium, and are not discussed further because these metals are not a risk concern. The concentrations of several metals in subsurface soil sample 10SB090204 were greater than background concentrations. However, this appears to be an artifact of having only one background soil sample for Soil Group 9. On average, the probability of obtaining a result at the SWMU 10 that is greater than the single background value is 50% when there is just one site sample of the same soil group. The observed rate of background exceedances (16 out of 23 metals, or 70%) is not inconsistent with this expectation. Furthermore, the range of metal concentrations in sample 10SB090204 are comparable to the other subsurface soil metal concentrations at SWMU 10, indicating that sample 10SB090204 does not reflect soil contamination. To be conservative, however, the tags of Figure 7-13 show a "BACK" flag for all detected metals in sample 10SB090204 because the background comparison showed those metal concentrations to exceed the background concentration and no data are available to demonstrate otherwise.

As shown in Figure 7-13, the concentrations of metals detected across SWMU 10 subsurface soil are similar to each other (i.e., within one order of magnitude). These metals are frequently detected but are not detected in an apparent spatial pattern. These metals were also detected in surface soil but at concentrations comparable to background concentrations. Concentrations of metals in subsurface soil are lower than the most sensitive risk-based screening levels (see HHRA Section 7.6.1).

Miscellaneous Parameters

Cyanide was not detected in SWMU 10 subsurface soil. Samples 10SB010810, 10SB040305, 10SB060507, 10SB090204, and 10SB100608 were analyzed for miscellaneous parameters. TOC concentrations ranged from 2,000 mg/kg to 3,200 mg/kg. The CEC ranged from 7.8 MEQ/100 g to 10 MEQ/100 g. The pH ranged from 5.2 to 7.7, which is slightly acidic to near-neutral.

7.4.3 Ground Water

As detailed in Table 7-1 and Section 7.2, 18 ground water samples and one upgradient ground water (10GWC5201) sample were collected to evaluate the nature and extent of contamination. Sample 10GWC5201 was analyzed for Appendix IX VOCs, Appendix IX explosives, TAL metals (plus tin), cyanide, nitrate, and nitrate/nitrite. Nine ground water samples were analyzed for Appendix IX VOCs. Seventeen ground water samples were analyzed for Appendix IX explosives, total TAL metals (plus tin),

and cyanide. Eighteen ground water samples were analyzed for nitrate/nitrite. One of the samples was also analyzed for dissolved TAL metals (plus) tin.

Table 7-6 presents a summary of the positive results reported for compounds detected in the ground water samples collected from SWMU 10. Table 7-7 presents a summary of descriptive statistics for positive ground water detections including range of detections, frequency of detection, location of maximum, and comparison to upgradient concentration. Appendix E.1.4 contains a copy of the entire analytical database for SWMU 10 ground water. Figure 7-14 presents a geographical depiction of organic and inorganic detections in ground water. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R9TAP) on the tag at the affected sampling location shows this on the figure. If an inorganic chemical whose data set exceeded the upgradient ground water concentration was detected at a particular location, this is indicated with a "UP" flag on the tag at the affected location. If "UP" does not appear on the tag it means that the chemical was detected at that location but the concentration of the chemical was less than the upgradient concentration.

Volatile Organic Compounds

No VOCs were detected in SWMU 10 ground water samples.

Explosives

The explosive compounds 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, 2,6-dintrotoluene, 2-amino-4,6-dintrotoluene, 4-amino-2,6-dintrotoluene, HMX, and RDX were detected in the ground water samples. 1,3,5-Trinitrobenzene was detected in samples 10GW1701 (3.5 µg/kg) and 10GWC5501 (2.7 µg/kg). 2,4,6-Trinitrotoluene was detected in wells 10-17, 10C55, and 10C55P2 at concentrations of 26 mg/kg, 56 µg/kg, and 5.8 µg/kg, respectively. 2,6-Dinitrotoluene was only detected in sample 10GWC5501 at a concentration of 1.5 µg/kg. 2-Amino-4,6-dinitrotoluene was detected in wells 10-17, 10C55, and 10C55P2 at concentrations of 20 µg/kg, 2.8 µg/kg, and 7.2 µg/kg, respectively. 4-Amino-2,6-dinitrotoluene was detected in wells 10-17, 10C55, 10C55P2, and 10-02 at concentrations of 18 µg/kg, 3.7 mg/kg, 15 µg/kg, and 1.7 µg/kg, respectively. HMX was detected in wells 10-17, 10C55, 10C55P2, and 10-02 at concentrations of 240 µg/kg, 59 µg/kg, 91 µg/kg, and 12 µg/kg, respectively. RDX was detected in wells 10-17, 10C55, 10C55P2, and 10-02 at concentrations of 33 µg/kg, 240 µg/kg, 21 µg/kg, and 4.9 µg/kg, respectively.

No explosive compounds were detected in any of the ground water wells located within the SWMU boundary. Explosives were only detected in four wells: 10-02, 10-17, 10C55, and 10C55P2. Three of these four wells are within 300 feet of the northern SWMU border (10-17, 10C55, and 10C55P2) and not far from the pink water pool. Well 10-02 is located approximately 3,000 feet northeast of the northern site border. The detections of RDX and HMX in sample 10GW0201 were approximately one order of magnitude lower than in the other three wells. Well 10C57, which is located just north (approximately 300 feet) of well 10-17, did not contain any explosive compounds.

Metals

As shown in Table 7-7, 19 metals were detected in these ground water samples. The maximum detected concentrations of all 19 metals were in excess of respective upgradient concentrations. Antimony, chromium, silver, vanadium, and tin were not detected in these ground water samples. Four of the detected metals (calcium, magnesium, potassium, and sodium) are considered to be essential nutrients and will not be discussed any further.

Barium was detected in all 17 samples at concentrations ranging from 7.9 µg/L to 104 µg/L; the maximum concentration occurred in sample 10GW1701. Cadmium, mercury, and thallium were detected in only one sample. Cadmium and thallium were detected in sample 10GW1601 at concentrations of 4.5 µg/L and 1.2 µg/L, respectively. Mercury was detected in 10GW1701 at a concentration of 0.2 µg/L. Lead was detected in samples 10GW1601 and 10GWC37P301 at concentrations of 13.4 µg/L and 1.2 µg/L, respectively. Aluminum was detected in five of 17 samples at concentrations ranging from 416 µg/L to 22,300 µg/L with the maximum detected concentration occurring in sample 10GW1601. Beryllium was detected in four of 17 samples at concentrations ranging from 1.6 µg/L to 20.3 µg/L with the maximum occurring in sample 10GW1601. Copper was detected in six of 17 samples at concentrations ranging from 2.1 µg/L to 34.8 µg/L with the maximum occurring in sample 10GWC41P301. Nickel was detected in 12 of 17 samples at concentrations ranging from 12 µg/L to 695 µg/L with the maximum occurring in sample 10GWC31P301. Selenium was detected at concentrations ranging from 1.3 µg/L to 9.3 µg/L with the maximum occurring in sample 10GWC41P301. Zinc was detected in 12 of 17 samples at concentrations ranging from 11.8 µg/L to 1,660 µg/L with the maximum occurring in sample 10GW1601. Arsenic was detected in nine samples at concentrations ranging from 0.18 µg/L to 5.1 µg/L; the maximum was in 10GWC33P201. Cobalt was detected in 11 samples at concentrations ranging from 7.8 µg/L to 299 µg/L with the maximum occurring in sample10GW1601. Manganese was detected in 15 samples at concentrations ranging from 176 µg/L to 21,800 µg/L; the maximum was in sample 10GWC31P301.

Sample 10GWC5701 was the only ground water sample analyzed for dissolved metals. Barium, calcium, cobalt, iron, magnesium, manganese, nickel, sodium, and zinc were detected in the dissolved sample. The concentrations of these metals were similar to the concentrations detected in the total analysis (see Table 7-7). This indicates that the metals in the ground water near well 10C57 and perhaps elsewhere are predominantly dissolved.

Although the SWMU ground water metals concentrations frequently exceed the single upgradient concentration value, the concentrations are generally within those typical of ground water (Dragun, 1988). The exceptions are aluminum, beryllium, cadmium, cobalt, nickel, and manganese. The concentrations of these metals in SWMU 10 ground water exceed the typical background range by more than a factor of two. The typical maximum background concentrations for these metals, in µg/L, are: aluminum = 1000, beryllium < 10 cadmium <1.0, cobalt <10, nickel = 50, and manganese = 1000. Of these metals all but cobalt and manganese have just one exceedance of the typical maximum ground water concentration. Ironically, the second greatest manganese concentration was found in well 10C41 which is upgradient of other SWMU 10 wells. The general variability of the manganese data and this latter observation suggest that the observed manganese concentrations reflect local geology rather than contamination. Cobalt concentrations, however, exceeded the typical maximum concentration of 10 g/L in nine samples: 10GW1601 (299 µg/L), 10GWC31P301 (163 µg/L), 10GWC33P201 (17.4 µg/L),10GWC3501 (140 µg/L), and 10GWC35P201 (60.2 µg/L), 10GWC37P301 (145 µg/L), 10GWC4101 (154 µg/L), 10GWC41P301 (72.7 µg/L), and 10GWC5701 (26.7 µg/L). In addition, these concentrations are generally much greater than risk-based concentrations.

As shown in Figure 7-14, there does not appear to be a pattern of metals contamination in the ground water. The metals detected in ground water were also detected in surface and subsurface soil samples at SWMU 10. Maximum detections occurred most frequently in sample 10GW1601, which is located within the SWMU boundary. This suggests that the metal concentrations are adequately represented by the available data.

Miscellaneous Parameters

Cyanide was not detected in these ground water samples. Nitrate/nitrite was detected in nine of 18 samples analyzed, at concentrations ranging from 0.04 mg/L to 0.40 mg/L; the maximum was in sample 10GW1701.

7.4.4 Surface water

As detailed in Table 7-1 and Section 7.2, 12 surface water samples were collected to evaluate the nature and extent of contamination. All surface water samples were analyzed for Appendix IX explosives, total and dissolved TAL metals (plus tin), cyanide, hardness, nitrate/nitrite, and total suspended solids. No upgradient surface water samples were collected at SWMU 10.

Table 7-8 presents a summary of the positive results reported for compounds detected in the surface water samples collected from SWMU 10. Table 7-9 presents a summary of descriptive statistics for positive surface water detections including range of detections, frequency of detection, and location of maximum. Appendix E.1.4 contains a copy of the entire analytical database for SWMU 10 surface water. Figure 7-15 presents a geographical depiction of organic and inorganic detections in surface water. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R9TAP) on the tag at the affected sampling location shows this on the figure. If an inorganic chemical whose data set exceeded the upgradient surface water concentration was detected at a particular location, this is indicated with a "UP" flag on the tag at the affected location. If "UP" does not appear on the tag it means that the chemical was detected at that location but the concentration of the chemical was less than the upgradient concentration.

Explosives

The explosive compounds 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX were detected in these surface water samples. 2,4,6-Trinitrotoluene was detected in samples 10SW0401 (2.6 µg/L), 10SW0501 (1.6 µg/L), and 10SW0701 (4.4 µg/L). 2-Amino-4,6-dinitrotoluene was detected in sample 10SW0401 at a concentration of 0.41 µg/L. 4-Amino-2,6-dinitrotoluene was detected in samples 10SW0401 (1.1 µg/L), 10SW0501 (0.96 µg/L), and 10SW0701 (1.4 µg/L). HMX and RDX were both detected in samples 10SW0401, 10SW0501, 10SW0601, 10SW0701, 10SW0901, 10SW1101, and 10SW1201. Concentrations of HMX ranged from 6.4 µg/L to 22 µg/L; the maximum concentration was in sample 10SW0701. Concentrations of RDX ranged from 1.9 µg/L to 18 µg/L; the maximum concentration also was in sample 10SW0701.

Samples 10SW0101, 10SW02021, 10SW0301, 10SW0801, and 10SW1001 did not yield any explosive compound detections. These locations are all outside the SWMU 10 boundaries. Detection of HMX and RDX coincide in seven surface water samples. Sample 10SW0701 contains the maximum detected concentrations of 2,4,6-trinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX. The only detection of 2-amino-4,6-dinitrotoluene was found in sample 10SW0401. Sample 10SW07101 is located in the area

of the pink water discharges. Sample 10SW0401 is northeast of the site, near an area where wash water from munitions production was released (drainpipe). Explosive compounds are present in surface water extending outside the SWMU 10 boundary.

Metals

As shown in Table 7-9, aluminum, arsenic, barium, calcium, copper, iron, magnesium, manganese, sodium, and zinc were detected in these surface water samples. Three of the detected metals (calcium, magnesium, and sodium) are considered to be essential nutrients and will not be discussed any further. There are no upgradient data associated with these surface water samples.

Arsenic, barium, and iron were detected in all 12 samples. The maximum detected concentrations of arsenic and barium, 1.8 µg/L and 86.4 µg/L respectively, were found in sample 10SW0901. The maximum concentration of iron, 1,120 µg/L, was found in sample 10SW1101. Aluminum was detected in 11 of 12 samples at concentrations ranging from 213 µg/L to 837 µg/L. The maximum detected aluminum concentration was found in sample 10SW0801. Copper was detected in sample 10SW0901 at a concentration of 2 µg/L. Manganese was detected in 10 of 12 samples at a maximum concentration of 125 µg/L, in sample 10SW0801. Zinc was detected in samples 10SW0801 and 10SW0901 at concentrations of 11.2 µg/L and 113 µg/L, respectively.

All these surface water samples were also analyzed for dissolved metals. All the metals detected in the total (unfiltered samples), except aluminum and copper, were detected in the dissolved (filtered) metals samples. Additionally, antimony was detected in one of the dissolved samples (10SW0101-F). The concentrations and frequency of detection of these metals were similar to those found in the total (unfiltered) samples. The maximum detected concentrations of dissolved metals, except antimony, iron, and manganese, were detected in sample 10SW0901, which was collected in the southwestern corner of SWMU 10.

As shown in Figure 7-15, there not does appear to be a pattern of metals contamination in the surface water. These metals were also detected in surface soil, subsurface soil, and ground water samples at SWMU 10. These metals do not coincide with significant explosive detections.

Miscellaneous Parameters

Cyanide was not detected in these surface water samples. The hardness of these samples ranged from 27 mg/L to 260 mg/L, the total suspended solids ranged from 3 mg/L to 50 mg/L, and the nitrate ranged

from 0.09 mg/L to 1.6 mg/L. Sample 10SW0901 possessed the maximum hardness, total suspended solids, and nitrate values.

7.4.5 Sediment

As detailed in Table 7-1 and Section 7.2, 12 sediment samples were collected to evaluate the nature and extent of contamination. All sediment samples were analyzed for Appendix IX explosives, TAL metals (plus tin), cyanide, and TOC. No upgradient sediment samples were collected at SWMU 10.

Table 7-10 presents a summary of the positive results reported for compounds detected in the sediment samples collected from SWMU 10. Table 7-11 presents a summary of descriptive statistics for positive sediment detections including range of detections, frequency of detection, and location of maximum. Appendix E.1.4 contains a copy of the entire analytical database for SWMU 10 sediment. Figure 7-16 presents a geographical depiction of organic and inorganic detections in sediment. If the concentration of an organic or inorganic chemical exceeded a risk-based or applicable regulatory concentration criterion, a flag (e.g., R9PRG) on the tag at the affected sampling location shows this on the figure. If an inorganic chemical whose data set exceeded the upgradient sediment concentration was detected at a particular location, this is indicated with a "UP" flag on the tag at the affected location. If "UP" does not appear on the tag it means that the chemical was detected at that location but the concentration of the chemical was less than the upgradient concentration.

Explosives

The explosive compound, HMX, was detected in only one sample (10SD070006) at a concentration of 51 mg/kg. Sample 10SD070006 was collected at the location of the pink water discharge (located outside the northern SWMU boundary). This compound was also detected in the subsurface soil and surface water collected from this same area. In addition, the compound 2-amino-4,6-dinitrotoluene (0.53 mg/kg), a 2,4,6-trinitrotoluene degradation product, was detected in the surface soil in this area. Pink water derives its color from the presence of 2,3,6-trinitrotoluene, so the presence of the degradation product suggests that the 2,4,6-trinitrotoluene is degrading naturally. No other explosive compounds were detected in SWMU 10 sediment samples.

Metals

As shown in Table 7-11, 18 metals were detected in these sediment samples. Two of the detected metals (calcium and magnesium) are considered to be essential nutrients and will not be discussed any further. There are no background data associated with these sediment samples.

Aluminum, arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, vanadium, and zinc were detected in all 12 samples. Antimony was detected in three of 12 samples. Beryllium was detected in five of 12 samples. Cadmium was detected in four of 12 samples. Mercury was detected in two of 12 samples. Maximum detected concentrations of aluminum, beryllium, cobalt, copper, and nickel were present in sample 10SD080006. Maximum detected concentrations of arsenic, chromium, iron, lead, mercury, and vanadium were present in sample 10SD040006. Maximum detected concentrations of the remaining metals (barium, cadmium, manganese, and zinc) were divided among sample locations 10SD050006, 10SD120006, 10SD070006, and 10SD090006. Samples 10SD080006 and 10SD040006 are the two samples located farthest north of SWMU 10.

Concentrations of aluminum ranged from 4,430 mg/kg to 9,190 mg/kg. Concentrations of arsenic ranged from 3.1 mg/kg to 34.2 mg/kg. Chromium concentrations ranged from 9 mg/kg to 65.7 mg/kg. Iron concentrations ranged from 121,000 mg/kg to 71,100 mg/kg. Lead concentrations ranged from 13.3 mg/kg to 37 mg/kg. Manganese concentrations ranged from 165 mg/kg to 3,900 mg/kg. Vanadium concentrations ranged from 13.2 mg/kg to 63.2 mg/kg. Antimony was detected in three of 12 samples at concentrations ranging from 4,430 mg/kg to 9,190 mg/kg with the maximum detected concentration occurring in sample 10SD0506. Barium was detected in all 12 samples at concentrations ranging from 45.2 mg/kg to 276 mg/kg with the maximum occurring in sample 10SD120006. Beryllium was detected in five of 12 samples at concentrations ranging from 1.4 mg/kg to 2.1 mg/kg with the maximum occurring in sample 10SD90006. Cadmium was detected in four of 12 samples at concentrations ranging from 1.3 mg/kg to 2.4 mg/kg with the maximum occurring in sample 10SD070006. Cobalt was detected in all 12 samples at concentrations ranging from 6 mg/kg to 51.8 mg/kg with the maximum occurring in sample 10SD080006. Copper was detected in all 12 samples at concentrations ranging from 7.5 mg/kg to 126.9 mg/kg with the maximum occurring in sample 10SD080006. Mercury was detected in samples 10SD04006 (0.5 mg/kg) and 10SD040006 (0.04 mg/kg). Nickel was detected in all 12 samples at concentrations ranging from 7.5 mg/kg to 44.6 mg/kg with the maximum occurring in sample 10SD080006. Zinc was detected in all 12 samples at concentrations ranging from 36.5 mg/kg to 301 mg/kg with the maximum occurring in sample 10SD090006.

As shown in Figure 7-16, there not does appear to be a pattern of metals contamination in the sediment. These metals were also detected in surface soil, subsurface soil, ground water, and surface water samples at SWMU 10. These metals do not coincide with significant explosive detections.

Miscellaneous Parameters

Cyanide was not detected in these sediment samples. The TOC of these samples ranged from 4,000 mg/kg to 22,000 mg/kg and sample 10SD010006 possessed the maximum total organic carbon value.

7.4.6 Summary

Thirteen PAHs were detected in surface soil sample 10SB030002 at levels ranging from 110 µg/kg (anthracene) to 990 µg/kg [benzo(a)pyrene]. Acenaphthene (11 µg/kg) and di-n-octyl phthalate (1,400 µg/kg) were detected in the subsurface soil sample 10SB030810. This soil sample location, 10SB03, was located on the northern side of Building 2734 near the air discharge vent but has since been excavated and replaced with bioremediated soil. The replacement soil (10SB030002-REM and 10SB030810-REM) was not analyzed for SVOCs. Therefore, it was not possible to determine the nature and extent of potential SVOC contamination in soil at SWMU 10. No other SVOCs were detected in soil or any other media sampled at SWMU 10.

The explosive compounds 2-amino-4,6-dinitrotoluene, HMX, and RDX were detected in from one to five surface soil samples. HMX was detected in one subsurface soil sample, 10SB090204. However, HMX was not detected in the surface soil from this soil column, but 2-amino-4,6-dinitrotoluene was detected. Soil sample 10SB030810-REM contained 2,4,6-trinitrotoluene at a concentration of 0.53 mg/kg, HMX at a concentration of 44.3 mg/kg, and RDX at a concentration of 0.71 mg/kg. The explosive compounds 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, 2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX were detected in the ground water samples. The explosive compounds 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX were detected in from one to seven surface water samples. HMX was the only explosive detected in sediment. Consistent with contamination observed in other media, explosives contamination in ground water is confined to ground water wells near the pink water pooling area at the northeast boundary of the SWMU.

Sample location 10SW/SD07 was situated at the location of the pink water discharge located north of the SWMU boundary (Figure 7-16). This location contained the maximum detected concentrations of explosives in surface water and sediment samples. Downstream location 10SW/SD04 had slightly lesser concentrations of the same explosives (RDX, HMX, and 2,4,6-trinitrotoluene). Both locations had detectable concentrations of 2,4,6-trinitrotoluene degradation products (2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene), indicating that degradation of 2,4,6-trinitrotoluene is occurring. Explosives were only detected in four ground water wells: 10-02, 10-17, 10C55, and 10C55P2. Three of these four

wells are within 300 feet of the northern site border (i.e., 10-17, 10C55, and 10C55P2) and not far from the pink water pooling area. Most of these same explosives were detected in soil, ground water, surface water, and sediment during previous site investigations (TtNUS, August 2000a). The explosives contamination in surface water, sediment and ground water is limited to the northeastern and southern edges of the SWMU 10 and the observed concentrations decrease in a downgradient direction. Except in the vicinity of Building 2734, and the pink water pooling area, no soil explosives were observed to exceed risk-based criteria (no flags on tag maps, Figures 7-10 and 7-12). Thus, the degree of explosives contamination in soil appears to be limited in space and concentration. However, the continued presence of explosives in sediment suggest that releases continue, to ground water or through overland runoff or both.

Numerous metals were detected in both surface and subsurface soil samples (Figure 7-11 and 7-13, respectively). Of the metals detected in surface soil, concentrations of calcium and magnesium were present in SWMU 10 surface soils at concentrations in excess of background. All but one of the 17 metals (i.e., potassium) detected in subsurface soil samples were present at concentrations in excess of background for Soil Group 9, but no metals exceed Soil Group 8 background concentrations.

Although several metals were detected in surface and subsurface soils, the concentrations were comparable to background concentrations, except at location 10SB09. Sample 10S090204, which was classified as belonging to Soil Group 9 and that background soil group has only one value for each metal. This is believed to have created an appearance of SWMU 10 metals exceeding background concentrations when they probably do not. However, to be conservative, metals in subsurface soil group 9 that appeared to exceed background concentrations based on the background comparisons were carried forward to the COPC selection process, even though they do not appear to reflect site contamination.

Nineteen metals were detected in ground water samples collected from four different water bearing zones (Figure 7-14). On Figure 7-14, the sample labels shown on the tags are colored to show which water bearing zone they represent. Well 10C52 was selected to represent upgradient conditions for all Lower Pennsylvanian ground water samples. Only six metals were detected in this well which is located at the southeast corner of the SWMU (See Figure 7-14). There was no upgradient well for the other water bearing units, however, this did not adversely affect the selection of COPCs because COPC selection was influenced most heavily by the Lower Pennsylvanian wells, which comprised the majority of wells. All metals detected in ground water were in excess of the Lower Pennsylvanian upgradient concentrations from well 10C52 at one or more wells. Calcium, magnesium, potassium and sodium are essential nutrients and are not discussed here. Lower Pennsylvanian wells to the northeast show the greatest

metals concentrations with few exceptions. These wells are downgradient of the SWMU. Well 10-16 (Lower Pennsylvanian) showed the most frequent occurrences of upgradient exceedances. Although SMWU 10 Lower Pennsylvanian ground water concentrations commonly exceeded the single upgradient concentration, cobalt across the SMWU 10 appears to be the only significant metal contaminant in this aquifer. This is so because, of all the detected metals, the cobalt concentrations were the concentrations that were most consistently detected and were the most consistently greater than upgradient concentrations and regulatory or risk-based levels. The cobalt contamination is SWMU-wide with no obvious source(s) and exceeds risk-based concentrations at several locations. The cobalt contamination is not bounded in any direction relative to the risk-based concentrations, however, the wells to the north and east generally show lower cobalt concentrations than interior SWMU wells and the wells outside the southwest corner of the SWMU. Historical ground water data show that the maximum observed cobalt concentration (22 µg/L) reported previously was in well 10C55P2 located in the northeastern area just outside the SMWU boundary (TtNUS, 2000a). This well (10C55P2) is screened in the unconsolidated unit. If the SWMU is the source of the cobalt contamination, the greatest concentration likely to be encountered by a receptor appears to be adequately characterized by wells 10-16 and 10C31P3, which are located in the SWMU interior. The same is true for other metals. In this sense, the ground water metals contamination is adequately characterized to support the planned risk assessments. The tags on Figure 7-14 show all those metals whose concentrations exceed the upgradient concentration with a "UP" flag.

There was no upgradient surface water sample available to which downgradient samples could be compared (Figure 7-15). Despite this condition, the surface water metals concentrations are rather uniform across the site, or the downgradient locations exhibit lesser concentrations of a particular metal than the upgradient locations within the SMWU. This tends to indicate that the SMWU is not contaminated because the contamination would not be expected to be uniformly distributed across the site, or that the contamination is located within the SWMU. Few of the observed metals concentrations in surface water exceed risk-based criteria and most of the exceedances are associated with use of surface water as drinking water or ecological risk-based levels. In summary, although some risk-based concentrations are exceeded by surface water and sediment metals concentrations, the exceedances are relatively infrequent and metals concentrations at any one location are generally consistent with concentrations of the same metal at other site locations. This indicates that surface waters at SWMU 10 are not contaminated, of if they are contaminated are not much greater than expected background concentrations.

Similar to surface water, there was no upgradient sediment sample available for comparison to SMWU 10 samples (Figure 7-16). While several metals were detected in sediments, few of the observed

concentrations exceeded risk-based levels. Nickel concentrations in the southernmost sediment sampling locations (10SW/SD12 and 10SW/SD01) were the greatest of all nickel concentrations and were not bounded. Furthermore, those concentrations exceed typical surface soil nickel concentrations of 9.2 to 20 mg/kg and they exceed the EDQL for nickel in sediment. The other metals most frequently exceeding risk-based concentration limits are arsenic and cadmium. However, arsenic and cadmium concentrations are generally comparable to typical NSWC Crane surface soil concentrations (2.4 to 10 mg/kg for arsenic and 0.1 to 3.6 mg/kg for cadmium). Thus, while there are some exceedances of risk-based concentration limits, the exceedances are associated with metal concentrations that appear to be comparable to surface soils. Furthermore, surface soils, which are a common source of sediment metals contamination, did not exhibit contamination so the sediments would not be expected to have gotten contaminated from overland runoff. Despite the apparent lack of contamination in sediments, concentrations exceeding risk-based concentration limits are flagged on Figure 7-16. Almost without fail, sediment metal concentrations increase away from SWMU 10. The difference between the most upgradient and downgradient concentrations are generally within a half-order of magnitude. Such a pattern could indicate an influence from past operations that are not longer releasing metal contaminants. Because the upgradient and downgradient concentrations are not very different, this is not a significant concern.

The HHRA presented in Section 7.6.1 and the ERA presented in Section 7.6.3 provide discussions regarding metals selected as COPCs for SWMU 10.

7.5 CONTAMINANT FATE AND TRANSPORT

This section presents a brief overview of contaminant fate and transport issues at SWMU 10. This discussion focuses on some of the major types of contaminants found at the site. A description of SWMU 10 and release mechanisms at the site are provided in Section 1.4.4.

The following classes of chemicals were detected in the media of concern at SWMU 10.

Soil - PAHs, explosives, and metals
Ground water - Explosives and metals
Surface Water - Explosives and metals
Sediment - Explosives (HMX only) and metals

Fate and transport characteristics of these chemicals are briefly discussed in the following sections.

7.5.1 Polycyclic Aromatic Hydrocarbons

PAHs are generally considered to be fairly immobile chemicals in the environment. They are large molecules with high organic carbon partition coefficients and low solubilities when compared to the volatile organics. These compounds, when found in the soil, generally do not migrate vertically to a great extent. Instead, they are more likely to adhere to soil particles and be removed from the site via surface runoff and erosional processes. Their absence in ground water is evidence of their immobility. Their presence in sediment may stem from surface erosion, but their absence in surface water is consistent with their low water solubilities and their ability to bind to soil and sediment.

7.5.2 Explosives

Nitrogen-containing compounds, such as 2,4,6-trinitrotoluene, 2-amino-2,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX have relatively low K_{oc} values and tend to be fairly mobile in the environment. The K_{oc} for 1,3,5-trinitrobenzene is somewhat higher, indicating that this compound is less mobile than the other explosives. The nitrotoluenes, RDX, and HMX in water are not expected to bioconcentrate significantly and will have only a slight tendency to partition to suspended and sediment organic. 2-Amino-2,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene are likely degradation products of the other explosives.

Explosives were detected in all media sampled at SWMU 10. Their presence in ground water indicates that migration from soil to ground water has occurred. The explosives may be present on particulate matter but since they are somewhat water soluble (compared to PAHs and PCBs, for example), they may also be present in the dissolved phase. They are also likely to be more environmentally mobile than PAHs and PCBs.

7.5.3 Inorganics

Because inorganics are frequently incorporated into the soil matrix and remain bound to particulate matter, they tend to migrate from the source areas via bulk movement processes (erosion). The larger particles (greater than 0.45 microns, which are removed via the filtration step prior to water analysis) are not generally considered to be mobile in ground water.

There are some instances, however, where these metals are found at such concentrations or in such form as to be able to migrate in solution. It is possible that industrial activities could saturate all available exchange sites in soil and result in a metal being mobilized. Metals are also more mobile under acidic conditions, which may exist in areas where plating-type activities have occurred. Finally, a metal solution

may be utilized in some industrial applications. In these cases, it is possible for metals to migrate vertically through the soil column and reach the ground water.

7.6 HUMAN HEALTH RISK ASSESSMENT

This section presents the results of the human health risk assessment for SWMU 10. The risk evaluation was performed using the general methodologies presented in Section 3.3. Site-specific information regarding data evaluation (i.e., the selection of COPCs), exposure assessment, characterization of estimated potential human health risks, and specific uncertainties for the risk screening process for the site are contained in the following sections.

7.6.1 Selection of Chemicals of Potential Concern

A medium-specific discussion of the chemicals selected as COPCs for SWMU 10 is provided in this section.

7.6.1.1 Soil

This section presents the results of the COPC selection process for surface and subsurface soil. The COPC screening process and the results of the screening are presented in Tables 7-12 and 7-13 for surface soil and in Tables 7-14 and 7-15 for subsurface soil.

COPC Selection for Surface Soil

Ten surface soil samples were collected at SWMU 10 from a depth of 0 to 2 foot bgs and analyzed for explosives and inorganics. One sample (10SB030002) was also analyzed for semivolatiles. During the third quarter of 2001, the area around this sample location (10SB03) was excavated and backfilled with bioremediated soil. The bioremediated soil was analyzed for HMX, RDX, and TNT, only. Because there is some uncertainty in regard to the constituent concentrations in the backfilled soil, results from the analysis of sample 10SB030002 (except for HMX, RDX, and TNT) are used for COPC selection and in risk assessment calculations, for purposes of conservatism. Eight samples were collected on the sumps and discharge areas around the five main buildings of the facility. One sample (10SB09002) was collected to evaluate soil conditions in an area where pink water discharges pooled. One sample (10SB100002) was collected near Building 2726C because it is historically documented that a chlorination tank for the now incapacitated sewage treatment plant was present in this area. The following chemicals were retained as COPCs for surface soil:

- PAHs - benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene
- Explosives - 2-amino-4,6-dinitrotoluene and RDX

COPC Selection for Surface/Subsurface Soil

Twenty surface/subsurface soil samples were collected at SWMU 10 from depths of 0 to 10 feet bgs. Ten subsurface soil samples were collocated with the surface soil samples discussed above. One subsurface soil sample (10SB030810) was also analyzed for semivolatile organics. During the third quarter of 2001, the area around this sample location (10SB03) was excavated and backfilled with bioremediated soil. The bioremediated soil was analyzed for HMX, RDX, and TNT, only. As with surface soil, there is uncertainty in regard to the constituent concentrations in the backfilled soil. Therefore, for purposes of conservatism, results from the analysis of sample 10SB030810 (except for HMX, RDX, and TNT) are used for COPC selection and in risk assessment calculation. The following chemicals were retained as COPCs for surface/subsurface soil:

- PAHs - benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene
- Explosives - 2-amino-4,6-dinitrotoluene and RDX

These constituents were identified as COPCs in surface and subsurface soil because maximum concentrations exceeded one or more of the human health risk screening levels for residential land use (i.e., U.S. EPA Region 9 risk-based screening levels for residential soil, U.S. EPA Region 3 risk-based screening levels for residential soil, U.S. EPA generic SSLs for migration to ground water, IDEM default closure levels for direct contact and migration to ground water, and representative basewide background concentrations). The maximum concentrations were also compared to U.S. EPA SSLs for migration from soil to air (inhalation). As shown in Tables 7-13 and 7-15, the maximum concentrations of all constituents were less than the inhalation SSLs. Therefore, potential risks from inhalation of chemicals detected in soil are expected to be minimal and this pathway was not evaluated further in the risk assessment. Chemicals present at concentrations greater than screening concentrations but within representative basewide background levels [aluminum, arsenic, barium, iron, and manganese in surface soil and aluminum, arsenic, barium, cadmium, chromium (total), manganese, and nickel in surface/subsurface soil] are not considered to be site-related contaminants, were eliminated as COPCs, and were not carried through the quantitative risk assessment.

Migration from Soil to Ground water

As indicated in Tables 7-12, 7-13, 7-14, and 7-15, some constituents in soil were selected as COPCs because the maximum concentrations exceeded risk-based screening levels for residential soil exposure; some were selected as COPCs because the maximum concentration exceeded risk-based screening levels for residential soil and SSLs for migration to ground water; and one chemical [benzo(a)anthracene] was selected because the maximum concentration exceeded the SSL for migration to ground water only. Because the concentration of benzo(a)anthracene was less than the screening levels for direct contact with soil and U.S. EPA generic SSLs for inhalation, potential risks from direct exposure to this COPC in soil are expected to be minimal. However, exceedances of U.S. EPA and IDEM migration to ground water SSLs may indicate the potential for chemicals to leach to ground water and impact water quality. However, neither benzo(a)anthracene nor any other PAHs were detected in any ground water samples collected at the site. A discussion of the ground water data for SWMU 10 is provided in Section 7.6.1.2.

7.6.1.2 Ground water

Table 7-16 presents details of the COPC selection process for ground water. The COPC selection for ground water at SWMU 10 is based on analytical data from 17 unfiltered ground water samples collected from monitoring wells installed at the site. The samples were collected to assess the potential risks associated with the migration of soil constituents to ground water. One well, 10GW5201 upgradient of the site was used as background for COPC selection. The following chemicals were retained as COPCs in ground water:

- Explosives - 2-amino-4,6-dinitrotoluene, 4-amino-4,6-dinitrotoluene, 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, HMX, and RDX.

- Inorganics - aluminum, arsenic, beryllium, cadmium, cobalt, iron, manganese, nickel, thallium, and zinc.

These constituents were identified as COPCs in ground water because the maximum concentrations exceeded one or more of the human health screening levels (i.e., U.S. EPA Region 9 risk-based screening concentrations for tapwater, U.S. EPA Region 3 risk-based screening levels for tapwater, federal MCLs or SMCLs, and IDEM residential default closure levels for ground water). No chemicals were eliminated from the quantitative risk assessment on the basis of background because maximum concentrations in the site ground water samples were greater than concentrations in the upgradient well.

7.6.1.3 Surface Water

Table 7-17 summarizes the COPC selection process for surface water at SWMU 10. Twelve unfiltered (and 12 filtered) surface water samples were collected to assess risks associated with migration (ground water discharge and surface runoff) of ground water and soil chemicals to surface water and sediment. Prior to 1978, explosive-contaminated wastewater collected in sumps on the northern side of Buildings 2734 and 2731 and was released to several drainageways that lead to various tributaries and/or creeks. Samples from six stations (10SW/SD01, 10SW/SD02, 10SW/SD03, 10SW/SD04, 10SW/SD05, 10SW/SD06) were used to evaluate contributions of affected runoff from the northern and eastern drainageways, which lead to a tributary of Sulphur Creek. Location 10SW/SD08 was used to assess impacts of runoff northwest of the site. West of the site, runoff from the Area A drainageway, which leads to a tributary of Furst Creek, was assessed by samples at two stations (10SW/SD09 and 10SW/SD10). Contributions from the southern side of the facility to Turkey Creek were determined by collecting samples at two stations (10SW/SD11 and 10SW/SD12) near the Area D, F, and G and drainageways (Figure 7-15). Samples from 10SW/SD07 were used to evaluate contributions of pink water discharge that pooled near Area E (Figure 7-15). No chemicals were eliminated from the quantitative risk assessment on the basis of background because appropriate upgradient locations could not determined for SWMU 10.

The following chemicals were retained as COPCs in surface water:

- Explosives - 2-amino-4,6-dinitrotoluene, 4-amino-4,6-dinitrotoluene, 2,4,6-trinitrotoluene, and RDX
- Inorganics - aluminum, arsenic, iron, and manganese

These constituents were identified as COPCs in surface water because the maximum concentrations exceeded one or more of the human health screening levels (i.e., U.S.EPA Region 9 risk-based screening concentrations for tapwater, U.S. EPA Region 3 risk-based screening levels for tapwater (for aminodinitrotoluenes), federal MCLs or SMCLs, and IDEM residential default closure levels for ground water. The use of these criteria for surface water assumes that the surface water is used as a drinking source (i.e., potential receptors ingest 2 liters of water per day/350 days per year). Drinking water criteria are used because surface water criteria for human health are currently not available. The use of these criteria for screening and risk assessment is conservative because it is unlikely that the water in the creek or marshy area would ever be used as a source of drinking water.

7.6.1.4 Sediment

Table 7-18 summarizes the COPC selection process for sediment at SWMU 10. Twelve sediment samples collocated with the surface water samples were collected during the investigation. No chemicals were eliminated from the quantitative risk assessment on the basis of background because appropriate upgradient locations could not determined for SWMU 10.

The following chemicals were retained as COPCs in sediment:

- Inorganics - aluminum, arsenic, chromium (total) iron, manganese, and vanadium

These constituents were identified as COPCs in sediment because maximum concentrations exceeded U.S. EPA Region 9 risk-based screening levels for residential soil, IDEM default closure levels for direct contact, and concentrations in the upgradient sample. The use of the U.S. EPA Region 9 and IDEM risk-based concentrations for soil to evaluate chemical concentrations in sediment is conservative because these criteria were established assuming residential land use scenarios (e.g., routine daily contact with soils). However, it is anticipated that a human receptor would be exposed to the sediments in the streams and marshy areas of the site on a less frequent basis than is assumed for a typical residential exposure to soil. Consequently, the use of soil criteria for screening and risk estimation is likely to overestimate potential risks from exposure to sediment.

7.6.2 Exposure Assessment

This section presents the exposure assessment for SWMU 10. The general exposure assessment approach and the exposure factors, which serve as the basis of the risk assessment, are provided in Section 3.3.3.

7.6.2.1 Conceptual Site Model

The CSM for the Rockeye site, which defines the contaminant source, transport mechanisms, exposure routes, and potential receptors for the site, is presented in Figure 7-17. Based on a review of the existing data for the site, a release of hazardous constituents to the surrounding soil and drainageways has occurred as a result of historical site operations (i.e., bomb production). The historical data also indicate that contaminants have migrated to ground water via infiltration and percolation. Prior to installation of a wastewater treatment facility, sumps receiving production wastewater discharged directly to streams and/or tributaries of Furst, Sulphur, and Turkey Creeks. Additional release mechanisms, which are also expected to contribute to the contaminant transport, include discharge of ground water to surface water

and sediment, deposition via surface water runoff, and deposition of fugitive dust and volatile emissions to soils from production operations.

Land use at Rockeye is not expected to change from its present use as a munitions production facility. Based on the general scenarios and receptor classes identified in Section 4.0 of the work plan, the following potential receptors may be exposed to contaminated media at the site:

- Trespassers (ages 6 to 17 years) - Likely receptor under future land use. This receptor may be exposed to potentially contaminated surface soil, air, surface water, and sediment in tributaries of Furst, Sulphur, and Turkey Creeks. Because this site is active, it is unlikely that there would be current exposure for this receptor.

- Maintenance Workers - Likely receptor under current and future land use. Rockeye is currently maintained and this receptor may be exposed to potentially contaminated surface soil and air. Exposure to ground water at the site and surface water and sediment in the creeks is not expected to occur.

- Construction Workers - Potential receptor under current and future land use. Very infrequently, upgrading to the bonding and grounding at Rockeye occurs. This process requires excavation. No construction activities are currently planned at the site. However, the site could be developed or a small, short-term construction project, such as a utility installation, could result in exposure to potentially contaminated media. This receptor may be exposed to surface and subsurface soil, air, and ground water.

- Occupational Workers - Likely receptor under current and future land use. Currently, the site is active and receptors may be exposed to surface soil and air. Exposure to surface water and sediment is not expected to occur.

- Recreational Users - Potential receptor under future land use. If the Facility were to close, the most likely scenario is that the property would be converted into a state park. This receptor may be exposed to potentially contaminated surface soil, air, surface water, and sediment in the creeks located near the site. However, it is highly unlikely that NSWC Crane would close because principal Base operations, the demilitarization of munitions, are critical to support the U.S. Naval Fleet.

Table 7-19 presents a summary of the potentially complete and incomplete exposure pathways for potential receptors at SWMU 10. Details regarding the assumed receptor characteristics (intake rate,

frequency and duration of exposure, body weight, etc.) are defined in Section 3.3, which presents the methodologies for the human health risk assessment.

As indicated in Section 3.3.3, the following exposure pathways are evaluated in the human health risk for SWMU 10.

- Ingestion of soil, sediment, ground water, and surface water
- Dermal contact with soil, sediment, ground water, and surface water
- Inhalation of air (transfers from soil to air)
- Inhalation of air (transfers from ground water to air for volatiles only)

Based on the human health risk screening presented in Table 7-13 (surface soil) and Table 7-15 (subsurface soil), exposure via inhalation of contaminants migrating from soil to air is not expected to be a significant exposure pathway. Maximum site concentrations do not exceed the available U.S. EPA generic SSLs for transfers from soil to air. In addition, a large portion of the site is overgrown with vegetation, which would limit emissions and mechanical suspension of soil particulates. Because no VOCs were selected as COPCs in ground water, the inhalation while showering pathway is not quantified for hypothetical future residents in the risk assessment.

95% UCLs were used as the EPCs for exposure to surface soil, surface/subsurface soil, ground water, surface water, and sediment. Maximum detected concentrations were used as EPCs for PAHs in soil because fewer than 10 samples were analyzed for these compounds. The EPCs for those chemicals identified as COPCs in surface soil, subsurface soil, ground water, surface water, and sediment at SWMU 10 are presented in Table 7-20.

7.6.3 Risk Characterization

This section contains a summary of the human health risk assessment for SWMU 10. Uncertainties associated with the risk estimates are discussed in Section 7.6.4. The methodology used to calculate the risks presented in this section is provided in Section 3.3. Quantitative risk estimates for potential human receptors are developed for those chemicals identified as COPCs. Potential noncarcinogenic and carcinogenic risks for the construction worker, maintenance worker, occupational worker, adult recreational user, adolescent trespasser, and future residents (adult and child) under the RME and CTE scenarios are summarized in Tables 7-21 and 7-22, respectively. The RAGS Part D Table 9s in Appendix G.3 provides the chemical-specific risks for each COPC and the total HIs for affected target organs. Risks for each receptor are summed across all applicable exposure routes. Example risk spreadsheets

containing the detailed, chemical-specific risks are included in Appendix G.1. A discussion of the estimated noncarcinogenic and carcinogenic risks is provided in the remainder of this section.

Noncarcinogenic Risks – RME

Cumulative HIs for the maintenance worker, occupational worker, adult recreational user, and adolescent trespasser under the RME scenario are less than unity (1), indicating that no toxic effects are anticipated for these receptors under the defined exposure conditions. Cumulative HIs for the construction worker, future adult and child resident exceed unity.

The cumulative HI for the construction worker is 1.6. The major contributor to this elevated HI is manganese (HI = 1.5) by dermal contact with ground water. The construction worker may be exposed very infrequently during the upgrading to the bonding and grounding at Rockeye. Although the construction is expected to be exposed very infrequently, this receptor was assumed to be exposed 150 days per year in the risk assessment. Therefore, risks for the construction worker at Rockeye may be overestimated. Note that the construction worker was assumed to be exposed to the maximum concentration detected in ground water (21,800 µg/L) because the 95 percent lognormal UCL exceeded the maximum concentration. Manganese was detected in 15 of 17 ground water samples; the maximum concentration was in sample 10GWC31P301 and the average concentration was 4,800 µg/L. This sample also contained concentrations of calcium and magnesium, which were noticeably higher than the other ground water samples.

Cumulative HIs for the future adult and child residents are 42 and 150 respectively. These elevated risks result from exposure to iron in sediment (adult HI = 0.11, child HI = 1.0) and to explosives (adult HI = 7.0, child HI = 24), iron (adult HI = 4.3, child HI = 15), manganese (adult HI = 28, child HI = 97), and nickel (adult HI = 0.98, child HI = 3.4) in ground water, primarily by ingestion.

The HIs calculated for residential exposure scenarios are subject to the following sources of uncertainty:

- The calculated risks are based on analytical results for unfiltered ground water samples. Metal concentrations may be elevated because of suspended particulate matter in the samples.

- There is uncertainty associated with the toxicity criteria used to estimate potential risks for iron. The NCEA provisional RfD for iron, which is based on allowable daily intakes rather than adverse effect levels, was used to quantify risks from exposure to iron. Since the provisional RfD is not based on adverse health effects, the risks associated with iron are expected to be overestimated.

- The risks calculated for manganese were based on the maximum detected concentrations of manganese (21,800 µg/L) and HMX (240 µg/L) because the 95% UCLs on a lognormal exceeded the maximum. It is likely that the risks from HMX and manganese in ground water are overestimated by assuming that hypothetical future residents are exposed to the maximum concentration for a lifetime.

- The residential ground water scenario assumes that ground water at the site is used as a source of domestic drinking water. However, because of the shallow depth to ground water, it is unlikely that ground water at the site would be used as a source of potable water in the future.

- Residential risks from sediment are based on the assumption that hypothetical future residents would be exposed to sediment 350 days a year for 30 years. This assumption overestimates risks because a human receptor would be exposed to the sediment on a less frequent basis than is assumed for a typical residential exposure to soil. Risks for the more reasonable exposure scenarios (i.e., the adolescent trespasser and the adult recreational user) were within U.S. EPA's target risk range.

- No chemicals in surface water and sediment were eliminated from the quantitative risk assessment on the basis of background because appropriate upgradient locations could not be determined for these media at SWMU 10.

The HIs associated with direct exposure to other media at the site are minimal for all receptors (i.e., HIs are less than unity).

Carcinogenic Risks

Cumulative ILCRs for the construction worker and maintenance worker are less than U.S. EPA target risk range, $1x10^{-6}$ to $1x10^{-4}$. Risks for the occupational worker, adult recreational worker, and adolescent trespasser are within the U.S. EPA's target range. The total residential ILCR (adult + child) is $3.5x10^{-4}$ which exceeds the target risk range.

The elevated carcinogenic risks for residents are primarily a result of exposure to explosives (primarily RDX) and arsenic in ground water (by ingestion). Explosives account for 57 percent of the calculated total carcinogenic risk, and arsenic accounts for approximately 32 percent of the total carcinogenic risk.

The carcinogenic risks calculated for residential exposure to ground water are subject to the following sources of uncertainty:

- Arsenic was detected in nine of 17 ground water samples at SWMU 10 at a maximum concentration of 5.1 µg/L. This concentration is less than the current MCL for arsenic (50 µg/L) and the recently proposed MCL (10 µg/L). In addition, the concentrations of arsenic in a number of ground water samples were less than the detection limit for the upgradient well. Consequently, the concentrations of arsenic in ground water at the site may be within naturally occurring levels. In addition, carcinogenic risks from exposure to arsenic may be overestimated based on the body's ability to metabolize arsenic (see Section 7.6.4.5).

- The residential ground water scenario assumes that ground water at the site is used as a source of domestic drinking water. However, because of the shallow depth to ground water, it is unlikely that ground water at the site would be used as a source of potable water in the future.

The carcinogenic risks associated with exposure to other media at the site are minimal for all receptors (i.e., ILCRs are less than or within the U.S. EPA target risk range).

The significant sources of uncertainty are further discussed in Section 7.6.4.

7.6.3.1 CTE Evaluation

As discussed in Section 3.3.2.2, an evaluation of the potential risks associated with the CTE scenario is included to provide a measure of the central or average case exposure. Summaries of the estimated risks for the CTE scenarios are contained in Table 7-22.

Cumulative HIs for the maintenance worker, adult recreational user, occupational worker, and adolescent trespasser under the CTE scenario are less than unity (1), indicating that no toxic effects are anticipated for these receptors under the CTE exposure conditions. Cumulative HIs for future construction workers, adult residents, and child residents exceed unity. The cumulative HIs for the CTE for the construction worker, future adult, and child residents are 1.1, 28, and 63, respectively. These elevated risks result from exposure to explosives, iron, manganese, and nickel in ground water.

Cumulative ILCRs for the construction worker, maintenance worker, adult recreational user, occupational worker, and adolescent trespasser are less than the U.S. EPA target risk range, $1x10^{-6}$ to $1x10^{-4}$, and ILCRs for future residents (adult + child) were within the target risk range.

7.6.3.2 Evaluation of Chemicals Eliminated on the Basis of Background Comparison

This following chemicals were eliminated as COPCs solely on the basis of comparison to background.

Surface chemicals eliminated on the basis of background: Al, As, Fe, Mn.

Subsurface soils eliminated on the basis of background: Al, As, Fe, Mn.

Ground water: None.

Surface water: None.

Sediment: None.

Qualitative Risk Evaluation of Metals Eliminated as COPCS Based on Background Comparison.

Aluminum, arsenic, iron, and manganese were detected in soils and/or sediments at concentrations exceeding the conservative screening levels established for COPC selection but were not selected as COPCs because study area concentrations did not exceed background concentrations. The following table provides a qualitative risk evaluation of these metals by comparing the maximum detected concentrations to the EPA Region 9 PRGs for residential and industrial soil exposure.

Parameter	Surface Soil Concentration (mg/kg)	Subsurface Soil Concentration (mg/kg)	Sediment Concentration (mg/kg)	Region 9 Residential (mg/kg)	Region 9 Industrial PRG (mg/kg)	Literature Background (mg/kg)
Aluminum	12,200	12,200		76,000	100,000	10,000 – 300,000
Arsenic	9.3	12.2		0.39	1.6	0.1 - 97
Iron	26,500	36,600		23,000	100,000	7,000 – 555,000
Manganese	674	1,260		1,800	19,000	100 – 4,000

The PRGs presented for aluminum, iron, and manganese are based on the potential for non-cancer health effects (the values are 10 times the COPC screening levels used in this HHRA). The maximum detected concentration of aluminum is approximately one-sixth the relevant residential PRG, and one-eighth the relevant industrial PRG. However, based on toxicity information provided by EPA Region 1, the Region 9 PRG for aluminum is very conservative and may over predict the potential for non-cancer effects. The maximum detected concentration of manganese is approximately two-thirds the relevant

residential PRG, and one-fifteenth of the relevant industrial PRG. The maximum concentration of iron does exceed the PRG; however, the PRG for iron is actually based on a recommended daily intake for iron. Consequently, an exceedance of the PRG for iron is not a definitive indication of the potential for adverse non-cancer health effects. The PRG presented for arsenic is based on the potential for cancer effects and represent the 1 $x10^{-6}$ (one-in-one-million) cancer risk level (the values are the COPC screening levels used in this HHRA). PRGs representing the 1 $x10^{-5}$ and 1 $x10^{-4}$ cancer risk levels would be 10 and 100 times the values presented for the 1 $x10^{-6}$ cancer risk level. Consequently, the maximum detected concentration of arsenic exceeds the 1 $x10^{-6}$ and 1 $x10^{-5}$ cancer risk levels, but not the1 $x10^{-4}$ risk level. Additionally, as indicated above, the metals concentrations reported in the soils and sediments are within the background range reported in the literature.

No metals in ground water or surface water were eliminated as COPCs on the basis of background because the study area concentrations did not exceed background levels.

7.7 ECOLOGICAL RISK ASSESSMENT

7.7.1 Site Description

Section 1.0 of this report presents the site background, site layout, and a general site description. The following text discusses the site description as it pertains to the ecological habitat at the site.

SWMU 10, Rockeye, consists of approximately 10 acres located on a flattened ridge that separates Sulphur and Boggs Creeks. No trees are located on SWMU 10 (Schuman, et al.), but nearby stands consist mainly of oaks and poplars. To the north of the site, pignut hickory and shagbark hickory (*Carya spp.*), black oak (*Quercus velutina*), chestnut oak and red oak (*Quercus spp.*), scarlet oak (*Quercus coccinea*), white oak (*Quercus alba*), and yellow poplar (*Liriodendron tulipifera.*) dominate the landscape. To the south, maple, white oak, black oak, pine, hickory, and yellow poplar are present.

As discussed in Section 7.3.1, the drainage ditches adjacent to the site ultimately lead to streams that discharge into either Sulphur Creek or Turkey Creek. In October 1997, a fish inventory was performed on Boggs, Furst, Turkey, Seed Tick, and Sulphur Creeks. Boggs Creek had 29 species, Turkey Creek had 16 species, Furst Creek had 20 species, and Lake Greenwood had 13 species. Boggs Creek has a small watershed; ponds within the watershed are stocked annually with largemouth bass (*Micropterus salmoides*), bluegill sunfish (*Leopomis macrochirus*), redear sunfish (*Etheostoma whipplei*), and golden shiners (*Notemigonus crysoleucus*). Also in this area, a single male Indiana bat, an endangered species, was captured along the Little Sulphur and Furst Creeks (Brent, personal comm).

The waterbodies at SWMU 10 eventually discharge to either Sulphur Creek or Turkey Creek because SWMU 10 is located atop a ridge. The Sulphur Creek-Little Sulphur Creek waterbody segment designated state water uses are aquatic life support, fish consumption, and primary contact. This waterbody segment was assessed as part of the 2004 Indiana Integrated Water Quality Monitoring and Assessment Report to determine if the waterbody was supporting those uses (IDEM, 2004). The Sulphur Creek-Little Sulphur Creek waterbody segment is fully supporting the aquatic life support and primary contact water uses; it was not assessed for the fish consumption water use (IDEM, 2004). The Turkey Creek waterbody segment was included in the IDEM Assessment Report but was not assessed because insufficient data or no data was available to determine a designated use.

Sulphur Creek discharges off-site to the East Fork of the White River. Turkey Creek discharges to Boggs Creek which also discharges off-site to the East Fork of the White River. River otters, a state endangered species, 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 (IDFW, 2000). Also, the East Fork of the White River is the site for an ongoing study of lake sturgeon populations, another state endangered species (IDFW, 2000). Finally, spotted darters, a state endangered species, has been found in the East Fork of the White River (IDFW, 2000). Note that other threatened, endangered, or special concern species also may be present in the water bodies just off-site of Crane, as well.

7.7.2 Potential Ecological Receptors and Exposure Pathways

Based on the above description of the site and potential contaminant migration pathways, ecological receptors could be directly exposed to chemicals in the surface water and surface soil (i.e., plant and soil invertebrates) and indirectly via the food chain (i.e., through the ingestion of plants and invertebrates). Figure 7-18 presents the conceptual site model for SWMU 10. Additionally, ecological receptors (i.e., aquatic invertebrates) could be exposed to chemicals in the surface water and sediment in the stream. The following assessment endpoints (and surrogate wildlife species where applicable) were selected for this site:

- Soil invertebrates
- Terrestrial vegetation
- Benthic invertebrates
- Fish
- Soil invertebrate-eating mammal (short-tailed shrew)
- Herbivorous mammal (meadow vole)

- Invertebrate-eating bird (American robin)
- Herbivorous bird (bobwhite quail)
- Aquatic invertebrate-eating mammal (little brown bat)
- Piscivorous mammal (raccoon)
- Piscivorous bird (belted Kingfisher)

Although piscivorous mammals and birds were included as assessment endpoints, the actual exposure to site chemicals is expected to be low. The drainageways by the site are small and shallow and unlikely to sustain large fish populations. The measurement endpoints for each of these assessment endpoints are presented in Section 3.4.

7.7.3 Sampling Investigation and Results

A total of 10 surface soil locations (Figures 7-12 and 7-13), six sediment locations (Figure 7-16), and six surface water locations (Figure 7-15) were sampled at the site and were evaluated as part of the SERA.

Section 7.4 of this report discusses the analytical results and the nature and extent of contamination for the site. In summary, SVOCs, energetics, and/or inorganic chemicals are detected in the soil, sediment, and surface water. Note that no upgradient surface water and sediment locations were identified at this SWMU because the SWMU is the high point of the general area and the local tributaries originate from the SWMU.

7.7.4 Ecological Screening

This section contains the ecological risk screening evaluation that was conducted for the chemicals detected in the surface soil, sediment, and surface water samples. The general methodologies used for the exposure assessment and risk characterization are discussed in Section 3.4 of this report. The EDQLs used for screening are presented in Tables 3-14 and 3-15.

7.7.4.1 Surface Soil

Table 7-24 is the screening table for plants, invertebrates, and terrestrial wildlife exposed to chemicals detected in the surface soil samples. In addition to summary statistics (e.g., frequency of detection), the table also includes a comparison to oil background values for inorganics, which are used to select COPCs. Thirteen SVOCs, four energetics, and 18 inorganic chemicals are detected in the surface soil samples.

All energetics are retained as COPCs because there are no surface soil COPC screening levels available for these chemicals. Arsenic, barium, cadmium, chromium, cobalt, copper, lead, nickel, vanadium, and zinc are not retained as COPCs, even though their maximum concentrations exceed their respective surface soil COPC screening levels. This is because the chemical concentrations in the site samples were not statistically determined to be greater that background concentrations.

7.7.4.2 Sediment

Table 7-25 is the screening table for aquatic receptors and piscivorous wildlife exposed to chemicals detected in the sediment. One energetic and 18 inorganics are detected in the sediment samples.

HMX and seven inorganic chemicals including aluminum, antimony, barium, beryllium, iron, manganese, and vanadium are retained as COPCs because no sediment COPC screening levels are available for these chemicals. Arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc are retained as COPCs because the maximum concentrations exceed their respective sediment COPC screening level.

7.7.4.3 Surface Water

Table 7-26 is the surface water screening table for aquatic receptors. Five energetics, 10 inorganic chemicals (in unfiltered samples), and nine inorganic chemicals (in filtered samples) are detected in the surface water samples. All energetics, aluminum, iron, and manganese are retained as COPCs because no surface water COPC screening levels are available for these chemicals. Zinc is retained as a COPC because the maximum concentration exceeds the surface water COPC screening level.

7.7.5 Scientific/Management Decision Point

The SERA includes the estimation of exposure levels and screening for ecological risks. The SERA is concluded by a Scientific/Management Decision Point (SMDP) at which point one of the following decisions is made (DON, 1999):

(1) Adequate information exists to conclude that ecological threats at a site are negligible; no further evaluations of ecological risks are necessary.

(2) Adequate information exists and there is a potential for adverse ecological effects. In this case, the decision can be to either conduct an interim cleanup (if cost-effective to do so) or continue to Step 3.

Included in the decisions listed above is an evaluation of the adequacy of the available information on which the decisions are based. Questions answered during this evaluation include the following:

- Were adequate numbers of samples collected in the appropriate locations?
- Were the samples analyzed for the appropriate parameters and was the data of sufficient quality for use in a risk assessment?

This section of the ERA describes whether or not the collected data are adequate for making ecological risk decisions for SWMU 10. Section 7.4 of this report presents the nature and extent of contamination at SWMU 10.

SWMU 10 (Rockeye) is 10 acres in size and is located on a flattened ridge crest that separates Sulphur Creek and Boggs Creek in the north central portion of the Base. The SWMU is located adjacent to Highway 45. The site map for SWMU 10, Rockeye is presented as Figure 7-1. Rockeye is located on a topographic ridge with ground surface elevations at approximately 815 feet. The SWMU rests on a major north-south drainage divide. Drainage northeast of the divide ultimately flows toward Sulphur Creek and drainage southwest of the divide flows toward Turkey Creek. Several manmade drainage ditches convey stormwater away from the SWMU. These ditches typically run along the SWMU access roads, trending in a northwest-southeast pattern. Flow in the ditches follows the regional surface water divide patterns as dictated by topography, and ultimately lead to streams that discharge into either Sulphur Creek or Turkey Creek.

SWMU 10 is an operational ammunitions facility. Historically, large volumes of explosive-contaminated wastewater generated during production were collected in sumps surrounding the buildings at the site. Prior to 1978, the wastewater was discharged via drainage pipes to the local intermittent tributaries located near the site. On the northern and eastern sides of the production facility, the wastewater was released to tributaries of Sulphur Creek, on the southern side the water was released to Turkey Creek, and on the western side the water was released to a tributary of Furst Creek. Building 3044 was constructed in 1978 as an activated carbon water treatment facility to purify the wastewater previously released to surrounding creek systems. With the installation of Building 3044, the release of explosive-contaminated waters has been eliminated.

7.7.5.1 Surface Soil

10 surface soil samples were collected at SWMU 10 and analyzed for Appendix IX explosives, TAL metals (plus tin), and cyanide. In addition, one surface soil sample (10SB030002) was analyzed for

Appendix IX SVOCs. Figures 7-10 and 7-11 are tag maps that depicting analytical data for SWMU 10. Table 7-2 presents a summary of the results reported for compounds detected in the surface soil samples collected from SWMU 10 and Table 7-24 is the ecological risk screening table. Thirteen SVOCs, four explosives, and 18 inorganics were detected in surface soil samples. Of these, only the four explosives were retained as COPCs. COPCs considered bioaccumulative (U.S. EPA, 2000) were retained for food-chain modeling (see Table 7-27). 2,4,6-TNT, 2-amino-4,6-dinitrotoluene, and RDX were detected relatively infrequently at 1 of 10, 1 of 10, and 2 of 10 samples collected, respectively. HMX was encountered more frequently in half of the samples collected. Because SWMU 10 is an active munitions production area and detections of these explosives are likely attributable to site activities, potential risks to ecological receptors will be further evaluated in Step 3a of the BERA.

7.7.5.2 Sediment/Surface Water

To assess potential risks associated with migration of chemicals from groundwater and soil to surface water and sediment, surface water and sediment samples were collected from 12 locations.

7.7.5.2.1 Sediment

Results from the analysis of the 12 sediment samples are displayed spatially on Figure 7-16. Table 7-10 presents the summary of positive sediment analytical results and Table 7-25 is the ecological risk screening table for sediment. One explosive and 18 inorganics were detected in SWMU 10 sediment samples. Of these, one explosive and 15 inorganics were retained as COPCs. COPCs considered bioaccumulative (U.S. EPA, 2000) were retained for food-chain modeling (see Table 7-27). HMX, aluminum, antimony, barium, beryllium, iron, manganese, and vanadium were retained as COPCs because EDQLs were not available for comparison. Arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc were retained as COPCs because their maximum detected concentrations exceeded the EDQL. HMX was the only detected explosive in SWMU 10 sediment samples and was detected in only one of 12 samples collected (sample location 10SD07 located just north of the SWMU boundary in a tributary of Sulphur Creek). Sample 10SD070006 was collected at the location of the historic pink water discharge. HMX was also detected in the surface water sample collected from this same location. Maximum concentrations for different chemicals were found in different samples indicating no clear pattern of contamination. EEQs for inorganics exceeding the EDQLs ranged from 1.04 to 5.8 (see Table 7-25), and for this reason will be further evaluated in Step 3a of the BERA.

7.7.5.2.2 Surface Water

Surface water results are presented on Figure 7-15. Table 7-8 presents the summary of positive surface water analytical results and Table 7-26 is the ecological risk screening table for surface water. Five explosives, ten inorganics (in unfiltered samples), and nine inorganics (in filtered samples) were detected in SMWU 10 surface water samples. Of these, five explosives, four inorganics in unfiltered samples, and three inorganics in filtered samples were retained as COPCs. COPCs considered bioaccumulative (U.S. EPA, 2000) were retained for food-chain modeling (see Table 7-27). All five explosives, aluminum, iron, and manganese were retained as COPCs because EDQLs were not available for comparison. Zinc was retained as a COPC because the maximum concentrations exceeded the EDQL. EEQs for zinc are 1.9 and 1.73 for unfiltered and filtered samples, respectively. The explosives were detected in several samples with maximum concentrations primarily at sample location 10SW07. This sample was collected in an area of a historic pooled pink discharge. Aluminum, iron, and manganese were detected frequently in both unfiltered and filtered samples. Zinc was detected relatively infrequently in two of the 12 samples collected. Maximum concentrations of most inorganics are found at locations 10SW09 and 10SW11. These locations are within tributaries west and south of the SWMU. Due to the lack of EDQLs for explosives, aluminum, iron, and manganese, and because the maximum zinc concentration exceeded its EDQL, explosives and inorganics will be further evaluated in Step 3a of the BERA.

7.7.5.3 Summary

In summary, a SERA was performed for SWMU 10. Based on the results of the collected data, adequate information exists to determine that potential risks are possible to receptors from exposure to the selected COPCs. Additionally, the samples were collected from areas where the contamination, if present, would be detected. Therefore, the SERA is advancing to the Step 3a of the BERA – the refinement of the site related COPCs.

7.7.6 Step 3a Refinement

Subsequent to the initial screening, other factors are considered to further refine COPCs. These factors include food chain modeling, habitat quality, area use factors, toxicological evaluation of COPCs, frequency of detection, background concentrations, and comparisons of COPCs to alternate benchmarks/toxicity (U.S. EPA, June 1997; and 2001; Navy, April 1999). Section 3.4.4 presents the methodologies used to further evaluate risks to ecological receptors in Step 3a.

Food chain modeling is conducted to investigate potential risks to representative receptors from ingested doses of COPCs that are known to bioaccumulate or biomagnify. The methods used to model the doses

that representative receptors could receive, as well as the selection of TRVs and the calculation sheets for the food chain model, are described and presented in Section 3.4.4.2 and Appendix H. The assessment endpoints associated with food chain modeling are the protection of ecological receptors from adverse effects of COPCs on growth, survival, and reproduction. The associated measurement endpoints are doses of COPCs associated with adverse effects on growth, survival, and reproduction of these receptor groups.

Concentrations of COPCs are compared to alternate (usually less conservative) guidelines in Step 3A of this assessment. These alternate guidelines are presented in Tables 7-28 (surface soil), 7-29 (sediment) 7-30 (surface water), and 7-35 (terrestrial food chain modeling) along with the Step 3a evaluation.

7.7.6.1 Risks to Terrestrial Plants, Terrestrial and Sediment Invertebrates

Potential risks to terrestrial plants, terrestrial and aquatic invertebrates, and fish from exposure to COPCs were evaluated using the methodologies described in Section 3.4.4. The following subsections discuss whether the chemicals initially selected as COPCs should be retained for further evaluation of risks to soil invertebrates and terrestrial vegetation (Section 7.7.6.1.1) and benthic invertebrates (Section 7.7.6.1.2).

7.7.6.1.1 Terrestrial Plants and Invertebrates – Surface Soil Risk

Risks to terrestrial plants and invertebrates resulting from exposure to the COPCs in surface soil are evaluated using the methodologies described in Section 3.4.4. Table 7-28 presents a summary of some of the common alternate benchmarks available for surface soil COPCs, along with a summary of the Step 3a evaluation. The toxicological basis of the alternate benchmarks is presented below. As presented in Table 7-24, several chemicals were detected at concentrations exceeding screening levels (or screening levels were not available) but were eliminated as COPCs because they were not detected at concentrations greater than background concentrations. For soil, these chemicals included the detected metals (aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, vanadium, and zinc). Therefore, risks to these chemicals were not evaluated in the ERA, however, any risks would be within background risks and not related to site activities.

2,4,6-Trinitrotoluene

2,4,6-Trinitrotoluene (TNT) was initially selected as a COPC because a Region 5 screening level is not available. The following toxicity information for TNT was located in the literature:

- Plants – 30 mg/kg (Talmage et al., 1999)
- Soil invertebrates (earthworms) – 140 mg/kg (Talmage et al., 1999)

The plant benchmark of 30 mg/kg from Talmage et al. (1999) is based on a study in which a reduction in plant height of 25 percent was observed in soil with 30 mg/kg TNT [Lowest Observed Effect Concentration (LOEC)] but not in soil with 10 mg/kg TNT [No Observed Effect Concentration (NOEC)]. The soil earthworm concentration of 140 mg/kg is recorded as a LOEC based on sublethal endpoint of weight loss; the NOEC from the same study was 110 mg/kg (Talmage et al., 1999)

TNT was detected in one of 10 surface soil samples collected at SWMU 10 at a concentration of 0.53 mg/kg in sample 10SB030002-REM. The maximum detected concentration is well below the NOECs for plants and invertebrates so impacts to those receptors are not likely. Therefore, risks to plants and soil invertebrates from TNT are acceptable and TNT is not retained as a COPC for risks to plants and soil invertebrates. Although, TNT is not considered a bioaccumulative chemical, risks to piscivorous wildlife are evaluated in Section 7.7.6.3 of this ERA to be conservative.

2-amino-4,6-dinitrotoluene

2-amino-4,6-dinitrotoluene (2-ADNT) was initially selected as a COPC because a Region 5 screening level is not available. The following toxicity information for 2-ADNT was located in the literature:

- Plants – 80 mg/kg (Talmage et al., 1999)
- Soil microbial processes – 80 mg/kg (Talmage et al., 1999)

The plant value is based on a study in which soil amended with 80 mg/kg of 2-ADNT was not toxic to yellow nutsedge over a 42 day period (Talmage et al., 1999) No studies based on toxicity of 2-ADNT were located, but a soil microbial processes value of 80 mg/kg was reported as nontoxic (Talmage et al., 1999). However, Talmage et al., (1999) indicated that confidence in this value is low and the value unlikely to be conservative because the organisms were probably acclimated to the test compound. 2-ADNT was detected in one of 10 samples collected at SWMU 10 at a concentration of 0.53 mg/kg (location 10SB09). The single detected concentration of 2-ADNT is over 100 times less than the toxicity values presented above so 2-ADNT is unlikely to impact plants or invertebrates at SWMU 10. Therefore, risks to plants and earthworms are acceptable so 2-ADNT is not retained as a COPC for risks to plants and invertebrates. Although, 2-ADNT is not considered a bioaccumulative chemical, risks to piscivorous wildlife are evaluated in Section 7.7.6.3 of this ERA to be conservative.

HMX

HMX was initially selected as a COPC because a Region 5 screening level is not available. The following toxicity information for HMX was located:

- LOEC (280 mg/kg) for earthworm reproduction (Robidoux et al., 2001)

The LOEC was based on the number of juveniles hatching per cocoon being significantly reduced by HMX at 280 mg/kg in soil; a NOEC was not generated from the study (Robidoux et al., 2001). Also, a significant reduction in productivity of cocoons and juveniles as well as total biomass of juveniles were significantly reduced by HMX at >280 mg/kg in soil (Robidoux et al., 2001). HMX was detected in 5 of the 10 samples collected at SWMU 10 with the maximum HMX concentration of 55 mg/kg detected at location 10SB05. This location is in the middle of the site in the industrial area with many buildings and roadways and as such, has little ecological habitat (see Figures 1-14 and 7-10). The field sheet for the sample from this location described the soil as a silty clay with gravel and sand, which further supports the fact that the area is poor habitat for ecological receptors. The four other samples with HMX detections also were located in the industrial area, and the maximum detected concentration in these samples was 5 mg/kg (see Figure 7-10). Because significant effects are associated with the LOEC of 280 mg/kg and a NOEC was not available, a concentration of HMX in the soil of 55 mg/kg could impacts invertebrates. It is less likely that concentrations of 5 mg/kg or less would impact invertebrates because they are over 10 times less that the LOEC. However, because the detection of 55 mg/kg is in a industrialized area where invertebrates either would not be present, or where their presence is not ecologically significant (i.e., wildlife would not be feeding in this area), risks to invertebrates are acceptable.

No toxicological data for plants could be located. However, the only detections of HMX were in the industrialized area where plants would not be expected based on the habitat. The areas surrounding SWMU 10 boundaries are heavily vegetated (see Figure 1-14), so it does not appear that HMX is significantly impacting plants areas where terrestrial vegetation habitat exists.

In summary, risks to invertebrates and plants at the site from HMX in the soil are acceptable so HMX is not retained as a COPC for risks to plants and invertebrates. Although, HMX is not considered a bioaccumulative chemical, risks to piscivorous wildlife are evaluated in Section 7.7.6.3 of this ERA to be conservative.

RDX

RDX was initially selected as a COPC because a Region 5 screening level is not available. The following toxicity information for RDX was located:

- Plants – 100 mg/kg (Talmage et al., 1999)
- LOEC (95 mg/kg) for earthworm reproduction (Robidoux et al., 2000)

The plant benchmark of 100 mg/kg from Talmage et al. (1999) is from a study in which an RDX concentration of 100 mg/kg significantly reduced the biomass of cucumber plants. RDX was detected in 2 of the 10 samples collected at SWMU 10. The maximum RDX concentration of 8 mg/kg was detected at location 10SB03. Although significant effects are associated with the LOEC of 100 mg/kg and a NOEC was not available, a concentration of RDX in the soil of 8 mg/kg is unlikely to impacts invertebrates, because it is over 10 times less than the LOEC. Also, as discussed above for HMX, the locations of the two RDX detections were in the industrialized area where habitat for plants is poor (see Figure 7-10). The areas surrounding SWMU 10 boundaries are heavily vegetated (see Figure 1-14), so it does not appear that RDX is not significantly impacting plants areas where terrestrial vegetation habitat exists.

The LOEC was based on the productivity of juveniles (total number of juveniles, biomass, number of juveniles per hatched cocoon) being significantly reduced by RDX at 95 mg/kg in soil; a NOEC was not generated from the study (Robidoux et al., 2000). RDX was detected in 2 of the 10 samples collected at SWMU 10 with the maximum RDX concentration of 8.0 mg/kg detected at location 10SB03. This location is in the middle of the site, an industrial area with many buildings and roadways, and as such, has little ecological habitat (see Figures 1-14 and 7-10). The field sheet for the sample from this location described the soil as fill (silty clay with some gravel) which further supports the fact that the area is poor habitat for ecological receptors. The other sample with an RDX detection (1.6 mg/kg) also was located in the industrial area (see Figure 7-10). Although significant effects are associated with the LOEC of 95 mg/kg and a NOEC was not available, a concentration of RDX in the soil of 8 mg/kg is unlikely to impacts invertebrates, because it is over 10 times less than the LOEC. Also, the two detections of RDX are in the industrialized area where invertebrates either would not be present, or where their presence is not ecologically significant (i.e., wildlife would not be feeding in this area). Therefore, risks to invertebrates are acceptable from RDX in the soil.

In summary, risks to invertebrates and plants at the site from RDX in the soil are acceptable; RDX is not retained as a COPC for risks to plants and invertebrates. Although, RDX is not considered a

bioaccumulative chemical, risks to piscivorous wildlife are evaluated in Section 7.7.6.3 of this ERA to be conservative.

7.7.6.1.2 Sediment

Table 7-29 presents a summary of the common alternate benchmarks used in refining the list of COPCs in sediment, along with a summary of the Step 3a evaluation. As noted in Table 7-25, no obvious upgradient sediment samples were collected at SWMU 10.

HMX

HMX was initially selected as a COPC because no Region 5 screening level is available. It was detected in one sediment sample at a concentration of 51 mg/kg (in sample 10SD07006), but it was not detected in the downstream sample (10SD04006) from the same water body. In a study by Steevens et al., (2002), HMX did not have a significant effect on survival of *Chironomus tentans* at a measured concentration of 146 mg/kg in sediment, or a significant effect on survival of *Hyalelle azteca* at a measured concentration of 126 mg/kg in sediment. Because the maximum detection of HMX in the sediment at SWMU 10 is less than these values, significant impacts to benthic invertebrates from HMX in the sediment are not expected. Therefore, risks to sediment invertebrates from HMX in the sediment are acceptable so HMX is not retained as a COPC for risks to these receptors. Although, HMX is not considered a bioaccumulative chemical, risks to piscivorous wildlife are evaluated in Section 7.7.6.3 of this ERA to be conservative.

Aluminum

Aluminum was initially selected as a COPC because a Region 5 screening level is not available. The alternate benchmark selected for aluminum is the Threshold-Effects Level (TEL) of 25,500 mg/kg (Buchman, 1999). The TEL represents the concentration below which adverse effects on survival or growth of the amphipod Hyalella azteca are expected to occur only rarely in 28 day tests (MacDonald et al., 2000). The maximum aluminum concentration (9,190 mg/kg) at location 10SD08 is below the TEL. Therefore, risks to sediment dwelling invertebrates are acceptable; aluminum is not retained as a COPC for risks to sediment invertebrates.

Antimony

Antimony was initially selected as a COPC because a Region 5 screening level is not available. The alternate benchmark selected for antimony is the Effects Range-Low (ER-L) of 2 mg/kg (Long and

Morgan., 1991). The ER-L values were developed by first ranking the chemical concentrations in sediment associated with adverse effects by ascending concentrations then the lower 10th percentile of the data was selected as the ER-L. The ER-L represents the low end of the range of concentrations at which effects were observed or predicted. The maximum antimony concentration (2.2 mg/kg) at location 10SD05 is only slightly greater than the ER-L; all other sample concentrations were less than the ER-L. Therefore, impacts to benthic invertebrates from antimony in the sediment are unlikely so risks to sediment dwelling invertebrates are acceptable; antimony is not retained as a COPC for risks to sediment invertebrates. Note that there is some uncertainty in using these benchmarks to evaluate risks to sediment dwelling invertebrates at SWMU 10 because toxicity data from saltwater studies were used to develop the ER-L.

Arsenic

Arsenic was initially selected as a COPC because the maximum detected sediment concentration (34.2 mg/kg) in sample 10SD040006 exceeded the Region 5 screening level of 5.9 mg/kg. However, the most recent EDQL (U.S. EPA, 2003) is based on the Consensus-based Threshold Effect Concentration (TEC) and is therefore a more appropriate value for comparing the maximum arsenic concentration:

- Consensus-based TEC – 9.79 mg/kg (MacDonald et al., 2000)
- Consensus-based Probable Effect Concentration (PEC) – 33 mg/kg (MacDonald et al., 2000)

The consensus-based TEC is the geometric mean of the threshold effect level (TEL; Smith et al., 1996), effect range low value (ER-L; Long and Morgan, 1991), lowest effect level (LEL; Persaud et al., 1993), minimal effect threshold (MET; EC and MENVIQ, 1992), and sediment quality advisory levels (SQALs; U.S. EPA, 1997) for arsenic. These individual effect levels for each of the studies cited above were calculated using slightly different methods, but they all represent concentrations below which impacts to sediment invertebrates are either unlikely or not expected. For that reason, the consensus-based TEC is intended to identify contaminant concentrations below which harmful effects on sediment dwelling organisms are not expected. The maximum arsenic concentration is greater than the consensus-based TEC and therefore, was compared to the consensus-based PEC to provide an estimate of the overall risk range. The PEC was derived similarly to the TEC but is the geometric mean of the probable effect levels (PELs; Smith et al., 1996), effect range median values (ER-Ms; Long and Morgan, 1991), severe effect levels (SELs; Persaud et al., 1993) and Toxic Effect Thresholds (TETs; EC and MENVIQ, 1992). The PEC is the level above which harmful effects on sediment dwelling organisms are expected to frequently occur (MacDonald, et al., 2000). The maximum concentration is slightly greater than the PEC.

The most likely source of metals in sediment is surface soil run-off from SWMU 10, because the headwaters of all the tributaries originate at SWMU 10 (see Figure 7-16). Therefore, because arsenic concentrations in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and are not site-related, it is likely that the arsenic in the sediment is not site related.

In summary, one arsenic detection is greater than the PEC, while all other detections were either less than the PEC or less than the TEC. At the locations where the arsenic concentration is less than the TEC, risks to invertebrates are unlikely. At the locations where the arsenic concentrations are between the TEC and PEC (10SD01, -05, -08, -12) impacts to benthic invertebrates are possible, and at locations where arsenic concentrations are greater than the PEC (10SD04), impacts to benthic invertebrates are probable. Therefore, although it is possible that the arsenic concentrations in the sediment are adversely impacting benthic invertebrates at some locations, the arsenic in the sediment does not appear to be related to site activities. For that reason, site-related risks to benthic invertebrates from arsenic are acceptable so arsenic is not retained as a COPC for risks to sediment dwelling invertebrates. Because arsenic is a bioaccumulative chemical, risks to piscivorous wildlife from arsenic are evaluated in Section 7.7.6.3 of this ERA.

Barium

Barium was initially selected as a COPC because a Region 5 screening level is not available. The only toxicity data available for barium in sediment is an Apparent Effects Threshold (AET) value of 48 mg/kg (Buchman, September 1999), which is based on marine organisms. Because the AET is a concentration above which, adverse impacts to sediment invertebrates are always expected, risks to sediment invertebrates exposed to barium at concentrations below the AET cannot be determined. Based on the Navy's agreement with U.S. EPA, if a chemical only has a higher effects level such as an AET the chemical will not be eliminated as a COPC even if the maximum detection is below the higher effects level, unless other Step 3a factors can be used to justify the chemicals elimination as a COPC.

Barium was detected at concentrations greater than the AET in all but one site sample. The most likely source of metals in sediment is surface soil run-off from SWMU 10, because the headwaters of all the tributaries originate at SWMU 10 (see Figure 7-16). Therefore, because barium concentrations in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and are not site-related, it is likely that the barium in the sediment is not site related. Therefore, although risks to benthic invertebrates cannot be ruled out because of the lack of lower-effects toxicity data, any potential site-related risks from barium are not great enough to warrant carrying barium further through the BERA

process (i.e., they reflect background conditions). Barium is not retained as a COPC for sediment dwelling invertebrates.

Beryllium

Beryllium was initially selected as a COPC because a Region 5 screening level is not available. No alternate benchmarks are available for beryllium. However, beryllium was detected in five of 12 samples collected at SWMU 10 at similar concentrations (1.4 to 2.1 mg/kg). Additionally, beryllium was not detected in the surface water samples at SWMU 10 and was only detected in one of 10 surface soil samples (within background concentrations). For these reasons, detections of beryllium are likely not attributable to past site operations and are more likely reflective of background conditions. Therefore, although risks to benthic invertebrates cannot be ruled out because of the lack of toxicity data, any potential site-related risks from beryllium are not great enough to warrant carrying beryllium further through the BERA process. Risks to sediment dwelling invertebrates are acceptable and beryllium is not retained as a COPC.

Cadmium

Cadmium was initially selected as a COPC because the maximum detected sediment concentration (2.4 mg/kg) exceeded the Region 5 screening level (see Table 7-25). However, the most recent ESL (U.S. EPA, 2003) is based on the consensus-based TEC and is therefore a more appropriate value for comparing to the maximum cadmium concentration:

- Consensus-based TEC – 0.99 mg/kg (MacDonald et al., 2000)
- Consensus-based PEC – 4.98 mg/kg (MacDonald et al. 2000)

The basis of the TEC and PEC are described above for arsenic. The four cadmium concentrations detected in SWMU 10 sediment are greater than the TEC and therefore, were compared to the PEC to provide an estimate of the overall risk range. The maximum cadmium concentration is less than the PEC.

As mentioned above, the most likely source of metals in sediment is surface soil run-off from SWMU 10, because the headwaters of all the tributaries originate at SWMU 10 (see Figure 7-16). Because cadmium concentrations in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and are not site-related, it is likely that the cadmium in the sediment is not site related. Also, because the concentrations of the four cadmium detections are between the TEC and the PEC, impacts to benthic invertebrates are possible, but not probably. Therefore, although it is possible that the cadmium

concentrations in the sediment are adversely impacting benthic invertebrates at some locations, the cadmium in the sediment does not appear to be related to site activities. For that reason, site-related risks to benthic invertebrates from cadmium are acceptable so cadmium is not retained as a COPC for risks to sediment dwelling invertebrates. Because cadmium is a bioaccumulative chemical, risks to piscivorous wildlife from cadmium are evaluated in Section 7.7.6.3 of this ERA.

Chromium

Chromium was initially selected as a COPC because the maximum detected sediment (65.7 mg/kg) exceeded the Region 5 screening level. However, the most recent ESL (U.S. EPA, 2003) is based on the consensus-based TEC and is therefore a more appropriate value for comparing to the maximum chromium concentration:

- Consensus-based TEC – 31.6 mg/kg (MacDonald et al., 2000)
- Consensus-based PEC – 111 mg/kg (MacDonald et al. 2000)

As mentioned above, the most likely source of metals in sediment is surface soil run-off from SWMU 10, because the headwaters of all the tributaries originate at SWMU 10 (see Figure 7-16). Because chromium concentrations in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and are not site-related, it is likely that the chromium in the sediment is not site related. Also, because none of the chromium concentrations exceeded the PEC, and the concentrations in four samples are between the TEC and the PEC, impacts to benthic invertebrates are possible, but not probably. Therefore, although it is possible that the chromium concentrations in the sediment are adversely impacting benthic invertebrates at some locations, the chromium in the sediment does not appear to be related to site activities. For that reason, site-related risks to benthic invertebrates from chromium are acceptable so chromium is not retained as a COPC for risks to sediment dwelling invertebrates. Because chromium is a bioaccumulative chemical, risks to piscivorous wildlife from chromium are evaluated in Section 7.7.6.3 of this ERA.

Cobalt

Cobalt was initially selected as a COPC because the maximum detected sediment concentration (51.8 mg/kg) in sample 10SD080006 slightly exceeded the Region 5 screening level of 50 mg/kg. Cobalt was detected in all 12 sediment samples at SWMU 10 but only the maximum concentration was greater than the EDQL. Because the maximum concentration just slightly exceeds the conservative screening level, risks to benthic invertebrates from cobalt are not expected. Additionally, as with the other metals,

cobalt was detected in surface soil at concentrations within the background soils concentration range so concentrations in the sediment are not likely to be related to site activities. Risks to sediment dwelling invertebrates are acceptable and cobalt is not retained as a COPC for these receptors.

Copper

Copper was initially selected as a COPC because the maximum detected sediment concentration (16.9 mg/kg) exceeded the Region 5 screening level of 16 mg/kg. However, the most recent ESL (U.S. EPA, 2003) is based on the consensus-based TEC and is therefore a more appropriate value for comparing to the maximum copper concentration:

- Consensus-based TEC – 31.6 mg/kg (MacDonald et al., 2000)

The maximum copper concentration is less than the consensus-based TEC so risks to sediment dwelling invertebrates are acceptable. Therefore, copper was eliminated as a COPC for risks to sediment dwelling invertebrates. Because copper is a bioaccumulative chemical, risks to piscivorous wildlife from copper are evaluated in Section 7.7.6.3 of this ERA

Iron

Iron was initially selected as a COPC because a Region 5 screening level is not available. Iron concentrations are compared to the Canadian SQG because a consensus based TEC is not available.

- Canadian Sediment Guidelines LEL – 20,000 mg/kg [Ontario Ministry of the Environment (OMOE), 1993]
- Canadian Sediment Guidelines SEL – 40,000 mg/kg (OMOE, 1993)

The LEL indicates the level of sediment contamination which has no effect on and can be tolerated by the majority of sediment-dwelling organisms. The Canadian sediment guidelines were developed by first calculating the 90th percentile of the concentrations evaluated in toxicity studies where a species was present, and then plotting the 90th percentile concentrations for all of the species considered to develop the guideline. The 5th percentile of the plot was selected as the LEL for metals and the 95th percentile from the plot was selected as the SEL for metals. The maximum detected concentration of iron (71,100 mg/kg in 10SD04), and the iron concentrations in several other samples are greater than the LEL and SEL. Based on the definition of the SEL, potential impacts to benthic invertebrates at those locations are probable. However, iron concentrations are highly variable in the environment and typically not very

bioavailable so there is probably more uncertainty in the sediment guidelines for iron than for some other chemicals. Also, because iron concentrations in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and is not site-related, it is likely that the iron in the sediment is not site related.

In summary, although it is possible that the iron concentrations in the sediment are adversely impacting benthic invertebrates at some locations, the iron in the sediment does not appear to be related to site activities. For that reason, site-related risks to benthic invertebrates from iron are acceptable so iron is not retained as a COPC for risks to sediment dwelling invertebrates.

Lead

Lead was initially selected as a COPC because the maximum detected sediment concentration (37 mg/kg) exceeded the Region 5 screening level of 31 mg/kg. However, the most recent ESL (U.S. EPA, 2003) is based on the consensus-based TEC and is therefore a more appropriate value for comparing to the maximum lead concentration:

- Consensus-based TEC – 35.8 mg/kg (MacDonald et al., 2000)

The maximum lead concentration only slightly exceeds the consensus-based TEC; all other lead concentrations were less than the TEC. Therefore risks to sediment dwelling invertebrates are acceptable. Lead is not retained as a COPC for risks to sediment dwelling invertebrates. Because lead is a bioaccumulative chemical, risks to piscivorous wildlife from lead are evaluated in Section 7.7.6.3.

Manganese

Manganese was initially selected as a COPC because a Region 5 screening level is not available. Manganese concentrations are compared to the Canadian SQG because a consensus based TEC is not available.

- Canadian Sediment Guidelines LEL – 460 mg/kg (OMOE, 1993)
- Canadian Sediment Guidelines SEL – 1,1 00 mg/kg (OMOE, 1993)

The toxicological basis for the LEL and SEL are described above for iron. The maximum detected concentration of manganese (3,900 mg/kg), and the manganese concentrations in several other samples are greater than the LEL and SEL. Based on the definition of the SEL, potential impacts to benthic

invertebrates at those locations are probable. However, similar to iron, manganese concentrations are highly variable in the environment so there is probably more uncertainty in the sediment guidelines for manganese than for some other chemicals. Also, because manganese concentrations in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and is not site-related, it is likely that the manganese in the sediment is not site related.

In summary, although it is possible that the manganese concentrations in the sediment are adversely impacting benthic invertebrates at some locations, the manganese in the sediment does not appear to be related to site activities. For that reason, site-related risks to benthic invertebrates from manganese are acceptable so manganese is not retained as a COPC for risks to sediment dwelling invertebrates.

Nickel

Nickel was initially selected as a COPC because the maximum detected sediment concentration (44.6 mg/kg) exceeded the Region 5 screening level of 16 mg/kg. However, the most recent ESL (U.S. EPA, 2003) is based on the consensus-based TEC and is therefore a more appropriate value for comparing to the maximum nickel concentration:

- Consensus-based TEC – 22.7 mg/kg (MacDonald et al., 2000)
- Consensus-based PEC – 48.6 mg/kg (MacDonald et al. 2000)

The maximum concentration exceeds the TEC but not the PEC. As mentioned above, the most likely source of metals in sediment is surface soil run-off from SWMU 10, because the headwaters of all the tributaries originate at SWMU 10 (see Figure 7-16). Because nickel concentrations in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and are not site-related, it is likely that the nickel in the sediment is not site related. Also, because none of the nickel concentrations exceeded the PEC, and the concentrations in four samples are between the TEC and the PEC, impacts to benthic invertebrates are possible, but not probably. Therefore, although it is possible that the nickel concentrations in the sediment are adversely impacting benthic invertebrates at some locations, the nickel in the sediment does not appear to be related to site activities. For that reason, site-related risks to benthic invertebrates from nickel are acceptable so nickel is not retained as a COPC for risks to sediment dwelling invertebrates. Because nickel is a bioaccumulative chemical, risks to piscivorous wildlife from nickel are evaluated in Section 7.7.6.3 of this ERA.

Vanadium

Vanadium was initially selected as a COPC because a Region 5 screening level is not available. The only available alternate benchmark for vanadium is the AET of 57 mg/kg (Buchman, 1999), which is based on marine organisms. Based on the Navy's agreement with U.S. EPA, if a chemical only has a higher effects level such as an AET the chemical will not be eliminated as a COPC even if the maximum detection is below the higher effects level, unless other Step 3a factors can be used to justify the chemicals elimination as a COPC. At SWMU 10, vanadium was detected at concentrations less than the AET in all but one sample. The maximum detection (63.2 mg/kg) was detected at location 10SD04.

As mentioned above, the most likely source of metals in sediment is surface soil run-off from SWMU 10, because the headwaters of all the tributaries originate at SWMU 10 (see Figure 7-16). Because vanadium concentrations in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and are not site-related, it is likely that the vanadium in the sediment is not site related. Therefore, although risks to benthic invertebrates cannot be ruled out because of the lack of lower-effects toxicity data, any potential site-related risks from vanadium are not great enough to warrant carrying vanadium further through the BERA process. Vanadium is not retained as a COPC for risks to sediment dwelling invertebrates.

Zinc

Zinc was initially selected as a COPC because the maximum detected sediment concentration (301 mg/kg) exceeded the Region 5 screening level. However, the most recent ESL (U.S. EPA, 2003) is based on the consensus-based TEC and is therefore a more appropriate value for comparing to the maximum zinc concentration:

- Consensus-based TEC – 121 mg/kg (MacDonald et al., 2000)
- Consensus-based PEC – 459 mg/kg (MacDonald et al. 2000)

The maximum concentration exceeds the consensus-based TEC and not the consensus based PEC. Only the maximum concentration exceeds the TEC; all other sample concentrations are less than the TEC; therefore risks to sediment dwelling invertebrates at this location (10SW09) are possible. Risks to sediment dwelling invertebrates at all other locations are acceptable. As mentioned above, the most likely source of metals in sediment is surface soil run-off from SWMU 10, because the headwaters of all the tributaries originate at SWMU 10 (see Figure 7-16). Because zinc concentrations in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and are not site-related, it is likely

that the zinc in the sediment is not site related. Therefore, although risks to benthic invertebrates cannot be ruled out at the location of the maximum detection, any potential site-related risks from zinc are not great enough to warrant carrying zinc further through the BERA process (i.e., they reflect background concentrations). Risks to sediment dwelling invertebrates are acceptable and zinc is not retained as a COPC. Because zinc is a bioaccumulative chemical, risks to piscivorous wildlife from nickel are evaluated in Section 7.7.6.3 of this ERA.

7.7.6.1.3 Surface Water

Table 7-30 presents a summary of the common alternate benchmarks used in refining the list of COPCs in surface water, along with a summary of the Step 3a evaluation. Water-quality standards (WQS) for surface water have been developed for Indiana (IDEM, 1998). In addition, U.S. EPA has established water-quality criteria (WQC) for a few contaminants (U.S. EPA, November 2002). The Indiana WQS were not used in the evaluation because the WQS are based on the dated U.S. EPA WQC. Therefore, it is more appropriate to use the updated U.S. EPA WQC.

A total of 12 samples were collected and analyzed for total and filtered metals. The Step 3a evaluation was focused primarily on the filtered results because it is the dissolved portion (i.e. filtered) that is considered to be bioavailable (U.S. EPA, 1992). However, both unfiltered and filtered samples are presented in Table 7-30 and discussed herein for informational purposes. Unfiltered surface water results were used for food chain modeling (Section 7.7.6.3).

2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX

These energetics were initially selected as COPCs because no Region 5 surface water screening levels were available. The maximum detections of TNT (4.4 µg/L), 2-ADNT (0.41 µg/L), HMX (22 µg/L), and RDX (18 µg/L) were less than the chronic water-quality screening benchmark (for 2,4,6-TNT) of 90 µg/L, and secondary chronic values (SCVs) of 20 µg/L, 330 µg/L, and 190 µg/L, for 2-ADNT,, HMX, and RDX, respectively, developed in Talmage et al. (1999). No screening benchmarks are available for 4-amino-2,6-dinitrotoluene (4-ADNT), but the maximum detection of 1.4 µg/L is likely below concentrations that would cause a risk to aquatic receptors, based on the screening benchmarks for the other energetic compounds. Therefore, the energetics in the surface water are not likely to cause adverse effects to aquatic receptors and risks are considered acceptable; energetics are not retained as COPCs for risks to aquatic receptors.

Aluminum

Aluminum was initially selected as a COPC because a Region 5 screening level is not available. The maximum concentration of aluminum was detected in sample 10SW0801 at 837 µg/L. Aluminum was detected in 11 of 12 unfiltered samples collected but was not detected in the filtered samples. For this reason, risks associated with aluminum to aquatic organisms are considered acceptable because it is only the dissolved portion of the metals that is considered bioavailable (U.S. EPA, 1992). Therefore, aluminum is not retained as a COPC for aquatic receptors.

Iron

Iron was initially selected as a COPC because a Region 5 screening level is not available. The maximum detected iron concentration was 1,120 µg/L (for unfiltered), but all other iron detections (both filtered and unfiltered) were less than 877 µg/L. Iron was detected frequently in samples with average surface water concentrations of 510 µg/L (unfiltered samples) and 231 µg/L (filtered samples). The U.S. EPA WQC (U.S. EPA, November 2002) for iron is 1,000 µg/L. The maximum iron concentration in filtered samples (which represents the most bioavailable portion of iron in the water column) is less than the WQC. Therefore, risks to aquatic receptors are acceptable and iron is not retained as a COPC for aquatic receptors.

Manganese

Manganese was initially selected as a COPC because a Region 5 screening level is not available. Because an EDQL and AWQC are not available for manganese, concentrations in the surface water are compared to the following benchmark:

- ORNL chronic benchmark for aquatic life - 120 µg/L (Suter and Tsao, 1996))

The ORNL chronic benchmark was developed using the Tier II method described in the U.S. EPA's Proposed Water Quality Guidance for the Great Lakes System in U.S. EPA (1993b) (Suter and Tsao, 1996). Tier II values were developed so that aquatic benchmarks could be established with fewer data than are required for the U.S. EPA water quality criteria. Tier II values are concentrations expected to be higher than AWQC in no more than 20 percent of cases (Suter and Tsao, 1996). Also, in the U.S. EPA 1986 Quality Criteria for Water (the Gold Book), it states that ions of manganese are found rarely at concentrations above 1 mg/L and, because the tolerance values reported range from 1.5 mg/L to over 1000 mg/L, manganese is not considered to be a problem in fresh waters (U.S. EPA, 1986). For manganese, the maximum detected concentration was 139 µg/L (filtered). Because the ORNL

benchmark for manganese is very conservative (Suter and Tsao, 1996), risks to aquatic life from manganese is expected to be low especially based on the information in U.S. EPA (1986). For these reasons, risks to aquatic organisms from manganese in the surface water are acceptable and manganese is not retained as a COPC for these receptors.

Zinc

Zinc was initially selected as a COPC because the maximum detected surface water concentrations (113 µg/L for unfiltered and 102 µg/L for filtered) at location 10SW09 exceeded the Region 5 screening level of 58.8 µg/L. However the maximum concentrations are less than the U.S. EPA WQC for chronic and acute (248 µg/L) exposure, after adjusting for a hardness of 260 mg/L in the sample with the greatest zinc detections (U.S. EPA, November 2002). The zinc concentrations in the other sample in which zinc was detected were less than the EDQL. Therefore, zinc is not expected to cause a risk to aquatic organisms and zinc is not retained as a COPC for these receptors.

7.7.6.2 Risks to Terrestrial Wildlife

The discussions in Sections 7.7.6.2.1 and 7.7.6.2.2 were not designed to evaluate risks to wildlife through ingestion of food items, drinking water, and incidental ingestion of soil. Instead, a food-chain model was used to evaluate potential risks posed by COPCs to upper-level terrestrial wildlife receptors. Section 3.4.4.2 describes the food-chain model methodology. Chemicals evaluated in the terrestrial food-chain model were limited to those identified by the U.S. EPA as bioaccumulative (U.S. EPA, 2000). Separate discussions are provided below for evaluations of potential risk to insectivorous/herbivorous and piscivorous receptors. The 95% UCL detected in the surface soil, surface water, and sediment samples is used as the EPC for the conservative food chain model. The average concentration detected in the surface soil, surface water, and sediment samples is used as the EPC for the average food chain model. Appendix H.4 presents the spreadsheets used to calculate the doses and EEQs.

7.7.6.2.1 Risks to Insectivorous/Herbivorous Receptors

Table 7-31 presents the terrestrial wildlife model EEQs based on conservative input parameters, for the meadow vole, short-tailed shrew, American robin, and northern bobwhite quail. No EEQs are calculated for some of the energetics because NOAELs and LOAELs have not been developed for those chemicals. The NOAEL and LOAEL EEQs calculated for HMX are greater than 1.0 for the meadow vole (33 and 13, respectively) and the short-tailed shrew (14 and 5.6, respectively). The NOAEL and LOAEL EEQ calculated for zinc is greater than 1.0 at 10 and 1.1, respectively in the American robin food chain model.

Table 7-32 presents the terrestrial wildlife model EEQs (based on average input parameters NOAELs and LOAELs) for those chemicals with NOAEL based EEQs greater than 1.0 under the maximum input, conservative scenario. The NOAEL and LOAEL EEQs calculated for HMX in the meadow vole model are 5.2 and 2.1, respectively. The NOAEL EEQ calculated for HMX is also greater than 1.0 in the shrew model at 1.4. Finally, the NOAEL EEQ calculated for zinc in the robin model is 1.7 while the LOAEL EEQ is less than 1.0.

Average COPC concentrations are typically more realistic exposure point concentrations (EPCs) for mammals and birds than maximum concentrations because mammals and birds are exposed to COPC concentrations throughout the SWMU, rather than a single location. However, for SWMU 10, average COPC concentrations serve to overestimate risks to mammals and birds because the majority of the surface soil samples were collected in the middle of the site where there is little ecological habitat. This is especially true for the energetic chemicals which were almost solely detected in the samples from the industrial area (see Figure 7-10)

The mammal NOAEL and LOAEL for HMX were developed from a study in which no significant increase in mortality was observed among mice consuming 30 mg/kg-day HMX, but a significant increase in mortality was observed among mice consuming 75 mg/kg-day HMX (Talmage et al., 1999). Because the study was 13 weeks in duration the 30 mg/kg-day dose was considered a subchronic NOAEL and the 75 mg/kg-day dose was considered a subchronic LOAEL. The NOAEL and LOAEL values were multiplied by 0.1 to derive estimated chronic values. All of the HMX detections were in samples collected from the industrialized area of the SWMU where there is little ecological habitat (see Figure 7-10). Therefore, although the NOAEL and LOAEL EEQs calculated for HMX in the meadow vole model, and the NOAEL EEQ calculated for HMX in the shrew model are greater than 1.0, impacts to mammals are not expected from HMX because mammals will not be feeding in the area of the HMX detections. For that reason, risks to mammals from HMX in the soil are acceptable and HMX is not retained as a COPC for risks to mammals.

Zinc was included in the food chain model because it is bioaccumulative and it was retained as a COPC in surface water. It was not retained as a COPC in surface soil, because the concentrations of zinc in the surface soil were within background concentrations. The surface water portion of the dose in the food chain model for the robin is less than 1 percent of the total dose. In fact, if the surface water component of the food chain model is removed, the NOAEL EEQ calculated for zinc in the robin model remains 1.7. This indicates that the EEQ is driven by the zinc concentration in the soil, which is within background levels. Therefore, risks to robins from zinc in the soil are within background risks so risks are acceptable and zinc is not retained as a COPC for risks to birds.

7.7.6.2.2 Risks to Piscivorous/Aquatic Invertebrate-Eating Receptors

Table 7-33 presents a summary of the terrestrial wildlife model EEQs based on conservative input parameters for the raccoon, belted kingfisher, and little brown bat. No EEQs are calculated for some of the energetics because NOAELs and LOAELs have not been developed. Overall, chemicals had EEQs exceeding 1.0 in the raccoon and bat food chain model only. No chemicals had NOAEL or LOAEL EEQs greater than 1.0 in the kingfisher model. The NOAEL EEQ calculated for HMX was greater than 1.0 in the raccoon model while the LOAEL EEQ was less than 1.0. The NOAEL and LOAEL EEQs calculated for all seven inorganics were greater than 1.0 in the raccoon model. The NOAEL and LOAEL EEQs calculated for arsenic were greater than 1.0 in the bat food chain model.

Table 7-34 presents the terrestrial wildlife model EEQs (based on average input parameters NOAELs and LOAELs) for those chemicals with NOAEL based EEQs greater than 1.0 under the maximum input, conservative scenario. EEQs calculated for arsenic were less than 1.0 in the bat model. Overall in the raccoon food chain model, NOAEL and LOAEL exceedances were similar although the NOAEL EEQ calculated for HMX was less than 1.0. The greatest NOAEL and LOAEL EEQs were calculated for arsenic (4,500 and 450, respectively). NOAEL EEQs calculated for cadmium, chromium, copper, lead, nickel, and zinc ranged from 1.3 (copper) to 30 (chromium). LOAEL based EEQs for these inorganics ranged from 1.0 (copper) to 7.5 (chromium) (see Table 7-34). Although, risks to mammals consuming fish are possible because the LOAEL EEQs calculated for several inorganics were greater than 1.0, actual site-related risks are unlikely for the following reasons:

- The water bodies associated with SWMU 10 are expected to account for only a small portion of the raccoon's diet, because the home range of the raccoon (>250 acres) is much larger than the SWMU. Also, the streams are very small and likely do not have large enough numbers of fish to support the diet of raccoons.

- As presented in Section 7.7.6.1.2, the most likely source of metals in sediment is surface soil run-off from SWMU 10, because the headwaters of all the tributaries originate at SWMU 10 (see Figure 7-16). All of the metals in the surface soil samples are within background concentrations (see Section 7.7.6.1.1) and are not site-related. Therefore, it is likely that the metals in the sediment are not site related so any risks would not be site-related.

- All the metals have high EEQs, in part, because there are no sediment to fish BAF values for inorganics. Therefore, a BAF of 1.0 is used in the model, which assumes that the fish tissue

concentrations are equal to the sediment concentrations. This likely overestimates the exposure dose to the raccoon, which then increases the calculated EEQs.

For the reasons listed above, risks to piscivorous mammals are acceptable so metals are not retained as COPC in sediment for risks to mammals.

7.7.7 Ecological Risk Uncertainty Analysis

Section 3.4.6 in the general methodology section presents the uncertainties that apply to all the SWMUs. The uncertainty analysis presented in this section is the uncertainties associated with SWMU 10.

7.7.7.1 Measurement and Assessment Endpoints

As presented in Section 7.7.2, several assessment endpoints are selected for this risk assessment, including the selection of piscivorous wildlife as an assessment endpoint. The waterbodies adjacent to SWMU 10 are unlikely to contain a significant fish populations. Therefore, risks to piscivorous wildlife are overestimated. Also, the little brown bat is used as a surrogate species for the Indiana bat, based on the availability of exposure data for the little brown bat. Therefore, the calculated risks may be slightly different for the Indiana bat.

Risks to reptiles and amphibians are not quantitatively evaluated because exposure factors are not established for most species and toxicity data are very limited. Using aquatic organisms as a surrogate species, risks to amphibians exposed to the surface water and sediment are expected to be acceptable based on the Step 3a evaluations. Potential risks to reptiles cannot be evaluated in this ERA because of a lack of toxicity and exposure data (see below for a discussion of potential risks to the timber rattlesnake).

Food-chain modeling was not conducted for large carnivorous mammals and birds for several reasons including, the uncertainty of estimating contaminant uptake into the diet source (small mammal tissue) and area use factors discussed in Appendix H.2. Four explosives were retained as COPCs in surface soil samples. Explosives are not expected to bioaccumulate in small mammals. According to Major et al. (2002), "because of the rapid excretion and lack of bioaccumulation in animals, it is unlikely that nitroaromatic compounds could be transferred between predator and prey animal species." Additionally, carnivorous birds and mammals are expected to obtain only a small fraction of their food from SWMU 10. The boundaries of SWMU 10 are approximately 10 acres and home ranges of the red fox and red-tailed hawk are 193 acres and 370 acres, respectively (U.S. EPA, 1993). Risks are expected to be greatest to

small herbivorous and insectivorous mammals and birds because it is assumed that these species obtain all of their food from SWMU 10.

As discussed in Section 1.3.7, several endangered and threatened species or species of special concern are present at NSWC Crane, and potentially may inhabit SWMU 10. Risks to these species were not specifically calculated so the uncertainties of not calculating risks to these species are presented here. As discussed above, risks to large carnivorous mammals and birds are expected to be negligible so risks to the bobcat, bald eagle, Northern harrier, and osprey are expected to be negligible, as are risks to carnivorous reptiles such as the timber rattlesnake. Loggerhead shrikes and the sedge wren consume mostly aboveground insects such as caterpillars, beetles, spiders, and flies, as opposed to the worms that are consumed by the American robin in the food-chain model. Because worms are in direct contact with exposure to the soil, it is expected that they would have greater levels of contaminants at SWMU 10 than aboveground insects; therefore, risks to the robin from consuming worms are expected to be greater than risks to the loggerhead shrike and sedge wren from consuming aboveground insects. Risks to the worm eating American robin from chemicals in the surface soil and surface water were acceptable; therefore, risks to the loggerhead shrike and sedge wren are also considered acceptable if these species are present at SWMU 10. The American bittern is a marshland loving bird that feeds on fish, frogs, eels, insects, and water snakes. Although there is some aquatic habitat, it is not suitable for the bittern. Additionally, risks to the belted kingfisher were acceptable; therefore, risks to the American bittern, if present at SMWU 10, would also be acceptable.

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 1.3.7, one threatened reptilian species is listed as potentially present at NSWC Crane. Based on the preferred habitat of the timber rattlesnake and the ecology of SWMU 10, this species may potentially inhabit areas of SWMU 10. Risks to these species were not specifically calculated so uncertainties exist as to how this species would be affected if an exposure to site chemical concentrations occurred.

7.7.7.2 Exposure Characterization

An upgradient surface water or sediment sample could not be identified for the site. Therefore, some inorganic chemicals may have been carried through the screening process, even though there are detected at background levels. This would cause the risk to be overestimated.

7.7.7.3 Ecological Effects Data

Toxicological data for a few of the chemicals are limited or do not exist. This occurred for a several inorganics in the surface soil, but it did not affect the outcome of the risk assessment because the chemicals without toxicity data were detected below base-specific background levels. This also occurred for some inorganics in the sediment, but it did not affect the outcome of the risk assessment because most of the samples with chemical without toxicity data were detected below Indiana background levels.

Several alternative benchmark values were used to gain a better understanding of the relationship between the maximum concentration values of the selected COPCs to the overall ecological assessment of the site. There is some uncertainty involved when using these alternative benchmarks. However, attempts have been made to lessen the uncertainties by providing the toxicological basis of the alternate benchmarks when they were used.

7.8 CONCLUSIONS

Tables 7-28, 7-29, 7-30, and 7-35 present summaries of the Step 3a evaluation including the overall conclusion of whether chemicals initially selected as COPCs are retained as COPCs after the refined evaluation. Based on the SERA and the first step of the BERA (step 3a), the following conclusions were made:

Terrestrial Plants and Invertebrates

After the initial screening, four energetics were initially selected as COPCs because Region 5 screening levels were not available. The potential risks to terrestrial vegetation and soil invertebrates associated with all the COPCs in the surface soil were further evaluated to determine whether site-related risks from the chemicals were acceptable or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

Toxicity data in the literature were found for the energetics to evaluate potential risks to plants and soil invertebrates from the detected concentrations of these chemicals in the soil. The detected concentrations were less than the effects levels, although some of the effects levels were LOECs because NOECs were not available for some endpoints for some chemicals. However, most of detections of the energetics were in the middle of the site in the industrial area that has many buildings and roadways (see Figures 1-14 and 7-10). One detection of 2-ADNT was located outside of this area but the concentration in that sample was lower than no effects levels. Therefore, although potential impacts to plants and invertebrates exist based solely on a comparison of detected concentrations to

toxicity values, the habitat where these energetics were detected does not support significant plant or invertebrate populations. The areas surrounding SWMU 10 boundaries are heavily vegetated (see Figure 1-14), so it does not appear that the energetics are significantly impacting plants in areas where terrestrial vegetation habitat exists. For these reasons, risks to plants and soil invertebrates from energetics in the soil are acceptable so energetics were not retained as COPCs for risks to plants and invertebrates.

In summary, no chemicals were retained as COPCs for risks to plants or invertebrates. However, although energetics are not typically considered to be bioaccumulative chemicals, risks to terrestrial wildlife from energetics are evaluated in Section 7.7.6.3 of this ERA to be conservative.

Benthic Invertebrates

After the initial screening, one energetic and 15 inorganics were initially selected as COPCs. Potential risks to sediment invertebrates associated with all the COPCs in the sediment were further evaluated to determine whether site-related risks from the chemicals were acceptable and/or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

For the one energetic (HMX) it was determined that the maximum detected concentration was less than toxicity data from the literature based on survival so risks from HMX were determined to be acceptable and HMX was eliminated as a COPC for risks to sediment invertebrates. Although, HMX is not considered a bioaccumulative chemical, risks to piscivorous wildlife from HMX in the sediment are evaluated in Section 7.7.6.3 of this ERA to be conservative.

Several of the inorganics were detected at concentrations that were greater than effects levels indicating the potential impacts to sediment invertebrates were possible, or even probable for some inorganics. However, the most likely source of metals in sediment is surface soil run-off from SWMU 10, because the headwaters of all the tributaries originate at SWMU 10 (see Figure 7-16). All of the inorganics in the surface soil samples were detected at concentrations within background concentrations (see Section 7.7.6.1.1) and are not site-related. Therefore, although it is possible that the concentrations of some inorganics in the sediment are adversely impacting benthic invertebrates at some locations, the inorganics in the sediment do not appear to be related to site activities. For that reason, site-related risks to benthic invertebrates from inorganics were determined to be acceptable so inorganics were not retained as COPCs for risks to sediment dwelling invertebrates.

In summary, no chemicals were retained as COPCs for risks to sediment invertebrates. However, because several of the inorganics are bioaccumulative chemicals, risks to piscivorous wildlife from these inorganics in the sediment are evaluated in Section 7.7.6.3 of this ERA.

Aquatic Organisms

After the initial screening, five energetics and four inorganics were initially selected as COPCs. Potential risks to aquatic receptors associated with all the COPCs in the surface water were further evaluated to determine whether site-related risks from the chemicals were acceptable or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

The detected concentrations of four of the five energetics (TNT, 2-ADNT, HMX, and RDX) were less than chronic benchmarks in the literature so risks to aquatic organisms from the levels of those energetics in the surface water are not expected. There was not toxicity data for the fifth energetic (4-ADNT) but the concentration was low compared to the chronic benchmarks for the other energetics, so risks to aquatic organisms from the levels of that energetic in the surface water are not expected. Therefore, risks to aquatic receptors from energetics in the surface water at SWMU 10 are acceptable so the energetics were eliminated as COPCs for risks to aquatic receptors.

Of the four inorganic chemicals retained as COPCs in surface water, aluminum was not detected in the filtered samples so risks to aquatic receptors from aluminum are not likely. Also, the concentrations of iron and zinc were less than U.S. EPA WQC so risks to aquatic receptors from these metals are not likely. Finally, the manganese levels in surface water are below levels expected to cause toxicity to aquatic receptors. Therefore, risks to aquatic receptors from inorganics in the surface water at SWMU 10 are acceptable so the inorganics were eliminated as COPCs for risks to aquatic receptors.

In summary, no chemicals were retained as COPCs for risks to aquatic organisms. However, because zinc is bioaccumulative, risks to piscivorous wildlife from the zinc are evaluated in Section 7.7.6.3 of this ERA. Also, although energetics are not typically considered to be bioaccumulative chemicals, risks to terrestrial wildlife from energetics in the surface water are evaluated in Section 7.7.6.3 of this ERA to be conservative.

Summary of Food Chain Modeling

After the initial screening, several energetics and inorganics were initially selected as COPCs for potential risks to mammals and birds. In Step 3a, one energetic and one metal inorganics in soil/surface water

were included in the food chain model for insectivorous and herbivorous mammals and birds. Also, five energetics and seven inorganics in sediment/surface water were included in the food chain model for piscivorous mammals and birds. The potential risks to mammals and birds associated with all the COPCs in the surface soil, sediment, and/or surface water were further evaluated to determine whether site-related risks from the chemicals were acceptable or whether the risks were great enough to warrant retaining the chemicals as COPCs and proceeding further into the BERA.

Risks to Insectivorous/Herbivorous Receptors

In the less conservative food chain model, the NOAEL and LOAEL EEQs calculated for HMX in the meadow vole model and the NOAEL EEQ calculated for HMX in the shrew model are greater than 1.0. Also, the NOAEL EEQ calculated for zinc in the robin model is greater than 1.0.

Although the NOAEL and LOAEL EEQs calculated for HMX in the meadow vole model, and the NOAEL EEQ calculated for HMX in the shrew model are greater than 1.0, impacts to mammals are not expected from HMX because mammals will not be feeding in the area of the HMX detections. This is because all of the HMX detections were in samples collected from the industrialized area of the SWMU where there is little ecological habitat (see Figure 7-10). For that reason, risks to mammals from HMX in the soil are within background risks so risks are acceptable and HMX is not retained as a COPC for risks to mammals.

Zinc was included in the food chain model because it is bioaccumulative and it was retained as a COPC in surface water. It was not retained as a COPC in surface soil, however, because the concentrations of zinc in the surface soil were within background concentrations. If the surface water component of the food chain model is removed, the NOAEL EEQ calculated for zinc in the robin model remains 1.7. This indicates that the EEQ is driven by the zinc concentration in the soil, which is within background levels. Therefore, risks to robins from zinc in the soil are within background risks so risks are acceptable and zinc is not retained as a COPC for risks to birds.

Risks to Piscivorous Receptors

In the less conservative food chain model, the NOAEL EEQs calculated for seven inorganics and the LOAEL EEQs calculated for six inorganics in the raccoon model are greater than 1.0. Although, risks to mammals consuming fish are possible because the LOAEL EEQs calculated for several inorganics were greater than 1.0, actual site-related risks are unlikely for the following reasons:

- The water bodies associated with SWMU 10 are expected to account for only a small portion of the raccoon's diet, because of the raccoon's home range an because the streams are very small and likely do not have large enough numbers of fish to support the diet of raccoons.

- The exposure dose to the raccoon is likely overestimated by using default BAFs of 1.0 are used in the food chain model to estimate fish tissue concentrations from the sediment because chemical-specific BAFs for metals are not available. This overestimate of dose causes the EEQ to be overestimated.

- Finally, it is likely that the metals in the sediment are not site related so any risks would not be site-related.

In summary, for the reasons listed above, risks to piscivorous mammals are acceptable so metals are not retained as COPC in sediment for risks to mammals.

TABLE 7-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 10 – ROCKEYE
NSWC CRANE, CRANE, INDIANA

Location	Sample Depth	Sample Number	Analyses					
			Appendix IX SVOCs (PAHs via SIM)	Appendix IX VOCs	Explosives	TAL Metals + Sn	Cyanide	Miscellaneous Parameters(1)
SURFACE/SUBSURFACE SOIL								
10SB01	0 - 2 feet bgs	10SB010002	NA	NA	X	X	X	NA
	8 - 10 feet bgs	10SB010810	NA	NA	X	X	X	X
10SB02	0 - 2 feet bgs	10SB020002	NA	NA	X	X	X	X
	7 - 9 feet bgs	10SB020709	NA	NA	X	X	X	NA
10SB03	0 - 2 feet bgs	10SB030002	X	NA		X	X	NA
	8 - 10 feet bgs	10SB030810	X	NA		X	X	NA
10SB03-REM	replacement	10SB030002-REM	NA	NA	X	NA	NA	NA
		10SB030810-REM	NA	NA	X	NA	NA	NA
10SB04	0 - 2 feet bgs	10SB040002	NA	NA	X	X	X	NA
	3 - 5 feet bgs	10SB040305	NA	NA	X	X	X	X
10SB05	0 - 2 feet bgs	10SB050002	NA	NA	X	X	X	NA
	4 - 6 feet bgs	10SB050406	NA	NA	X	X	X	NA
10SB06	0 - 2 feet bgs	10SB060002	NA	NA	X	X	X	NA
	5 - 7 feet bgs	10SB060507	NA	NA	X	X	X	X
10SB07	0 - 2 feet bgs	10SB070002	NA	NA	X	X	X	NA
	4 - 6 feet bgs	10SB070406	NA	NA	X	X	X	NA
10SB08	0 - 2 feet bgs	10SB080002	NA	NA	X	X	X	X
	4 - 6 feet bgs	10SB080406	NA	NA	X	X	X	NA
10SB09	0 - 2 feet bgs	10SB090002	NA	NA	X	X	X	NA
	2 - 4 feet bgs	10SB090204	NA	NA	X	X	X	X
10SB10	0 - 2 feet bgs	10SB100002	NA	NA	X	X	X	NA
	6 - 8 feet bgs	10SB100608	NA	NA	X	X	X	X
SEDIMENT								
10SW/SD01	0 - 6 inches	10SD010006	NA	NA	X	X	X	X
10SW/SD02	0 - 6 inches	10SD020006	NA	NA	X	X	X	X
10SW/SD03	0 - 6 inches	10SD030006	NA	NA	X	X	X	X
10SW/SD04	0 - 6 inches	10SD040006	NA	NA	X	X	X	X

TABLE 7-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 10 – ROCKEYE
NSWC CRANE, CRANE, INDIANA

Location	Sample Depth	Sample Number	Analyses					
			Appendix IX SVOCs (PAHs via SIM)	Appendix IX VOCs	Explosives	TAL Metals + Sn	Cyanide	Miscellaneous Parameters(1)
10SW/SD05	0 - 6 inches	10SD050006	NA	NA	X	X	X	X
10SW/SD06	0 - 6 inches	10SD060006	NA	NA	X	X	X	X
10SW/SD07	0 - 6 inches	10SD070006	NA	NA	X	X	X	X
10SW/SD08	0 - 6 inches	10SD080006	NA	NA	X	X	X	X
10SW/SD09	0 - 6 inches	10SD090006	NA	NA	X	X	X	X
10SW/SD10	0 - 6 inches	10SD100006	NA	NA	X	X	X	X
10SW/SD11	0 - 6 inches	10SD110006	NA	NA	X	X	X	X
10SW/SD12	0 - 6 inches	10SD120006	NA	NA	X	X	X	X
GROUND WATER								
10-02		10GW0201	NA	NA	X	X	X	X
10-03		10GW0301	X	X	X	X	X	X
10-16		10GW1601	NA	NA	X	X	X	X
10-17		10GW1701	NA	NA	X	X	X	X
10C26		10GWC2601	X	X	NA	NA	NA	NA
10C26P3		10GWC26P301	X	X	NA	NA	NA	NA
10C31		10GWC3101	X	X	X	X	X	X
10C31P3		10GWC31P301	X	X	X	X	X	X
10C33		10GWC3301	NA	NA	X	X	X	X
10C33P2		10GWC33P201	NA	NA	X	X	X	X
10C35		10GWC3501	NA	NA	X	X	X	X
10C35P2		10GWC35P201	NA	NA	X	X	X	X
10C37		10GWC3701	NA	NA	X	X	X	X
10C37P3		10GWC37P301	NA	NA	X	X	X	X
10C41		10GWC4101	X	X	X	X	X	X

TABLE 7-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 10 – ROCKEYE
NSWC CRANE, CRANE, INDIANA

Location	Sample Depth	Sample Number	Analyses					
			Appendix IX SVOCs (PAHs via SIM)	Appendix IX VOCs	Explosives	TAL Metals + Sn	Cyanide	Miscellaneous Parameters(1)
10C41P3		10GWC41P301	X	X	X	X	X	X
10C52		10GWC5201 (upgradient)	X	X	X	X	X	X
10C55		10GWC5501	X	X	X	X	X	X
10C55P2		10GWC55P201	X	X	X	X	X	X
10C57		10GWC5701	NA	NA	X	X	X	X
		10GWC5701-F	NA	NA	NA	X	NA	NA
SURFACE WATER								
10SW/SD01		10SW0101	NA	NA	X	X	X	X
		10SW0101-F	NA	NA	NA	X	NA	NA
10SW/SD02		10SW0201	NA	NA	X	X	X	X
		10SW0201-F	NA	NA	NA	X	NA	NA
10SW/SD03		10SW0301	NA	NA	X	X	X	X
		10SW0301-F	NA	NA	NA	X	NA	NA
10SW/SD04		10SW0401	NA	NA	X	X	X	X
		10SW0401-F	NA	NA	NA	X	NA	NA
10SW/SD05		10SW0501	NA	NA	X	X	X	X
		10SW0501-F	NA	NA	NA	X	NA	NA
10SW/SD06		10SW0601	NA	NA	X	X	X	X
		10SW0601-F	NA	NA	NA	X	NA	NA
10SW/SD07		10SW0701	NA	NA	X	X	X	X
		10SW0701-F	NA	NA	NA	X	NA	NA
10SW/SD08		10SW0801	NA	NA	X	X	X	X
		10SW0801-F	NA	NA	NA	X	NA	NA

TABLE 7-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 10 – ROCKEYE
NSWC CRANE, CRANE, INDIANA

Location	Sample Depth	Sample Number	Analyses					
			Appendix IX SVOCs (PAHs via SIM)	Appendix IX VOCs	Explosives	TAL Metals + Sn	Cyanide	Miscellaneous Parameters(1)
10SW/SD09		10SW0901	NA	NA	X	X	X	X
		10SW0901-F	NA	NA	NA	X	NA	NA
10SW/SD10		10SW1001	NA	NA	X	X	X	X
		10SW1001-F	NA	NA	NA	X	NA	NA
10SW/SD11		10SW1101	NA	NA	X	X	X	X
		10SW1101-F	NA	NA	NA	X	NA	NA
10SW/SD12		10SW1201	NA	NA	X	X	X	X
		10SW1201-F	NA	NA	NA	X	NA	NA

App. IX = Appendix IX.
NA = Not analyzed.
PAHs = Polycyclic aromatic hydrocarbons.
TAL = Target analyte list.
SIM = Selective ion monitoring.
Sn = Tin.
SVOCs = Semivolatile organic compounds.
VOCs = Volatile organic compounds.

Note: Sample numbers ending with "F" were field filtered prior to metals analyses.

1 Miscellaneous parameters -
- surface and subsurface soil were analyzed for cation exchange capacity, pH, and total organic carbon.
- ground water samples were analyzed for cyanide and nitrite/nitrate.
- surface water samples were analyzed for hardness and total suspended solids.
- sediment samples were analyzed for total organic carbon.

TABLE 7-2

SUMMARY OF POSITIVE SURFACE SOIL ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Sample Identification	10SB010002	10SB020002	10SB030002	10SB040002	10SB050002	10SB060002	10SB070002	10SB080002	10SB090002	10SB100002	10SB030002-REM
Depth range (feet bgs)	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	
Soil Group:	3	3	3	3	3	3	3	3	3	3	
Semi-Volatiles (µg/kg)											
ACENAPHTHYLENE			470 J								
ANTHRACENE			110 J								
BENZO(A)ANTHRACENE			530 J								
BENZO(A)PYRENE			990 J								
BENZO(B)FLUORANTHENE			960 J								
BENZO(G,H,I)PERYLENE			860 J								
BENZO(K)FLUORANTHENE			740 J								
BIS(2-ETHYLHEXYL)PHTHALATE			380 U								
CHRYSENE			560 J								
DIBENZO(A,H)ANTHRACENE			200 J								
FLUORANTHENE			370 J								
FLUORENE			38.0 U								
INDENO(1,2,3-CD)PYRENE			610 J								
PHENANTHRENE			130 J								
PYRENE			390 J								
Explosives (mg/kg)											
2-AMINO-4,6-DINITROTOLUENE	0.50 U	0.50 U		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.53	0.50 U	0.50 U
HMX	0.50 U	1.3		5.0	55	0.50 U	4.0	0.50 U	0.50 U	0.50 U	44.3
RDX	0.50 U	1.6		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	<0.71
2,4-Trinitrotoluene	0.50 U	0.50 U		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.53
Inorganics (mg/kg)											
ALUMINUM	7510 J	7980 J	8220 J	4970 J	12200 J	5260 J	7270 J	1530 J	8120 J	9520 J	
ARSENIC	3.4 J	3.9 J	4.4	4.0 J	3.6 J	3.2 J	2.7 J	0.87	9.3 J	4.5	
BARIUM	52.1 J	55.4 J	48.0 J	54.1 J	117 J	46.8 J	50.9 J	60.4 J	95.8 J	72.1 J	
BERYLLIUM	0.85 U	0.90 U	0.80 U	0.87 U	1.0 J	0.81 U	0.86 U	0.57 U	0.88 U	0.99 U	
CADMIUM	0.85 U	3.4 J	0.80 U	0.87 U	0.98 U	0.81 U	0.86 U	0.57 U	1.0 J	0.99 U	
CALCIUM	1330	32100	19500 J	20000	1320	103000	2220	249000 J	6090	960 J	
CHROMIUM	8.4	9.4	11.3	6.4	14.0	10.8	8.8	6.5	22.0	13.0	
COBALT	4.0	4.5	3.5	4.4	8.2	3.6	3.3	1.5	9.7	6.3	
COPPER	8.0 J	12.3 J	9.7	8.3 J	11.3 J	6.3 J	7.7 J	2.0	9.8 J	9.4	
IRON	13100 J	14900 J	13900 J	11500 J	13600 J	12100 J	13800 J	3420 J	26500 J	18100 J	
LEAD	9.2	12.0	9.4 J	9.3	19.4	6.6	8.7	4.2 J	25.1	15.3 J	
MAGNESIUM	1340 J	3040 J	1740 J	1310 J	1380 J	10200 J	1010 J	14700 J	1190 J	1070 J	
MANGANESE	93.9 J	123 J	94.2	215 J	165 J	144 J	104 J	78.1	674 J	353	
MERCURY	0.05 U	0.05 U	0.03 U	0.03 U	0.04	0.04	0.04 U	0.04 U	0.04	0.05 U	
NICKEL	7.0	8.1	7.2	9.1	13.9	9.5	6.4	15.7	9.6	7.9	
POTASSIUM	427 UJ	452 UJ	401 UJ	434 UJ	506 J	405 UJ	430 UJ	321 J	440 UJ	493 UJ	
VANADIUM	16.4 J	18.1 J	17.9	11.3 J	25.6 J	13.2 J	16.0 J	4.4	26.6 J	21.2	
ZINC	21.7 J	40.8 J	24.8	46.8 J	36.0 J	29.7 J	19.8 J	27.5	50.0 J	43.3	
Miscellaneous Parameters											
CATION EXCHANGE CAPACITY (MEQ/100 G)		10.0 J						1.5 J			
pH (S.U.)		8.0 J						8.5 J			
TOTAL ORGANIC CARBON (mg/kg)		1900						1600			

TABLE 7-2

SUMMARY OF POSITIVE SURFACE SOIL ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Sample Identification	10SB010002	10SB020002	10SB030002	10SB040002	10SB050002	10SB060002	10SB070002	10SB080002	10SB090002	10SB100002	10SB030002-REM
Depth range (feet bgs)	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	
Soil Group:	3	3	3	3	3	3	3	3	3	3	

Blank cells indicate sample was not analyzed for this parameter.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e.; holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected in this sample as well as the associated laboratory method blank but has been qualified non-detected as a result of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

bgs = Below ground surface.

MEQ - milliequivalents

Soil Group 3 - Alluvial, Mississippian, Pennsylvanian surface soil as per "Basewide Background Soil Investigation Report," NSWC Crane, Indiana (TtNUS, January 2001).

S.U. = Standard units.

TABLE 7-3

SURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency(1)	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?(2)
Semi-Volatile Organics (µg/kg)									
208-96-8	ACENAPHTHYLENE	1/1	470	J	470	J	---	10SB030002	---
120-12-7	ANTHRACENE	1/1	110	J	110	J	---	10SB030002	---
56-55-3	BENZO(A)ANTHRACENE	1/1	530	J	530	J	---	10SB030002	---
50-32-8	BENZO(A)PYRENE	1/1	990	J	990	J	---	10SB030002	---
205-99-2	BENZO(B)FLUORANTHENE	1/1	960	J	960	J	---	10SB030002	---
191-24-2	BENZO(G,H,I)PERYLENE	1/1	860	J	860	J	---	10SB030002	---
207-08-9	BENZO(K)FLUORANTHENE	1/1	740	J	740	J	---	10SB030002	---
218-01-9	CHRYSENE	1/1	560	J	560	J	---	10SB030002	---
53-70-3	DIBENZO(A,H)ANTHRACENE	1/1	200	J	200	J	---	10SB030002	---
206-44-0	FLUORANTHENE	1/1	370	J	370	J	---	10SB030002	---
193-39-5	INDENO(1,2,3-CD)PYRENE	1/1	610	J	610	J	---	10SB030002	---
85-01-8	PHENANTHRENE	1/1	130	J	130	J	---	10SB030002	---
129-00-0	PYRENE	1/1	390	J	390	J	---	10SB030002	---
Explosives (mg/kg)									
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	1/10	0.53		0.53		0.5	10SB090002	---
2691-41-0	HMX	5/10	1.3		55		0.5	10SB050002	---
121-82-4	RDX	2/10	0.71		8		0.5	10SB030002	---
	2,4,6-Trinitrotoluene	1/10	0.53		0.53		0.5	10SB030002-REM	---
Inorganics (mg/kg)									
7429-90-5	ALUMINUM	10/10	1530	J	12200	J	---	10SB050002	NO
7440-38-2	ARSENIC	10/10	0.87		9.3	J	---	10SB090002	NO
7440-39-3	BARIUM	10/10	46.8	J	117	J	---	10SB050002	NO
7440-41-7	BERYLLIUM	1/10	1	J	1	J	0.57 - 0.99	10SB050002	NO
7440-43-9	CADMIUM	2/10	1	J	3.4	J	0.57 - 0.99	10SB020002	NO
7440-70-2	**CALCIUM**	**10/10**	**960**	**J**	**249000**	**J**	---	**10SB080002**	**YES**
7440-47-3	CHROMIUM	10/10	6.4		22		---	10SB090002	NO
7440-48-4	COBALT	10/10	1.5		9.7		---	10SB090002	NO
7440-50-8	COPPER	10/10	2		12.3	J	---	10SB020002	NO
7439-89-6	IRON	10/10	3420	J	26500	J	---	10SB090002	NO
7439-92-1	LEAD	10/10	4.2	J	25.1		---	10SB090002	NO
7439-95-4	**MAGNESIUM**	**10/10**	**1010**	**J**	**14700**	**J**	---	**10SB080002**	**YES**
7439-96-5	MANGANESE	10/10	78.1		674	J	---	10SB090002	NO

TABLE 7-3

SURFACE SOIL ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency(1)	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?(2)
7439-97-6	MERCURY	3/10	0.04		0.04		0.03 - 0.05	10SB050002, 10SB060002, 10SB090002	NO
7440-02-0	NICKEL	10/10	6.4		15.7		---	10SB080002	NO
7440-09-7	POTASSIUM	2/10	321	J	506	J	401 - 493	10SB050002	NO
7440-62-2	VANADIUM	10/10	4.4		26.6	J	---	10SB090002	NO
7440-66-6	ZINC	10/10	19.8	J	50	J	---	10SB090002	NO
Miscellaneous Parameter (MEQ/100 g)									
	CATION EXCHANGE CAPACITY	2/2	1.5	J	10	J	---	10SB020002	---
Miscellaneous Parameter (S.U.)									
	pH	2/2	8	J	8.5	J	---	10SB080002	---
Miscellaneous Parameter (mg/kg)									
	TOTAL ORGANIC CARBON	2/2	1600		1900		---	10SB020002	---

1 - Associated Samples:
10SB010002
10SB020002
10SB030002
10SB040002
10SB050002
10SB060002
10SB070002
10SB080002
10SB090002
10SB100002
10SB030002-REM

2 - Background Samples:
BG1SBA0101
BG1SBA0401
BG1SBP0401
BG1SBP0601
BG1SBP0701
BG1SBP0801
BG1SBP0901
BG3SBA0101
BG3SBA0301
BG3SBA0501
BG3SBM0201
BG3SBM0401
BG3SBM0601
BG3SBM0701
BG3SBM0801

--- = Not applicable.
Bolding indicates that parameter is in excess of background.
CAS - Chemical abstract services.
MEQ/100 g = Milliequivalents per 100 grams.
S.U. = Standard units.

Note:
Surface soil samples were collected from the 0 to 2 foot depth interval. Samples collected for all analyses other than VOCs were taken from the full interval. Samples collected for VOCs were taken from the 1 to 2 foot interval because the 0 to 1 foot interval would be depleted in VOCs.

TABLE 7-4

SUMMARY OF POSITIVE SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Sample Identification	10SB010810	10SB020709	10SB030810	10SB040305	10SB050406	10SB060507	10SB070406	10SB080406	10SB090204	10SB100608	10SB030810-REM
Depth Range (feet bgs)	8 - 10	7 - 9	8 - 10	3 - 5	4 - 6	5 - 7	4 - 6	4 - 6	2 - 4	6 - 8	
Soil Group:	8	8	8	8	8	8	8	8	9	8	
Semi-Volatiles (µg/kg)											
ACENAPHTHENE			11.0								
DI-N-OCTYL PHTHALATE			1400								
Explosives (mg/kg)											
HMX	0.50 U	0.50 U		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.57	0.50 U	44.3
RDX	0.50 U	0.50 U		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.71
2,4,6-Trinitrotoluene	0.50 U	0.50 U		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.529
Inorganics (mg/kg)											
ALUMINUM	7340 J	9580 J	7320 J	8950 J	8890 J	7270 J	6910 J	5430 J	9080 J	8590 J	
ANTIMONY	0.90 U	0.96 U	0.88 U	0.90 U	1.4	0.87 U	0.94 U	0.82 U	1.0	0.94 U	
ARSENIC	0.09 J	3.3 J	4.8	3.1 J	7.8 J	4.1 J	1.6 J	1.3	12.2 J	4.6	
BARIUM	21.1 J	122 J	61.6 J	52.8 J	64.0 J	33.5 J	56.3 J	22.3 J	78.1 J	40.1 J	
CALCIUM	810	1660	1310 J	457 U	928	408 U	567	1080 J	998	525 J	
CHROMIUM	5.0	8.3	8.3	11.2	12.9	14.5	8.0	8.2	27.6	10.8	
COBALT	4.1	11.6	6.0	2.9	4.1	5.0	3.5	5.5	20.6	3.7	
COPPER	2.3 J	6.9 J	9.0	7.7 J	12.0 J	7.6 J	4.5 J	6.6	7.2 J	9.6	
IRON	2000 J	12300 J	13300 J	14000 J	19900 J	23000 J	11500 J	10200 J	36600 J	16700 J	
LEAD	6.3	14.7	9.1 J	9.1	15.6	12.8	6.9	7.5 J	20.6	10.0 J	
MAGNESIUM	819 J	983 J	911 J	1180 J	1330 J	896 J	1000 J	1430 J	858 J	1260 J	
MANGANESE	18.8 J	1260 J	186	66.6 J	150 J	212 J	34.5 J	29.8	1140 J	173	
MERCURY	0.03 U	0.05	0.04 U	0.04 U	0.03	0.04 U	0.04 U	0.04 U	0.05	0.05 U	
NICKEL	5.1	10.4	8.5	6.1	7.8	5.6	6.5	9.8	7.2	6.9	
POTASSIUM	438 UJ	454 UJ	410 UJ	457 UJ	456 UJ	408 UJ	424 UJ	513 J	472 UJ	417 UJ	
VANADIUM	2.6 J	18.8 J	17.1	20.3 J	22.0 J	23.8 J	15.5 J	8.3	33.8 J	19.7	
ZINC	7.1 J	31.4 J	30.0	18.5 J	23.5 J	18.7 J	14.9 J	24.5	27.5 J	27.5	
Miscellaneous Parameters											
CATION EXCHANGE CAPACITY (MEQ/100 g)	7.8 J			10.0		9.6 J			8.5 J	9.4 J	
pH (S.U.)	5.9 J			5.2 J		5.2 J			7.7 J	5.8 J	
TOTAL ORGANIC CARBON (mg/kg)	1000 U			2000		2200			3200	2900	

TABLE 7-4

SUMMARY OF POSITIVE SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Blank cells indicate sample was not analyzed for this parameter.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected in this sample as well as the associated laboratory method blank but has been qualified non-detected as a result of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

bgs = Below ground surface.

MEQ = milliequivalents

S.U. = Standard units.

Soil Group 8 - Pennsylvanian subsurface clay and silt as per "Basewide Background Soil Investigation Report," NSWC Crane, Indiana (TtNUS, January 2001).

Soil Group 9 - Pennsylvania subsurface sand as per "Basewide Background Soil Investigation Report," NSWC Crane, Indiana (TtNUS, January 2001).

TABLE 7-5

SUBSURFACE SOIL ANALTYICAL RESULTS SUMMARY STATISTICS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Site Above Background?[2]
Semi-Volatile Organics (µg/kg)									
83-32-9	ACENAPHTHENE	1/1	11		11		---	10SB030810	---
117-84-0	DI-N-OCTYL PHTHALATE	1/1	1400		1400		---	10SB030810	---
Explosives (mg/kg)									
2691-41-0	HMX	2/10	0.57		44.3		0.5	10SB030810-REM	---
121-82-4	RDX	1/10	0.71		0.71			10SB030810-REM	---
118-96-7	2,4,6-Trinitrotoluene	1/10	0.53		0.53		---	10SB030810-REM	---
Inorganics (mg/kg)									
7429-90-5	**ALUMINUM**	**10/10**	**5430**	**J**	**9580**	**J**	---	**10SB020709**	**YES**
7440-36-0	**ANTIMONY**	**2/10**	**1**		**1.4**		**0.82 - 0.96**	**10SB050406**	**YES**
7440-38-2	**ARSENIC**	**10/10**	**0.09**	**J**	**12.2**	**J**	---	**10SB090204**	**YES**
7440-39-3	**BARIUM**	**10/10**	**21.1**	**J**	**122**	**J**	---	**10SB020709**	**YES**
7440-70-2	**CALCIUM**	**8/10**	**525**	**J**	**1660**		**408 - 457**	**10SB020709**	**YES**
7440-47-3	**CHROMIUM**	**10/10**	**5**		**27.6**		---	**10SB090204**	**YES**
7440-48-4	**COBALT**	**10/10**	**2.9**		**20.6**		---	**10SB090204**	**YES**
7440-50-8	**COPPER**	**10/10**	**2.3**	**J**	**12**	**J**	---	**10SB050406**	**YES**
7439-89-6	**IRON**	**10/10**	**2000**	**J**	**36600**	**J**	---	**10SB090204**	**YES**
7439-92-1	**LEAD**	**10/10**	**6.3**		**20.6**		---	**10SB090204**	**YES**
7439-95-4	**MAGNESIUM**	**10/10**	**819**	**J**	**1430**	**J**	---	**10SB080406**	**YES**
7439-96-5	**MANGANESE**	**10/10**	**18.8**	**J**	**1260**	**J**	---	**10SB020709**	**YES**
7439-97-6	**MERCURY**	**3/10**	**0.03**		**0.05**		**0.03 - 0.05**	**10SB090204, 10SB020709**	**YES**
7440-02-0	**NICKEL**	**10/10**	**5.1**		**10.4**		---	**10SB020709**	**YES**
7440-09-7	POTASSIUM	1/10	513	J	513	J	408 - 472	10SB080406	NO
7440-62-2	**VANADIUM**	**10/10**	**2.6**	**J**	**33.8**	**J**	---	**10SB090204**	**YES**
7440-66-6	**ZINC**	**10/10**	**7.1**	**J**	**31.4**	**J**	---	**10SB020709**	**YES**
Miscellaneous Parameter (MEQ/100 g)									
	CATION EXCHANGE CAPACITY	5/5	7.8	J	10		---	10SB040305	---
Miscellaneous Parameter (S.U.)									
	pH	5/5	5.2	J	7.7	J	---	10SB090204	---
Miscellaneous Parameter (mg/kg)									
	TOTAL ORGANIC CARBON	4/5	2000		3200		1000	10SB090204	---

TABLE 7-5

SUBSURFACE SOIL ANALTYICAL RESULTS SUMMARY STATISTICS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

1 - Associated Samples:

10SB010810
10SB020709
10SB030810
10SB040305
10SB050406
10SB060507
10SB070406
10SB080406
10SB090204
10SB100608
10SB030810-REM

2 - Background Samples:

BG1SBP0806
BG1SBP0103
BG1SBP0204
BG1SBP0206
BG1SBP0305
BG1SBP0406-MAX
BG1SBP0505
BG1SBP0603
BG1SBP0804
BG1SBP1004

--- = Not applicable.
Bolding indicates that parameter is in excess of background.
CAS = Chemical abstract services.
MEQ/100 g = Milliequivalents per 100 grams.
S.U. = Standard units.

TABLE 7-6

SUMMARY OF POSITIVE GROUND WATER ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Well Number:	10-02	10-03	10-16	10-17	10C26	10C41P3	10C31	10C31P3	10-33	10C33P2	10C35	10C35P2	10C37
Sample Identification	10GW0201	10GW0301	10GW1601	10GW1701	10GWC2601[1]	10GWC26P301[1]	10GWC3101	10GWC31P301	10GWC3301	10GWC33P201	10GWC3501	10GWC35P201	10GWC3701
Explosives (µg/L)													
1,3,5-TRINITROBENZENE	1.0 U	0.70 U	1.7 U	3.5 J			0.70 U	1.2 U	0.43 U	0.58 U	0.49 U	0.52 U	0.68 U
2,4,6-TRINITROTOLUENE	1.0 U	0.70 U	1.7 U	26 J			0.70 U	1.2 U	0.43 U	0.58 U	0.49 U	0.52 U	0.68 U
2,6-DINITROTOLUENE	1.0 U	0.70 U	1.7 U	0.52 U			0.70 U	1.2 U	0.43 U	0.58 U	0.49 U	0.52 U	0.68 U
2-AMINO-4,6-DINITROTOLUENE	1.0 U	0.70 U	1.7 U	20			0.70 U	1.2 U	0.43 U	0.58 U	0.49 U	0.52 U	0.68 U
4-AMINO-2,6-DINITROTOLUENE	1.7 J	0.70 U	1.7 U	18			0.70 U	1.2 U	0.43 U	0.58 U	0.49 U	0.52 U	0.68 U
HMX	12	0.70 U	1.7 U	240			0.70 U	1.2 U	0.43 U	0.58 U	0.49 U	0.52 U	0.68 U
RDX	4.9	0.70 U	1.7 U	33			0.70 U	1.2 U	0.43 U	0.58 U	0.49 U	0.52 U	0.68 U
Inorganics (µg/L)													
ALUMINUM	200 U	200 U	22300 J	200 U			200 U	461 J	200 U	200 U	4200 J	3540 J	200 U
ARSENIC	0.18	1.0 U	1.0 U	1.0 U			1.0	1.2	1.0 U	5.1	2.3	2.0	1.0 U
BARIUM	51.0	28.8	11.4	104			20.9	10.1	65.1	54.8	10.0	8.2	19.4
BERYLLIUM	1.0 U	1.0 U	20.3	1.0 U			1.0 U	1.0 U	1.0 U	1.0 U	6.6	1.6	1.0 U
CADMIUM	1.0 U	1.0 U	4.5	1.0 U			1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
CALCIUM	30000	131000	62500	86800			45900	337000	124000	5000 U	107000	79100	27100
COBALT	3.0 U	7.8	299	3.0 U			3.0 U	163	3.0 U	17.4	140	60.2	3.0 U
COPPER	2.0 U	2.0 U	8.5	2.0 U			2.0 U	8.9	2.0 U	2.0 U	2.0 U	2.7	2.0 U
IRON	167	2400	23700	286			17100	1450	955	20200	93700	8050	16300
LEAD	1.0 U	1.0 U	13.4	1.0 U			1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
MAGNESIUM	7080 J	22400 J	68000 J	10800 J			19800 J	326000 J	29100 J	5000 U	90100 J	59100 J	12200 J
MANGANESE	15.0 U	643	5380	299			686 J	21800	176	5390	6780	2230	698
MERCURY	0.20 U	0.20 U	0.20 U	0.20			0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
NICKEL	10.0 U	25.2	643	18.5			10.0 U	695	10.0 U	12.0	299	283	10.0 U
POTASSIUM	5000 U	5000 U	5000 U	5000 U			5000 U	8310 J	8990 J	5000 U	8150 J	5000 U	5000 U
SELENIUM	1.0 U	2.0 J	2.1 J	1.0 U			1.0 U	6.6 J	1.0 U	1.0 U	1.3 J	6.1 J	1.0 U
SODIUM	5000 U	59800 J	103000 J	11600 J			19900	164000 J	39900 J	24000 J	88100 J	185000 J	13200 J
THALLIUM	1.0 U	1.0 U	1.2	1.0 U			1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
ZINC	10.0 U	39.9	1660	17.7			10.0 U	397	10.0 U	11.8	291	315	10.0 U
Filtered Metals (µg/L)													
BARIUM, FILTERED													
CALCIUM, FILTERED													
COBALT, FILTERED													
IRON, FILTERED													
MAGNESIUM, FILTERED													
MANGANESE, FILTERED													
NICKEL, FILTERED													
SODIUM, FILTERED													
ZINC, FILTERED													
Miscellaneous Parameters (mg/L)													
NITRITE/NITRATE	0.30	0.010 U	0.020 U	0.40			0.050	0.040 U	0.090	0.25 U	0.030 U	0.20 U	0.20 U

TABLE 7-6

SUMMARY OF POSITIVE GROUND WATER ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Well Number:	10C37P3	10C41	10C41P3	10C52	10C55	10C55P2	10C57	10C57
Sample Identification	10GWC37P301	10GWC4101	10GWC41P301	10GWC5201 (upgradient)(2)	10GWC5501	10GWC55P201	10GWC5701	10GWC5701-F
Explosives (µg/L)								
1,3,5-TRINITROBENZENE	0.29 U	0.61 U	0.49 U	0.90 U	2.7 J	0.73 U	0.64 U	
2,4,6-TRINITROTOLUENE	0.29 U	0.61 U	0.49 U	0.90 U	56 J	5.8 J	0.64 U	
2,6-DINITROTOLUENE	0.29 U	0.61 U	0.49 U	0.90 U	1.5	0.73 U	0.64 U	
2-AMINO-4,6-DINITROTOLUENE	0.29 U	0.61 U	0.49 U	0.90 U	2.8	7.2	0.64 U	
4-AMINO-2,6-DINITROTOLUENE	0.29 U	0.61 U	0.49 U	0.90 U	3.7	15	0.64 U	
HMX	0.29 U	0.61 U	0.49 U	0.90 U	59	91	0.64 U	
RDX	0.29 U	0.61 U	0.49 U	0.90 U	240	21	0.64 U	
Inorganics (µg/L)								
ALUMINUM	1640 J	200 U	200 U	200 U	200 U	200 U	200 U	
ARSENIC	0.63	0.22	1.2	1.0 U	1.0 U	1.0 U	1.0 U	
BARIUM	9.1	7.9	8.0	17.9	40.6	57.7	22.6	
BERYLLIUM	2.5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	
CADMIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	
CALCIUM	55700	154000	88400	17000	5000 U	26100	35300	
COBALT	145	154	72.7	3.0 U	14.6	3.0 U	26.7	
COPPER	13.3	2.0 U	34.8	2.0 U	2.1	2.0 U	2.0 U	
IRON	31400	39700	497	22200	612	100 U	17300	
LEAD	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	
MAGNESIUM	34500 J	105000 J	90800 J	11800 J	5000 U	5370 J	23300 J	
MANGANESE	9100 J	20900 J	8050 J	897	336	15.0 U	3330	
MERCURY	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	
NICKEL	281	273	148	10.0 U	43.3	10.0 U	72.9	
POTASSIUM	5000 U	10200 J	5000 U	5000 U	5000 U	5000 U	5000 U	
SELENIUM	3.9	1.0 U	9.3	1.0 U	1.0 U	1.0 U	1.0 U	
SODIUM	118000	24800	252000	15700 J	11000 J	6870 J	18400 J	
THALLIUM	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	
ZINC	290	275	139	10.0 U	70.0	10.0 U	67.9	
Filtered Metals (µg/L)								
BARIUM, FILTERED								27.5
CALCIUM, FILTERED								33400
COBALT, FILTERED								31.3
IRON, FILTERED								3510
MAGNESIUM, FILTERED								24600 J
MANGANESE, FILTERED								3940
NICKEL, FILTERED								89.2
SODIUM, FILTERED								22400 J
ZINC, FILTERED								114
Miscellaneous Parameters (mg/L)								
NITRITE/NITRATE	0.050	0.040	0.16	0.040	0.040 U	0.33	0.020 U	

TABLE 7-6

SUMMARY OF POSITIVE GROUND WATER ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

1 - Samples analyzed for VOCs only and none were detected.
2 - Sample was designated as the SWMU 10 upgradient ground water sample.
Blank cells indicate sample was not analyzed for this parameter.
Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected in this sample as well as the associated laboratory method blank but has been qualified non-detected as a result of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

TABLE 7-7

GROUND WATER ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient Value[2]	Site Above Upgradient Concentration?
Explosives (µg/L)										
99-35-4	1,3,5-TRINITROBENZENE	2/17	2.7	J	3.5	J	0.29 - 1.7	10GW1701	---	---
118-96-7	2,4,6-TRINITROTOLUENE	3/17	5.8	J	56	J	0.29 - 1.7	10GWC5501	---	---
606-20-2	2,6-DINITROTOLUENE	1/17	1.5		1.5		0.29 - 1.7	10GWC5501	---	---
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	3/17	2.8		20		0.29 - 1.7	10GW1701	---	---
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	4/17	1.7	J	18		0.29 - 1.7	10GW1701	---	---
2691-41-0	HMX	4/17	12		240		0.29 - 1.7	10GW1701	---	---
121-82-4	RDX	4/17	4.9		240		0.29 - 1.7	10GWC5501	---	---
Inorganics (µg/L)										
7429-90-5	ALUMINUM	5/17	461	J	22300	J	200	10GW1601	ND	YES
7440-38-2	ARSENIC	9/17	0.18		5.1		1	10GWC33P201	ND	YES
7440-39-3	BARIUM	17/17	7.9		104		---	10GW1701	17.9	YES
7440-41-7	BERYLLIUM	4/17	1.6		20.3		1	10GW1601	ND	YES
7440-43-9	CADMIUM	1/17	4.5		4.5		1	10GW1601	ND	YES
7440-70-2	CALCIUM	15/17	26100		337000		5000	10GWC31P301	17000	YES
7440-48-4	COBALT	11/17	7.8		299		3	10GW1601	ND	YES
7440-50-8	COPPER	6/17	2.1		34.8		2	10GWC41P301	ND	YES
7439-89-6	IRON	16/17	167		93700		100	10GWC3501	22200	YES
7439-92-1	LEAD	2/17	1.2		13.4		1	10GW1601	ND	YES
7439-95-4	MAGNESIUM	15/17	5370	J	326000	J	5000	10GWC31P301	11800	YES
7439-96-5	MANGANESE	15/17	176		21800		15	10GWC31P301	897	YES
7439-97-6	MERCURY	1/17	0.2		0.2		0.2	10GW1701	ND	YES
7440-02-0	NICKEL	12/17	12		695		10	10GWC31P301	ND	YES
7440-09-7	POTASSIUM	4/17	8150	J	10200	J	5000	10GWC4101	ND	YES
7782-49-2	SELENIUM	7/17	1.3	J	9.3		1	10GWC41P301	ND	YES
7440-23-5	SODIUM	16/17	6870	J	252000		5000	10GWC41P301	15700	YES
7440-28-0	THALLIUM	1/17	1.2		1.2		1	10GW1601	ND	YES
7440-66-6	ZINC	12/17	11.8		1660		10	10GW1601	ND	YES

TABLE 7-7

GROUND WATER ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration	Upgradient Value[2]	Site Above Upgradient Concentration?
Filtered Metals (µg/L)										
7440-39-3	BARIUM, FILTERED	1/1	27.5		27.5		---	10GWC5701-F	---	---
7440-70-2	CALCIUM, FILTERED	1/1	33400		33400		---	10GWC5701-F	---	---
7440-48-4	COBALT, FILTERED	1/1	31.3		31.3		---	10GWC5701-F	---	---
7439-89-6	IRON, FILTERED	1/1	3510		3510		---	10GWC5701-F	---	---
7439-95-4	MAGNESIUM, FILTERED	1/1	24600	J	24600	J	---	10GWC5701-F	---	---
7439-96-5	MANGANESE, FILTERED	1/1	3940		3940		---	10GWC5701-F	---	---
7440-02-0	NICKEL, FILTERED	1/1	89.2		89.2		---	10GWC5701-F	---	---
7440-23-5	SODIUM, FILTERED	1/1	22400	J	22400	J	---	10GWC5701-F	---	---
7440-66-6	ZINC, FILTERED	1/1	114		114		---	10GWC5701-F	---	---
Miscellaneous Parameters (mg/L)										
	NITRITE/NITRATE	**9/18**	**0.040**		**0.400**		**0.010-0.25**	**10GW1701**	**0.04**	**---**

1 - Associated Samples:

10GW0201	10GWC3501
10GW0301	10GWC35P201
10GW1601	10GWC3701
10GW1701	10GWC37P301
10GWC2601	10GWC4101
10GWC26P301	10GWC41P301
10GWC3101	10GWC5501
10GWC31P301	10GWC55P201
10GWC3301	10GWC5701
10GWC33P201	10GWC5701-F

2 - Upgradient Sample:
10GWC5201

---- = Not applicable.
Bolding indicates parameter is in excess of upgradient concentration.
ND = Not detected.
CAS = Chemical abstract services.

TABLE 7-8

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Sample Identification	10SW0101-F	10SW0201-F	10SW0301-F	10SW0401-F	10SW0501-F	10SW0601-F	10SW0701-F	10SW0801-F	10SW0901-F	10SW1001-F	10SW1101-F	10SW1201-F	10SW0101
Explosives (µg/L)													
2,4,6-TRINITROTOLUENE													1.1 U
2-AMINO-4,6-DINITROTOLUENE													1.1 U
4-AMINO-2,6-DINITROTOLUENE													1.1 U
HMX													1.1 U
RDX													1.1 U
Inorganics (µg/L)													
ALUMINUM													260 J
ARSENIC													0.24
BARIUM													41.6
CALCIUM													6540
COPPER													2.0 U
IRON													278 J
LEAD													1.0 U
MAGNESIUM													5000 U
MANGANESE													29.2 J
SODIUM													5000 U
ZINC													10.0 U
Filtered Metals (µg/L)													
ANTIMONY, FILTERED	1.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	
ARSENIC, FILTERED	0.19	0.28	0.21	0.27	0.25	0.17	0.26	0.23	1.6	0.68	0.40	0.27	
BARIUM, FILTERED	39.3	23.1	30.7	27.6	31.8	36.5	25.7	27.6	80.3	39.8	46.7	39.0	
CALCIUM, FILTERED	6360	19800	9480	16000	11300	8400	18700	15200	80100	37300	32000	15600	
IRON, FILTERED	141	100 U	111	216	195	116	149	209	259	200	962	158	
MAGNESIUM, FILTERED	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	10400 J	7260 J	5000 U	5000 U	
MANGANESE, FILTERED	22.1	15.0 U	15.0 U	15.0 U	16.8	23.8	15.0 U	97.0	43.4	49.0	139	74.9	
SODIUM, FILTERED	5000 U	14100 J	6190 J	6390 J	8370 J	5280 J	8290 J	5000 U	106000 J	35200 J	15000 J	7910 J	
ZINC, FILTERED	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.3	102	10.0 U	10.0 U	10.0 U	
Miscellaneous Parameters (mg/L)													
HARDNESS													27.0
NITRATE/NITRITE													0.090
TOTAL SUSPENDED SOLIDS													5.00 J

TABLE 7-8

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Sample Identification	10SW0201	10SW0301	10SW0401	10SW0501	10SW0601	10SW0701	10SW0801	10SW0901	10SW1001	10SW1101	10SW1201
Explosives (µg/L)											
2,4,6-TRINITROTOLUENE	1.2 U	0.82 U	2.6	1.6	0.99 U	4.4	0.90 U	0.53 U	0.87 U	1.3 U	1.0 U
2-AMINO-4,6-DINITROTOLUENE	1.2 U	0.82 U	0.41 J	0.36 U	0.99 U	0.60 U	0.90 U	0.53 U	0.87 U	1.3 U	1.0 U
4-AMINO-2,6-DINITROTOLUENE	1.2 U	0.82 U	1.1 J	0.96 J	0.99 U	1.4	0.90 U	0.53 U	0.87 U	1.3 U	1.0 U
HMX	1.2 U	0.82 U	19	13	6.4	22	0.90 U	7.5	0.87 U	18	8.4
RDX	1.2 U	0.82 U	11	7.5	2.6	18	0.90 U	2.3 J	0.87 U	5.1	1.9
Inorganics (µg/L)											
ALUMINUM	200 U	295 J	488 J	447 J	357 J	283 J	837 J	277 J	299 J	341 J	213 J
ARSENIC	0.28	0.29	0.42	0.41	0.30	0.33	0.53	1.8	0.71	0.44	0.34
BARIUM	24.1	35.4	32.1	38.6	39.5	27.1	35.4	86.4	43.0	38.7	39.9
CALCIUM	21300	10200	17000	12000	8590	18500	16300	85900	39400	27600	16300
COPPER	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0	2.0 U	2.0 U	2.0 U
IRON	181 J	385 J	615 J	574 J	401 J	397 J	877 J	547 J	438 J	1120 J	305 J
LEAD	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
MAGNESIUM	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	11100 J	7560 J	5000 U	5000 U
MANGANESE	15.0 U	26.0 J	25.7 J	34.3 J	38.6 J	15.0 U	125 J	49.1 J	57.3 J	112 J	73.6 J
SODIUM	14800 J	6650 J	6640 J	8730 J	5100 J	8050 J	5000 U	110000 J	35800 J	12000 J	8030 J
ZINC	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	11.2	113	10.0 U	10.0 U	10.0 U
Filtered Metals (µg/L)											
ANTIMONY, FILTERED											
ARSENIC, FILTERED											
BARIUM, FILTERED											
CALCIUM, FILTERED											
IRON, FILTERED											
MAGNESIUM, FILTERED											
MANGANESE, FILTERED											
SODIUM, FILTERED											
ZINC, FILTERED											
Miscellaneous Parameters (mg/L)											
HARDNESS	60.0	36.0	52.0	39.0	33.0	53.0	56.0	260	130	87.0	55.0
NITRATE/NITRITE	0.41	0.27	0.30	0.28	0.26	0.30	0.18	1.60	0.29	0.54	0.45
TOTAL SUSPENDED SOLIDS	3.00 J	9.00 J	15.0 J	10.0 J	26.0 J	8.00 J	13.0 J	50.0 J	2.00 UJ	4.00 J	2.00 UJ

TABLE 7-8

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Blank cells indicate sample was not analyzed for this parameter.

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected in this sample as well as the associated laboratory method blank but has been qualified non-detected as a result of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

TABLE 7-9

SURFACE WATER ANALYTICAL RESUTLS SUMMARY STATISTICS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration
Explosives (µg/L)								
118-96-7	2,4,6-TRINITROTOLUENE	3/12	1.6		4.4		0.53 - 1.3	10SW0701
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	1/12	0.41	J	0.41	J	0.36 - 1.3	10SW0401
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	3/12	0.96	J	1.4		0.53 - 1.3	10SW0701
2691-41-0	HMX	7/12	6.4		22		0.82 - 1.2	10SW0701
121-82-4	RDX	7/12	1.9		18		0.82 - 1.2	10SW0701
Inorganics (µg/L)								
7429-90-5	ALUMINUM	11/12	213	J	837	J	200	10SW0801
7440-38-2	ARSENIC	12/12	0.24		1.8		---	10SW0901
7440-39-3	BARIUM	12/12	24.1		86.4		---	10SW0901
7440-70-2	CALCIUM	12/12	6540		85900		---	10SW0901
7440-50-8	COPPER	1/12	2		2		2	10SW0901
7439-89-6	IRON	12/12	181	J	1120	J	---	10SW1101
7439-95-4	MAGNESIUM	2/12	7560	J	11100	J	5000	10SW0901
7439-96-5	MANGANESE	10/12	25.7	J	125	J	15	10SW0801
7440-23-5	SODIUM	10/12	5100	J	110000	J	5000	10SW0901
7440-66-6	ZINC	2/12	11.2		113		10	10SW0901
Filtered Metals (µg/L)								
7440-36-0	ANTIMONY, FILTERED	1/12	1		1		1	10SW0101-F
7440-38-2	ARSENIC, FILTERED	12/12	0.17		1.6		---	10SW0901-F
7440-39-3	BARIUM, FILTERED	12/12	23.1		80.3		---	10SW0901-F
7440-70-2	CALCIUM, FILTERED	12/12	6360		80100		---	10SW0901-F
7439-89-6	IRON, FILTERED	11/12	111		962		100	10SW1101-F
7439-95-4	MAGNESIUM, FILTERED	2/12	7260	J	10400	J	5000	10SW0901-F
7439-96-5	MANGANESE, FILTERED	8/12	16.8		139		15	10SW1101-F
7440-23-5	SODIUM, FILTERED	10/12	5280	J	106000	J	5000	10SW0901-F
7440-66-6	ZINC, FILTERED	2/12	10.3		102		10	10SW0901-F
Miscellaneous Parameters (mg/L)								
	HARDNESS	12/12	27		260		---	10SW0901
14797-55-8	NITRATE	12/12	0.09		1.6		---	10SW0901
	TOTAL SUSPENDED SOLIDS	10/12	3	J	50	J	2	10SW0901

TABLE 7-9

SURFACE WATER ANALYTICAL RESUTLS SUMMARY STATISTICS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration

1 - Associated Samples:

10SW0101	10SW0501	10SW0901
10SW0101-F	10SW0501-F	10SW0901-F
10SW0201	10SW0601	10SW1001
10SW0201-F	10SW0601-F	10SW1001-F
10SW0301	10SW0701	10SW1101
10SW0301-F	10SW0701-F	10SW1101-F
10SW0401	10SW0801	10SW1201
10SW0401-F	10SW0801-F	10SW1201-F

CAS = Chemical abstract services.

--- Not applicable.

TABLE 7-10

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Sample Identification	10SD010006	10SD020006	10SD030006	10SD040006	10SD050006	10SD060006	10SD070006	10SD080006	10SD090006	10SD100006	10SD110006	10SD120006
Depth Range (inches)	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6
Energetics (mg/kg)												
HMX	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	51	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Inorganics (mg/kg)												
ALUMINUM	8060	4810	5130	7260	6210	4430	6020	9190	8310	7370	6880	6370
ANTIMONY	1.2 U	1.1 U	1.1 U	1.8	2.2	0.98 U	1.1 U	1.4	1.2 U	0.98 U	1.0 U	1.1 U
ARSENIC	10.4 J	3.1 J	6.6 J	34.2 J	15.9 J	6.2 J	4.0 J	22.0 J	7.4 J	6.4 J	6.8 J	16.7 J
BARIUM	155 J	45.2 J	70.3 J	133 J	95.7 J	93.6 J	78.0 J	121 J	67.9 J	65.3 J	82.6 J	276 J
BERYLLIUM	1.6 J	1.0 U	1.0 U	1.4 J	1.9 J	0.98 U	1.0 U	2.1 J	1.2 U	1.0 U	0.99 U	1.8 J
CADMIUM	1.1 U	1.0 U	1.0 U	1.4 J	2.0 J	0.98 U	2.4 J	1.1 U	1.2 U	1.0 U	0.99 U	1.3 J
CALCIUM	1260	1620	564	1180	1070	773	3840	1330	5920	1660	2160	997
CHROMIUM	25.5 J	9.0 J	13.7 J	65.7 J	45.4 J	13.7 J	9.2 J	32.4 J	11.0 J	10.4 J	12.8 J	32.6 J
COBALT	29.4 J	6.0 J	17.0 J	24.7 J	24.5 J	14.3 J	6.3 J	51.8 J	9.0 J	12.2 J	14.0 J	41.7 J
COPPER	9.7 J	8.0 J	9.6 J	11.9 J	13.4 J	7.5 J	7.7 J	16.9 J	10.4 J	7.5 J	11.2 J	10.3 J
IRON	29800 J	13800 J	20600 J	71100 J	57700 J	19700 J	12100 J	52800 J	18300 J	14800 J	20400 J	47100 J
LEAD	25.5 J	13.3 J	17.5 J	37.0 J	26.7 J	16.2 J	19.2 J	32.9 J	18.5 J	16.2 J	17.1 J	26.4 J
MAGNESIUM	997	613	696	487 U	607 U	490 U	1230	805	1590	1010	1020	550 U
MANGANESE	2360 J	165 J	652 J	2300 J	1970 J	979 J	445 J	3360 J	625 J	985 J	778 J	3900 J
MERCURY	0.06 UJ	0.04 UJ	0.05 UJ	0.05 J	0.07 UJ	0.05 UJ	0.05 UJ	0.04 J	0.06 UJ	0.05 UJ	0.05 UJ	0.03 UJ
NICKEL	44.5 J	8.2 J	17.6 J	15.4 J	29.4 J	18.8 J	7.5 J	44.6 J	7.9 J	15.9 J	9.8 J	32.0 J
VANADIUM	30.0 J	13.2 J	18.1 J	63.2 J	40.0 J	15.0 J	15.4 J	42.9 J	21.5 J	20.7 J	21.0 J	39.1 J
ZINC	79.5 J	58.3 J	40.6 J	46.5 J	71.0 J	36.5 J	59.3 J	98.1 J	301 J	62.8 J	40.0 J	90.8 J
Miscellaneous Parameters (mg/kg)												
TOTAL ORGANIC CARBON	22000 J	4000 J	7900 J	5500 J	9300 J	18000 J	9700 J	6800 J	18000 J	6900 J	11000 J	13000 J

Data Validation Qualifiers:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ - Indicates that the chemical was not detected. However, the detection limit (sample-specific quantitation limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

J - Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory-reported concentration is considered to be an estimate of the true concentration.

UR - Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

R - Indicates that the chemical may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

BU - Indicates that the chemical was detected in this sample as well as the associated laboratory method blank but has been qualified non-detected as a result of laboratory blank contamination (i.e., concentration was less than the blank action level).

BJ - Indicates that the chemical was detected in this sample as well as the associated method blank, and is considered estimated because the concentration is in excess of the blank action level.

TABLE 7-11

SEDIMENT ANALYTICAL RESULTS SUMMARY STATISTICS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

CAS Number	Parameter	Detection Frequency[1]	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Range of Nondetects	Location of Maximum Concentration
Explosives (mg/kg)								
2691-41-0	HMX	1/12	51		51		0.5	10SD070006
Inorganics (mg/kg)								
7429-90-5	ALUMINUM	12/12	4430		9190		0	10SD080006
7440-36-0	ANTIMONY	3/12	1.4		2.2		0 - 1.2	10SD050006
7440-38-2	ARSENIC	12/12	3.1	J	34.2	J	0	10SD040006
7440-39-3	BARIUM	12/12	45.2	J	276	J	0	10SD120006
7440-41-7	BERYLLIUM	5/12	1.4	J	2.1	J	0 - 1.2	10SD080006
7440-43-9	CADMIUM	4/12	1.3	J	2.4	J	0 - 1.2	10SD070006
7440-70-2	CALCIUM	12/12	564		5920		0	10SD090006
7440-47-3	CHROMIUM	12/12	9	J	65.7	J	0	10SD040006
7440-48-4	COBALT	12/12	6	J	51.8	J	0	10SD080006
7440-50-8	COPPER	12/12	7.5	J	16.9	J	0	10SD080006
7439-89-6	IRON	12/12	12100	J	71100	J	0	10SD040006
7439-92-1	LEAD	12/12	13.3	J	37	J	0	10SD040006
7439-95-4	MAGNESIUM	8/12	613		1590		0 - 607	10SD090006
7439-96-5	MANGANESE	12/12	165	J	3900	J	0	10SD120006
7439-97-6	MERCURY	2/12	0.04	J	0.05	J	0 - 0.07	10SD040006
7440-02-0	NICKEL	12/12	7.5	J	44.6	J	0	10SD080006
7440-62-2	VANADIUM	12/12	13.2	J	63.2	J	0	10SD040006
7440-66-6	ZINC	12/12	36.5	J	301	J	0	10SD090006
Miscellaneous Parameter (mg/kg)								
	TOTAL ORGANIC CARBON	12/12	4000	J	22000	J	0	10SD010006

1 - Associated Samples:

10SD010006	10SD070006
10SD020006	10SD080006
10SD030006	10SD090006
10SD040006	10SD100006
10SD050006	10SD110006
10SD060006	10SD120006

--- = Not applicable.

CAS = Chemical abstract services.

TABLE 7-12

OCCURRENCE, DISTRIBUTION, AND SELECTIONOF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
SEMIVOLATILE ORGANICS																	
208-96-8	ACENAPHTHYLENE	0.47	J	0.47	J	mg/kg	10SB030002	1/1	---	0.47	NA	370(7)	N	9500(7)	IDEM	No	BSL
120-12-7	ANTHRACENE	0.11	J	0.11	J	mg/kg	10SB030002	1/1	---	0.11	NA	2200	N	47000	IDEM	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.53	J	0.53	J	mg/kg	10SB030002	1/1	---	0.53	NA	0.62	C	5	IDEM	No	BSL
50-32-8	BENZO(A)PYRENE	0.99	J	0.99	J	mg/kg	10SB030002	1/1	---	0.99	NA	0.062	C	0.5	IDEM	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.96	J	0.96	J	mg/kg	10SB030002	1/1	---	0.96	NA	0.62	C	5	IDEM	Yes	ASL
191-24-2	BENZO(G,H,I)PERYLENE	0.86	J	0.86	J	mg/kg	10SB030002	1/1	---	0.86	NA	230(8)	N	5500(8)	IDEM	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.74	J	0.74	J	mg/kg	10SB030002	1/1	---	0.74	NA	6.2	C	50	IDEM	No	BSL
218-01-9	CHRYSENE	0.56	J	0.56	J	mg/kg	10SB030002	1/1	---	0.56	NA	62	C	500	IDEM	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.2	J	0.2	J	mg/kg	10SB030002	1/1	---	0.2	NA	0.062	C	0.5	IDEM	Yes	ASL
206-44-0	FLUORANTHENE	0	J	0	J	mg/kg	10SB030002	1/1	---	0.37	NA	230	N	6300	IDEM	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.61	J	0.61	J	mg/kg	10SB030002	1/1	---	0.61	NA	0.62	C	5	IDEM	No	BSL
85-01-8	PHENANTHRENE	0.1	J	0.1	J	mg/kg	10SB030002	1/1	---	0.13	NA	230(8)	N	5500(8)	IDEM	No	BSL
129-00-0	PYRENE	0.39	J	0.39	J	mg/kg	10SB030002	1/1	---	0.39	NA	230	N	5500	IDEM	No	BSL
EXPLOSIVES																	
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	0.53		0.53		mg/kg	10SB090002	1/10	0.5	0.53	NA	0.47(9)	N	NA	IDEM	Yes	ASL
2691-41-0	HMX	1.3		55		mg/kg	10SB050002	5/10	0.5	55	NA	310	N	NA	IDEM	No	BSL
121-82-4	RDX	1.6		8		mg/kg	10SB030002	2/10	0.5	8	NA	4.4	C	NA	IDEM	Yes	ASL
INORGANICS																	
7429-90-5	ALUMINUM	1530	J	12200	J	mg/kg	10SB050002	10/10	---	12200	No	7600	N	NA	IDEM	No	BKG
7440-38-2	ARSENIC	0.87		9.3	J	mg/kg	10SB090002	10/10	---	9.3	No	0.39	C	3.9	IDEM	No	BKG
7440-39-3	BARIUM	46.8	J	117	J	mg/kg	10SB050002	10/10	---	117	No	540	N	23000	IDEM	No	BSL,BKG
7440-41-7	BERYLLIUM	1	J	1	J	mg/kg	10SB050002	1/10	0.57 - 0.99	1	No	15	N	680	IDEM	No	BSL,BKG
7440-43-9	CADMIUM	1	J	3.4	J	mg/kg	10SB020002	2/10	0.57 - 0.99	3.4	No	3.7	N	12	IDEM	No	BSL,BKG
7440-70-2	CALCIUM	960	J	249000	J	mg/kg	10SB080002	10/10	---	249000	Yes	NA		NA	IDEM	No	NUT
7440-47-3	CHROMIUM	6.4		22		mg/kg	10SB090002	10/10	---	22	No	30(10)	C	430(10)	IDEM	No	BSL,BKG
7440-48-4	COBALT	1.5		9.7		mg/kg	10SB090002	10/10	---	9.7	No	470	N	NA	IDEM	No	BSL,BKG
7440-50-8	COPPER	2		12.3	J	mg/kg	10SB020002	10/10	---	12.3	No	290	N	13000	IDEM	No	BSL,BKG
7439-89-6	IRON	3420	J	26500	J	mg/kg	10SB090002	10/10	---	26500	No	2300	N	NA	IDEM	No	BKG
7439-92-1	LEAD	4.2	J	25.1		mg/kg	10SB090002	10/10	---	25.1	No	400(11)	N	400	IDEM	No	BSL,BKG
7439-95-4	MAGNESIUM	1010	J	14700	J	mg/kg	10SB080002	10/10	---	14700	Yes	NA		NA	IDEM	No	NUT
7439-96-5	MANGANESE	78.1		674	J	mg/kg	10SB090002	10/10	---	674	No	180	N	NA	IDEM	No	BKG
7439-97-6	MERCURY	0.04		0.04		mg/kg	10SB060002,	3/10	0.03 - 0.05	0.04	No	2.3(12)	N	55	IDEM	No	BSL,BKG
7440-02-0	NICKEL	6.4		15.7		mg/kg	10SB080002	10/10	---	15.7	No	160	N	6900	IDEM	No	BSL,BKG
7440-09-7	POTASSIUM	321	J	506	J	mg/kg	10SB050002	2/10	401 - 493	506	No	NA		NA	IDEM	No	NUT, BKG
7440-62-2	VANADIUM	4.4		26.6	J	mg/kg	10SB090002	10/10	---	26.6	No	55	N	NA	IDEM	No	BSL,BKG
7440-66-6	ZINC	19.8	J	50	J	mg/kg	10SB090002	10/10	---	50	No	2300	N	100000	IDEM	No	BSL,BKG

TABLE 7-12

OCCURRENCE, DISTRIBUTION, AND SELECTIONOF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
MISCELLANEOUS PARAMETERS																
	CATION EXCHANGE CAPACITY	1.5	J	10	J	meq/100 g	10SB020002	2/2	---	10	NA	NA	NA	NA	No	NTX
	pH	8	J	8.5	J	S.U.	10SB080002	2/2	---	8.5	NA	NA	NA	NA	No	NTX
	TOTAL ORGANIC CARBON	1600		1900		mg/kg	10SB020002	2/2	---	1900	NA	NA	NA	NA	No	NTX

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TtNUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 The risk-based soil COPC screening level for residential land use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, November 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Acenaphthene is used as a surrogate for acenaphthylene.
8 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
9 Value is for aminodinitrotoluenes (U.S. EPA, Region 3, October 2001)
10 Hexavalent chromium.
11 OSWER soil screening level for residential land use (U.S. EPA, July 1994).
12 Value is for mercuric chloride (U.S. EPA, Region 3, October 2001).

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract service.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not a.ailable.
sat = Soil saturation concentration..

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Associated Samples:

10SB010002	10SB060002
10SB020002	10SB070002
10SB030002	10SB080002
10SB040002	10SB090002
10SB050002	10SB100002

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 7-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater		USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
SEMIVOLATILE ORGANICS																	
208-96-8	ACENAPHTHYLENE	0.47	J	0.47	J	mg/kg	10SB030002	1/1	---	0.47	NA	29(8)	N	NA	130(8)	No	BSL
120-12-7	ANTHRACENE	0.11	J	0.11	J	mg/kg	10SB030002	1/1	---	0.11	NA	590	N	NA	51	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.53	J	0.53	J	mg/kg	10SB030002	1/1	---	0.53	NA	0.08	C	NA	19	Yes	ASL
50-32-8	BENZO(A)PYRENE	0.99	J	0.99	J	mg/kg	10SB030002	1/1	---	0.99	NA	0.4	C	NA	8.2	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.96	J	0.96	J	mg/kg	10SB030002	1/1	---	0.96	NA	0.2	C	NA	57	Yes	ASL
191-24-2	BENZO(G,H,I)PERYLENE	0.86	J	0.86	J	mg/kg	10SB030002	1/1	---	0.86	NA	210(9)	N	NA	570(9)	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.74	J	0.74	J	mg/kg	10SB030002	1/1	---	0.74	NA	2	C	NA	39	No	BSL
218-01-9	CHRYSENE	0.56	J	0.56	J	mg/kg	10SB030002	1/1	---	0.56	NA	8	C	NA	25	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.2	J	0.2	J	mg/kg	10SB030002	1/1	---	0.2	NA	0.08	C	NA	18	Yes	ASL
206-44-0	FLUORANTHENE	0.37	J	0	J	mg/kg	10SB030002	1/1	---	0.37	NA	210	N	NA	880	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.61	J	0.61	J	mg/kg	10SB030002	1/1	---	0.61	NA	0.7	C	NA	3.1	No	BSL
85-01-8	PHENANTHRENE	0.13	J	0.1	J	mg/kg	10SB030002	1/1	---	0.13	NA	210(9)	N	NA	570(9)	No	BSL
129-00-0	PYRENE	0.39	J	0.39	J	mg/kg	10SB030002	1/1	---	0.39	NA	210	N	NA	570	No	BSL
EXPLOSIVES																	
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	0.53		0.53		mg/kg	10SB090002	1/10	0.5	0.53	NA	NA	N	NA	NA	No	NTX
2691-41-0	HMX	1.3		55		mg/kg	10SB050002	5/10	0.5	55	NA	NA	N	NA	NA	No	NTX
121-82-4	RDX	1.6		8		mg/kg	10SB030002	2/10	0.5	8	NA	NA	C	NA	NA	No	NTX
INORGANICS																	
7429-90-5	ALUMINUM	1530	J	12200	J	mg/kg	10SB050002	10/10	---	12200	No	NA	N	NA	NA	No	NTX, BKG
7440-38-2	ARSENIC	0.87		9.3	J	mg/kg	10SB090002	10/10	---	9.3	No	1	C	750	29	No	BKG
7440-39-3	BARIUM	46.8	J	117	J	mg/kg	10SB050002	10/10	---	117	No	82	N	690000	1600	No	BKG
7440-41-7	BERYLLIUM	1	J	1	J	mg/kg	10SB050002	1/10	0.57 - 0.99	1	No	3	N	1300	63	No	BSL,BKG
7440-43-9	CADMIUM	1	J	3.4	J	mg/kg	10SB020002	2/10	0.57 - 0.99	3.4	No	0.4	N	1800	7.5	No	BKG
7440-70-2	CALCIUM	960	J	249000	J	mg/kg	10SB080002	10/10	---	249000	Yes	NA		NA	NA	No	NUT
7440-47-3	CHROMIUM	6.4		22		mg/kg	10SB090002	10/10	---	22	No	2	C	270	38	No	BKG
7440-48-4	COBALT	1.5		9.7		mg/kg	10SB090002	10/10	---	9.7	No	NA	N	NA	NA	No	NTX, BKG
7440-50-8	COPPER	2		12.3	J	mg/kg	10SB020002	10/10	---	12.3	No	NA	N	NA	580	No	BSL,BKG
7439-89-6	IRON	3420	J	26500	J	mg/kg	10SB090002	10/10	---	26500	No	NA	N	NA	NA	No	NTX, BKG
7439-92-1	LEAD	4.2	J	25.1		mg/kg	10SB090002	10/10	---	25.1	No	NA	N	NA	81	No	BSL,BKG
7439-95-4	MAGNESIUM	1010	J	14700	J	mg/kg	10SB080002	10/10	---	14700	Yes	NA		NA	NA	No	NUT
7439-96-5	MANGANESE	78.1		674	J	mg/kg	10SB090002	10/10	---	674	No	NA	N	NA	NA	No	NTX, BKG
7439-97-6	MERCURY	0.04		0.04		mg/kg	10SB090002, 10SB060002, 10SB050002	3/10	0.03 - 0.05	0.04	No	0.1	N	10	2.1	No	BSL,BKG
7440-02-0	NICKEL	6.4		15.7		mg/kg	10SB080002	10/10	---	15.7	No	7	N	13000	950	No	BKG
7440-09-7	POTASSIUM	321	J	506	J	mg/kg	10SB050002	2/10	401 - 493	506	No	NA		NA	NA	No	NUT
7440-62-2	VANADIUM	4.4		26.6	J	mg/kg	10SB090002	10/10	---	26.6	No	300	N	NA	NA	No	BSL,BKG
7440-66-6	ZINC	19.8	J	50	J	mg/kg	10SB090002	10/10	---	50	No	620	N	NA	14000	No	BSL,BKG

TABLE 7-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater	USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
MISCELLANEOUS PARAMETERS																
	CATION EXCHANGE CAPACITY	1.5	J	10	J	meq/100 g	10SB020002	2/2	---	10	NA	NA	NA	NA	No	NTX
	pH	8	J	8.5	J	S.U.	10SB080002	2/2	---	8.5	NA	NA	NA	NA	No	NTX
	TOTAL ORGANIC CARBON	1600		1900		mg/kg	10SB020002	2/2	---	1900	NA	NA	NA	NA	No	NTX

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TINUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 Soil Screening Guidance: Technical Background Document. (U.S. EPA, May 1996). The migration to groundwater value represents a dilution and attenuation factor (DAF) of 1.
6 Residential levels for migration from soil to groundwater (IDEM, July 2001).
7 The chemical is selected as a COPC if the maximum detected concentration exceeds any screening level.
8 Acenaphthene is used as a surrogate for acenaphthylene.
9 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.

Associated Samples:

10SB010002	10SB060002
10SB020002	10SB070002
10SB030002	10SB080002
10SB040002	10SB090002
10SB050002	10SB100002

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for migration from soil to groundwater (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 7-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE/SUBSURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
Semi-Volatiles																	
83-32-9	ACENAPHTHENE	0.011		0.011		mg/kg	10SB030810	1/2	0.038	0.011	NA	370	N	9500	IDEM	No	BSL
208-96-8	ACENAPHTHYLENE	0.47	J	0.47	J	mg/kg	10SB030002	1/2	0.008	0.47	NA	370(7)	N	9500(7)	IDEM	No	BSL
120-12-7	ANTHRACENE	0.11	J	0.11	J	mg/kg	10SB030002	1/2	0.008	0.11	NA	2200	N	47000	IDEM	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.53	J	0.53	J	mg/kg	10SB030002	1/2	0.008	0.53	NA	0.62	C	5	IDEM	No	BSL
50-32-8	BENZO(A)PYRENE	0.99	J	0.99	J	mg/kg	10SB030002	1/2	0.008	0.99	NA	0.062	C	0.5	IDEM	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.96	J	0.96	J	mg/kg	10SB030002	1/2	0.008	0.96	NA	0.62	C	5	IDEM	Yes	ASL
191-24-2	BENZO(G,H,I)PERYLENE	0.86	J	0.86	J	mg/kg	10SB030002	1/2	0.008	0.86	NA	230(8)	N	5500(8)	IDEM	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.74	J	0.74	J	mg/kg	10SB030002	1/2	0.008	0.74	NA	6.2	C	50	IDEM	No	BSL
218-01-9	CHRYSENE	0.56	J	0.56	J	mg/kg	10SB030002	1/2	0.008	0.56	NA	62	C	500	IDEM	No	BSL
117-84-0	DI-N-OCTYL PHTHALATE	1		1		mg/kg	10SB030810	1/2	0.38	1.4	NA	120	N	3700	IDEM	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.2	J	0.2	J	mg/kg	10SB030002	1/2	0.008	0.2	NA	0.062	C	0.5	IDEM	Yes	ASL
206-44-0	FLUORANTHENE	0.4	J	0.4	J	mg/kg	10SB030002	1/2	0.008	0.37	NA	230	N	6300	IDEM	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.61	J	0.61	J	mg/kg	10SB030002	1/2	0.008	0.61	NA	0.62	C	5	IDEM	No	BSL
85-01-8	PHENANTHRENE	0.13	J	0.13	J	mg/kg	10SB030002	1/2	0.008	0.13	NA	230(8)	N	5500(8)	IDEM	No	BSL
129-00-0	PYRENE	0.39	J	0.39	J	mg/kg	10SB030002	1/2	0.008	0.39	NA	230	N	5500	IDEM	No	BSL
Explosives																	
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	0.53		0.53		mg/kg	10SB090002	1/20	0.5	0.53	NA	0.47(9)	N	NA	IDEM	Yes	ASL
2691-41-0	HMX	0.57		55		mg/kg	10SB050002	6/20	0.5	55	NA	310	N	NA	IDEM	No	BSL
121-82-4	RDX	1.6		8		mg/kg	10SB030002	2/20	0.5	8	NA	4.4	C	NA	IDEM	Yes	ASL
Inorganics																	
7429-90-5	ALUMINUM	1530	J	12200	J	mg/kg	10SB050002	20/20	---	12200	No	7600	N	NA	IDEM	No	BKG
7440-36-0	ANTIMONY	1		1.4		mg/kg	10SB050406	2/20	0.75 - 1	1.4	No	3.1	N	140	IDEM	No	BSL,BKG
7440-38-2	ARSENIC	0.09	J	12.2	J	mg/kg	10SB090204	20/20	---	12.2	No	0.39	C	3.9	IDEM	No	BKG
7440-39-3	BARIUM	21.1	J	122	J	mg/kg	10SB020709	20/20	---	122	No	540	N	23000	IDEM	No	BSL,BKG
7440-41-7	BERYLLIUM	1	J	1	J	mg/kg	10SB050002	1/20	0.57 - 0.99	1	No	15	N	680	IDEM	No	BSL,BKG
7440-43-9	CADMIUM	1	J	3.4	J	mg/kg	10SB020002	2/20	0.57 - 0.99	3.4	No	3.7	N	12	IDEM	No	BSL,BKG
7440-70-2	CALCIUM	525	J	249000	J	mg/kg	10SB080002	18/20	408 - 457	249000	Yes	NA		NA	IDEM	No	NUT
7440-47-3	CHROMIUM	5.0		27.6		mg/kg	10SB090204	20/20	---	27.6	No	30(10)	C	430(10)	IDEM	No	BSL,BKG
7440-48-4	COBALT	1.5		20.6		mg/kg	10SB090204	20/20	---	20.6	No	470	N	NA	IDEM	No	BSL,BKG
7440-50-8	COPPER	2		12.3	J	mg/kg	10SB020002	20/20	---	12.3	No	290	N	13000	IDEM	No	BSL,BKG
7439-89-6	IRON	2000	J	36600	J	mg/kg	10SB090204	20/20	---	36600	No	2400	N	NA	IDEM	No	BKG
7439-92-1	LEAD	4.2	J	25.1		mg/kg	10SB090002	20/20	---	25.1	No	400(11)	N	400	IDEM	No	BSL,BKG
7439-95-4	MAGNESIUM	819	J	14700	J	mg/kg	10SB080002	20/20	---	14700	Yes	NA		NA	IDEM	No	NUT
7439-96-5	MANGANESE	18.8	J	1260	J	mg/kg	10SB020709	20/20	---	1260	No	180	N	NA	IDEM	No	BKG
7439-97-6	MERCURY	0.03		0.05		mg/kg	8020709,10SB09	6/20	0.03 - 0.05	0.05	No	2.3(12)	N	55	IDEM	No	BSL,BKG
7440-02-0	NICKEL	5.1		15.7		mg/kg	10SB080002	20/20	---	15.7	No	160	N	6900	IDEM	No	BSL,BKG
7440-09-7	POTASSIUM	321	J	513	J	mg/kg	10SB080406	3/20	401 - 493	513	No	NA		NA	IDEM	No	NUT, BKG
7440-62-2	VANADIUM	2.6	J	33.8	J	mg/kg	10SB090204	20/20	---	33.8	No	55	N	NA	IDEM	No	BSL,BKG
7440-66-6	ZINC	7.1	J	50	J	mg/kg	10SB090002	20/20	---	50	No	2300	N	100000	IDEM	No	BSL,BKG
Miscellaneous Parameters																	
	CATION EXCHANGE CAPACITY	1.5	J	10	J	meq/100 g	020002, 10SB04	7/7	---	10	NA	NA		NA	IDEM	No	NTX
	pH	5.2	J	8.5	J	S.U.	080002,10SB08	7/7	---	8.5	NA	NA		NA	IDEM	No	NTX
	TOTAL ORGANIC CARBON	1600		3200		mg/kg	10SB090204	6/7	1000	3200	NA	NA		NA	IDEM	No	NTX

TABLE 7-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE/SUBSURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	Risk-Based COPC Screening Level (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TtNUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 The risk-based soil COPC screening level for residential land use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, November 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Acenaphthene is used as a surrogate for acenaphthylene.
8 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
9 Value is for aminodinitrotoluenes (U.S. EPA, Region 3, October 2001)
10 Hexavalent chromium.
11 OSWER soil screening level for residential land use (U.S. EPA, July 1994)
12 Value is for mercuric chloride (U.S. EPA, Region 3, October 2001)

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

Associated Sample:

10SB010002	10SB060002	10SB090204	10SB050406
10SB020002	10SB070002	10SB010810	10SB060507
10SB030002	10SB080002	10SB020709	10SB070406
10SB040002	10SB090002	10SB030810	10SB080406
10SB050002	10SB100002	10SB040305	10SB100608

TABLE 7-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE/SUBSURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

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

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Site Above Background ? (4)	USEPA Generic SSL for Migration to Groundwater (5)		USEPA Generic SSL for Soil to Air (5)	IDEM SSL for Migration to Groundwater (6)	COPC Flag	Rationale for Contaminant Deletion or Selection (7)
SEMIVOLATILE ORGANICS																	
83-32-9	ACENAPHTHENE	0.011		0.011		mg/kg	10SB030810	1/2	0.038	0.011	NA	29	N	NA	130	No	BSL
208-96-8	ACENAPHTHYLENE	0.47	J	0.47	J	mg/kg	10SB030002	1/2	0.008	0.47	NA	29(8)	N	NA	130(8)	No	BSL
120-12-7	ANTHRACENE	0.11	J	0.11	J	mg/kg	10SB030002	1/2	0.008	0.11	NA	590	N	NA	51	No	BSL
56-55-3	BENZO(A)ANTHRACENE	0.53	J	0.53	J	mg/kg	10SB030002	1/2	0.008	0.53	NA	0.08	C	NA	19	Yes	ASL
50-32-8	BENZO(A)PYRENE	0.99	J	0.99	J	mg/kg	10SB030002	1/2	0.008	0.99	NA	0.4	C	NA	8.2	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	0.96	J	0.96	J	mg/kg	10SB030002	1/2	0.008	0.96	NA	0.2	C	NA	57	Yes	ASL
191-24-2	BENZO(G,H,I)PERYLENE	0.86	J	0.86	J	mg/kg	10SB030002	1/2	0.008	0.86	NA	210(9)	N	NA	570(9)	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	0.74	J	0.74	J	mg/kg	10SB030002	1/2	0.008	0.74	NA	2	C	NA	39	No	BSL
218-01-9	CHRYSENE	0.56	J	0.56	J	mg/kg	10SB030002	1/2	0.008	0.56	NA	8	C	NA	25	No	BSL
117-84-0	DI-N-OCTYL PHTHALATE	1.4		1.4		mg/kg	10SB030810	1/2	0.38	1.4	NA	10000	N	10000	67000	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	0.2	J	0.2	J	mg/kg	10SB030002	1/2	0.008	0.2	NA	0.08	C	NA	18	Yes	ASL
206-44-0	FLUORANTHENE	0.37	J	0.37	J	mg/kg	10SB030002	1/2	0.008	0.37	NA	210	N	NA	880	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	0.61	J	0.61	J	mg/kg	10SB030002	1/2	0.008	0.61	NA	0.7	C	NA	3.1	No	BSL
85-01-8	PHENANTHRENE	0.13	J	0.13	J	mg/kg	10SB030002	1/2	0.008	0.13	NA	210(9)	N	NA	570(9)	No	BSL
129-00-0	PYRENE	0.39	J	0.39	J	mg/kg	10SB030002	1/2	0.008	0.39	NA	210	N	NA	570	No	BSL
EXPLOSIVES																	
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	0.53		0.53		mg/kg	10SB090002	1/20	0.5	0.53	NA	NA	N	NA	NA	No	NTX
2691-41-0	HMX	0.57		55		mg/kg	10SB050002	6/20	0.5	55	NA	NA	N	NA	NA	No	NTX
121-82-4	RDX	1.6		8		mg/kg	10SB030002	2/20	0.5	8	NA	NA	C	NA	NA	No	NTX
INORGANICS																	
7429-90-5	ALUMINUM	1530	J	12200	J	mg/kg	10SB050002	20/20	---	12200	No	NA	N	NA	NA	No	NTX, BKG
7440-36-0	ANTIMONY	1		1.4		mg/kg	10SB050406	2/20	0.75 - 1	1.4	No	0.3	N	NA	5.4	No	BKG
7440-38-2	ARSENIC	0.09	J	12.2	J	mg/kg	10SB090204	20/20	---	12.2	No	1	C	750	29	No	BKG
7440-39-3	BARIUM	21.1	J	122	J	mg/kg	10SB020709	20/20	---	122	No	82	N	690000	1600	No	BKG
7440-41-7	BERYLLIUM	1	J	1	J	mg/kg	10SB050002	1/20	0.57 - 0.99	1	No	3	N	1300	63	No	BSL,BKG
7440-43-9	CADMIUM	1	J	3.4	J	mg/kg	10SB020002	2/20	0.57 - 0.99	3.4	No	0.4	N	1800	7.5	No	BKG
7440-70-2	CALCIUM	525	J	249000	J	mg/kg	10SB080002	18/20	408 - 457	249000	Yes	NA		NA	NA	No	NUT
7440-47-3	CHROMIUM	5		27.6		mg/kg	10SB090204	20/20	---	27.6	No	2	C	270	38	No	BKG
7440-48-4	COBALT	1.5		20.6		mg/kg	10SB090204	20/20	---	20.6	No	NA	N	NA	NA	No	NTX, BKG
7440-50-8	COPPER	2		12.3	J	mg/kg	10SB020002	20/20	---	12.3	No	NA	N	NA	580	No	BSL,BKG
7439-89-6	IRON	2000	J	36600	J	mg/kg	10SB090204	20/20	---	36600	No	NA	N	NA	NA	No	NTX, BKG
7439-92-1	LEAD	4.2	J	25.1		mg/kg	10SB090002	20/20	---	25.1	No	NA	N	NA	81	No	BSL,BKG
7439-95-4	MAGNESIUM	819	J	14700	J	mg/kg	10SB080002	20/20	---	14700	Yes	NA		NA	NA	No	NUT
7439-96-5	MANGANESE	18.8	J	1260	J	mg/kg	10SB020709	20/20	---	1260	No	NA	N	NA	NA	No	NTX, BKG
7439-97-6	MERCURY	0.03		0.05		mg/kg	3020709,10SB09	6/20	0.03 - 0.05	0.05	No	0.1	N	10	2.1	No	BSL,BKG
7440-02-0	NICKEL	5.1		15.7		mg/kg	10SB080002	20/20	---	15.7	No	7	N	13000	950	No	BKG
7440-09-7	POTASSIUM	321	J	513	J	mg/kg	10SB080406	3/20	401 - 493	513	No	NA		NA	NA	No	NUT
7440-62-2	VANADIUM	2.6	J	33.8	J	mg/kg	10SB090204	20/20	---	33.8	No	300	N	NA	NA	No	BSL,BKG
7440-66-6	ZINC	7.1	J	50	J	mg/kg	10SB090002	20/20	---	50	No	620	N	NA	14000	No	BSL,BKG
MISCELLANEOUS PARAMETERS																	
	CATION EXCHANGE CAPACITY	1.5	J	10	J	meq/100 g	020002, 10SB04	7/7	---	10	NA	NA		NA	NA	No	NTX
	pH	5.2	J	8.5	J	S.U.	080002,10SB08	7/7	---	8.5	NA	NA		NA	NA	No	NTX
	TOTAL ORGANIC CARBON	1600		3200		mg/kg	10SB090204	6/7	1000	3200	NA	NA		NA	NA	No	NTX

TABLE 7-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION PATHWAYS FROM SURFACE/SUBSURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, soil concentrations were compared to base-wide background data presented in the Basewide Background Soil Investigation Report (TtNUS, Inc., January 2001) by means of the Wilcoxon Rank Sum Test. If the Wilcoxon Test determined that a constituent concentration was not significanty different from background, that chemical was not selected as a COPC.
5 Soil Screening Guidance: Technical Background Document. (U.S. EPA, May 1996). The migration to groundwater value represents a dilution and attenuation factor (DAF) of 1.
6 Residential levels for migration from soil to groundwater (IDEM, July 2001).
7 The chemical is selected as a COPC if the maximum detected concentration exceeds any screening level.
8 Acenaphthene is used as a surrogate for acenaphthylene.
9 Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.

Associated Samples:

10SB010002	10SB090204
10SB020002	10SB010810
10SB030002	10SB020709
10SB040002	10SB030810
10SB050002	10SB040305
10SB060002	10SB050406
10SB070002	10SB060507
10SB080002	10SB070406
10SB090002	10SB080406
10SB100002	10SB100608

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for migration from soil to groundwater (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 7-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUND WATER
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
EXPLOSIVES																
99-35-4	1,3,5-TRINITROBENZENE	2.7	J	3.5	J	µg/L	10GW1701	2/17	0.29 - 1.7	3.5	NA	110 N	NA NA	FED-MCL IDEM	No	BSL
118-96-7	2,4,6-TRINITROTOLUENE	5.8	J	56	J	µg/L	10GWC5501	3/17	0.29 - 1.7	56	NA	2.2 C	NA NA	FED-MCL IDEM	Yes	ASL
606-20-2	2,6-DINITROTOLUENE	1.5		1.5		µg/L	10GWC5501	1/17	0.29 - 1.7	1.5	NA	3.6 N	NA 1.3	FED-MCL IDEM	Yes	ASL
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	2.8		20		µg/L	10GW1701	3/17	0.29 - 1.7	20	NA	0.22(7) N	NA NA	FED-MCL IDEM	Yes	ASL
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	1.7	J	18		µg/L	10GW1701	4/17	0.29 - 1.7	18	NA	0.22(7) N	NA NA	FED-MCL IDEM	Yes	ASL
2691-41-0	HMX	12		240		µg/L	10GW1701	4/17	0.29 - 1.7	240	NA	180 N	NA NA	FED-MCL IDEM	Yes	ASL
121-82-4	RDX	4.9		240		µg/L	10GWC5501	4/17	0.29 - 1.7	240	NA	0.61 C	NA NA	FED-MCL IDEM	Yes	ASL
INORGANICS																
7429-90-5	ALUMINUM	461	J	22300	J	µg/L	10GW1601	5/17	200	22300	ND	3600 N	50 to 200(8) NA	FED-MCL IDEM	Yes	ASL
7440-38-2	ARSENIC	0.18		5.1		µg/L	10GWC33P201	9/17	1	5.1	ND	0.045 C	50 50	FED-MCL IDEM	Yes	ASL
7440-39-3	BARIUM	7.9		104		µg/L	10GW1701	17/17	0	104	17.9	260 N	2000 2000	FED-MCL IDEM	No	BSL
7440-41-7	BERYLLIUM	1.6		20.3		µg/L	10GW1601	4/17	1	20.3	ND	7.3 N	4 4	FED-MCL IDEM	Yes	ASL
7440-43-9	CADMIUM	4.5		4.5		µg/L	10GW1601	1/17	1	4.5	ND	1.8 N	5 5	FED-MCL IDEM	Yes	ASL
7440-70-2	CALCIUM	26100		337000		µg/L	10GWC31P301	15/17	5000	337000	17000	NA	NA NA	FED-MCL IDEM	No	NUT
7440-48-4	COBALT	7.8		299		µg/L	10GW1601	11/17	3	299	ND	220 N	NA NA	FED-AL IDEM	Yes	ASL
7440-50-8	COPPER	2.1		34.8		µg/L	10GWC41P301	6/17	2	34.8	ND	140 N	1300 1300	FED-MCL IDEM	No	BSL
7439-89-6	IRON	167		93700		µg/L	10GWC3501	16/17	100	93700	22000	1100 N	300(8) NA	FED-MCL IDEM	Yes	ASL
7439-92-1	LEAD	1.2		13.4		µg/L	10GW1601	2/17	1	13.4	ND	15	15 NA	FED-MCL IDEM	No	BSL
7439-95-4	MAGNESIUM	5370	J	326000	J	µg/L	10GWC31P301	15/17	5000	326000	11800	NA	NA NA	FED-MCL IDEM	No	NUT
7439-96-5	MANGANESE	176		21800		µg/L	10GWC31P301	15/17	15	21800	897	88 N	50(8) NA	FED-MCL IDEM	Yes	ASL
7439-97-6	MERCURY	0.2		0.2		µg/L	10GW1701	1/17	0.2	0.2	ND	1.1(9) N	2 2	FED-MCL IDEM	No	BSL
7440-02-0	NICKEL	12		695		µg/L	10GWC31P301	12/17	10	695	ND	73 N	NA 730	FED-MCL IDEM	Yes	ASL
7440-09-7	POTASSIUM	8150	J	10200	J	µg/L	10GWC4101	4/17	5000	10200	ND	NA	NA NA	FED-MCL IDEM	No	NUT
7782-49-2	SELENIUM	1.3	J	9.3		µg/L	10GWC41P301	7/17	1	9.3	ND	18 N	50 50	FED-MCL IDEM	No	BSL
7440-23-5	SODIUM	6870	J	252000		µg/L	10GWC41P301	16/17	5000	252000	15700	NA	NA NA	FED-MCL IDEM	No	NUT
7440-28-0	THALLIUM	1.2		1.2		µg/L	10GW1601	1/17	1	1.2	ND	0.24 N	2 2	FED-MCL IDEM	Yes	ASL
7440-66-6	ZINC	11.8		1660		µg/L	10GW1601	12/17	10	1660	ND	1100 N	5000 11000	FED-MCL IDEM	Yes	ASL

TABLE 7-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUND WATER
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
FILTERED METALS																
7440-39-3	BARIUM, FILTERED	27.5		27.5		µg/L	10GWC5701-F	1/1	---	27.5	NA	260 N	2000 2000	FED-MCL IDEM	No	BSL
7440-70-2	CALCIUM, FILTERED	33400		33400		µg/L	10GWC5701-F	1/1	5000	33400	NA	NA	NA NA	FED-MCL IDEM	No	NUT
7440-48-4	COBALT, FILTERED	31.3		31.3		µg/L	10GWC5701-F	1/1	3	31.3	NA	220 N	NA NA	FED-AL IDEM	No	BSL
7439-89-6	IRON, FILTERED	3510		3510		µg/L	10GWC5701-F	1/1	100	3510	NA	1100 N	300 NA	FED-MCL IDEM	Yes	ASL
7439-95-4	MAGNESIUM, FILTERED	24600	J	24600	J	µg/L	10GWC5701-F	1/1	5000	24600	NA	NA	NA NA	FED-MCL IDEM	No	NUT
7439-96-5	MANGANESE, FILTERED	3940		3940		µg/L	10GWC5701-F	1/1	15	3940	NA	88 N	50 NA	FED-MCL IDEM	Yes	ASL
7440-02-0	NICKEL, FILTERED	89.2		89.2		µg/L	10GWC5701-F	1/1	10	89.2	NA	73 N	NA 730	FED-MCL IDEM	Yes	ASL
7440-23-5	SODIUM, FILTERED	22400	J	22400	J	µg/L	10GWC5701-F	1/1	5000	22400	NA	NA	NA NA	FED-MCL IDEM	No	NUT
7440-66-6	ZINC, FILTERED	114		114		µg/L	10GWC5701-F	1/1	10	114	NA	1100 N	5000 11000	FED-MCL IDEM	No	BSL
MISCELLANEOUS PARAMETERS																
14797-55-8	NITRATE	40		300		µg/L	10GW0201	5/5	---	300	NA	1000 N	10000 NA	FED-MCL IDEM	No	BSL
	NITRITE/NITRATE	90		400		µg/L	10GW1701	3/12	10 - 250	400	NA	1000 N	NA NA	FED-MCL IDEM	No	BSL

Footnotes:

1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 To determine whether metal concentrations were within background levels, maximum groundwater concentrations were compared to concentrations in upgradient groundwater sample 10GWC5201. If the concentration in the site groundwater concentration was less than the upgradient concentration, that metal was not selected as a COPC.
5 The risk-based COPC screening level for tap water use is presented. The value is based on a targetHzard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, October 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Value is for aminodinitrotoluenes (U.S. EPA, Region 3, October 2001).
8 Secondary MCL, based on aesthetic water quality (i.e., color, odor, taste, etc.).
9 Value is for mercuric chloride (U.S. EPA, Region 3, October 2001).

Associated Samples:

10GW0201	10GWC3501	10GWC26F	10GWC41P301
10GW0301	10GWC35P201	10GWC31(	10GWC5501
10GW1601	10GWC3701	10GWC31F	10GWC55P201
10GW1701	10GWC37P301	10GWC33(	10GWC5701
10GWC2601	10GWC4101	10GWC33F	10GWC5701-F

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
J = Estimated value.
N = Noncarcinogen.
NA = Not analyzed / not applicable.
ND = Not detected.
FED-AL = Federal action level (U.S. EPA, 2000).
FED-MCL = Federal Maximum Contaminant Level (U.S. EPA, 2000).
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential closure levels for groundwater (IDEM, July 2001).

Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 7-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA
PAGE 1 OF 2

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
EXPLOSIVES																
118-96-7	2,4,6-TRINITROTOLUENE	1.6		4.4		µg/L	10SW0701	3/12	0.53 - 1.3	4.4	NA	2.2 C	NA NA	FED-MCL IDEM	Yes	ASL
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	0.41	J	0.41	J	µg/L	10SW0401	1/12	0.36 - 1.3	0.41	NA	0.22 N	NA NA	FED-MCL IDEM	Yes	ASL
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	0.96	J	1.4		µg/L	10SW0701	3/12	0.53 - 1.3	1.4	NA	0.22 N	NA NA	FED-MCL IDEM	Yes	ASL
2691-41-0	HMX	6.4		22		µg/L	10SW0701	7/12	0.82 - 1.2	22	NA	180 N	NA NA	FED-MCL IDEM	No	BSL
121-82-4	RDX	1.9		18		µg/L	10SW0701	7/12	0.82 - 1.2	18	NA	0.61 C	NA NA	FED-MCL IDEM	Yes	ASL
INORGANICS																
7429-90-5	ALUMINUM	213	J	837	J	µg/L	10SW0801	11/12	200	837	NA	3600 N	50 to 200(8) NA	FED-MCL IDEM	Yes	ASL
7440-38-2	ARSENIC	0.24		1.8		µg/L	10SW0901	12/12	---	1.8	NA	0.045 C	50 50	FED-MCL IDEM	Yes	ASL
7440-39-3	BARIUM	24.1		86.4		µg/L	10SW0901	12/12	---	86.4	NA	260 N	2000 2000	FED-MCL IDEM	No	BSL
7440-70-2	CALCIUM	6540		85900		µg/L	10SW0901	12/12	---	85900	NA	NA	NA NA	FED-MCL IDEM	No	NUT
7440-50-8	COPPER	2		2		µg/L	10SW0901	1/12	2	2	NA	140 N	1000 1300	FED-MCL IDEM	No	BSL
7439-89-6	IRON	181	J	1120	J	µg/L	10SW1101	12/12	---	1120	NA	1100 N	300 NA	FED-MCL IDEM	Yes	ASL
7439-95-4	MAGNESIUM	7560	J	11100	J	µg/L	10SW0901	2/12	5000	11100	NA	NA N	NA NA	FED-MCL IDEM	No	NUT
7439-96-5	MANGANESE	25.7	J	125	J	µg/L	10SW0801	10/12	15	125	NA	88 N	50 NA	FED-MCL IDEM	Yes	ASL
7440-23-5	SODIUM	5100	J	110000	J	µg/L	10SW0901	10/12	5000	110000	NA	NA	NA NA	FED-AL IDEM	No	NUT
7440-66-6	ZINC	11.2		113		µg/L	10SW0901	2/12	10	113	NA	1100 N	5000 11000	FED-MCL IDEM	No	BSL
FILTERED METALS																
7440-36-0	ANTIMONY, FILTERED	1		1		µg/L	10SW0101-F	1/12	1	1	NA	1.5 N	6 NA	FED-MCL IDEM	No	BSL
7440-38-2	ARSENIC, FILTERED	0.17		1.6		µg/L	10SW0901-F	12/12	---	1.6	NA	0.045 C	50 50	FED-MCL IDEM	Yes	ASL
7440-39-3	BARIUM, FILTERED	23.1		80.3		µg/L	10SW0901-F	12/12	---	80.3	NA	260 N	2000 2000	FED-MCL IDEM	No	BSL
7440-70-2	CALCIUM, FILTERED	6360		80100		µg/L	10SW0901-F	12/12	---	80100	NA	NA N	NA NA	FED-MCL IDEM	No	NUT
7439-89-6	IRON, FILTERED	111		962		µg/L	10SW1101-F	11/12	100	962	NA	1100 N	300 NA	FED-MCL IDEM	Yes	ASL
7439-95-4	MAGNESIUM, FILTERED	7260	J	10400	J	µg/L	10SW0901-F	2/12	5000	10400	NA	NA N	NA NA	FED-MCL IDEM	No	NUT
7439-96-5	MANGANESE, FILTERED	16.8		139		µg/L	10SW1101-F	8/12	15	139	NA	88 N	50	FED-MCL IDEM	Yes	ASL
7440-23-5	SODIUM, FILTERED	5280	J	106000	J	µg/L	10SW0901-F	10/12	5000	106000	NA	NA C	NA NA	FED-MCL IDEM	No	NUT
7440-66-6	ZINC, FILTERED	10.3		102		µg/L	10SW0901-F	2/12	10	102	NA	1100 N	5000 11000	FED-MCL IDEM	No	BSL

TABLE 7-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Entire Site

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level(5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
MISCELLANEOUS PARAMETERS																
	HARDNESS	27		260		µg/L	10SW0901	12/12	---	260	NA	NA	N N	FED-MCL IDEM	No	BSL
14797-55-8	NITRATE	0.09		1.6		µg/L	10SW0901	12/12	---	1.6	NA	1000 N	10000 N	FED-MCL IDEM	No	BSL
	TOTAL SUSPENDED SOLIDS	3	J	50	J	µg/L	10SW0901	10/12	2	50	NA	NA	N N	FED-MCL IDEM	No	BSL

Footnotes:

1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 No upgradient locations could be determined for surface water at SWMU 10. Therefore, no constituents were eliminated on the basis of background.
5 The risk-based COPC screening level for tap water use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, October 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Value is for aminodinitrotoluenes (U.S. EPA, Region 3, October 2001).
8 Secondary MCL, based on aesthetic water quality (i.e., color, odor, taste, etc.).

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
J = Estimated value.
N = Noncarcinogen.
NA = Not analyzed / not applicable.
ND = Not detected.
FED-AL = Federal action level (U.S. EPA, 2000).
FED-MCL = Federal Maximum Contaminant Level (U.S. EPA, 2000).
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential closure levels for groundwater (IDEM, July 2001).

Associated Samples:

10SW0101	10SW0501	10SW0901
10SW0101-F	10SW0501-F	10SW0901-F
10SW0201	10SW0601	10SW1001
10SW0201-F	10SW0601-F	10SW1001-F
10SW0301	10SW0701	10SW1101
10SW0301-F	10SW0701-F	10SW1101-F
10SW0401	10SW0801	10SW1201
10SW0401-F	10SW0801-F	10SW1201-F

Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.
For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 7-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Sediment
Exposure Point: Sediment

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects (2)	Concentration Used for Screening (3)	Upgradient Sample Concentration (4)	Risk-Based COPC Screening Level (5)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (6)
EXPLOSIVES																	
2691-41-0	HMX	51		51		mg/kg	10SD070006	1/12	0.5 - 0.5	51	NA	310	N	NA	IDEM	No	BSL
INORGANICS																	
7429-90-5	ALUMINUM	4430		9190		mg/kg	10SD080006	12/12	---	9190	NA	7600	N	NA	IDEM	Yes	ASL
7440-36-0	ANTIMONY	1.4		2.2		mg/kg	10SD050006	3/12	0.98 - 1.2	2.2	NA	3.1	N	140	IDEM	No	BSL
7440-38-2	ARSENIC	3.1	J	34.2	J	mg/kg	10SD040006	12/12	---	34.2	NA	0.39	C	3.9	IDEM	Yes	ASL
7440-39-3	BARIUM	45.2	J	276	J	mg/kg	10SD120006	12/12	---	276	NA	540	N	23000	IDEM	No	BSL
7440-41-7	BERYLLIUM	1.4	J	2.1	J	mg/kg	10SD080006	5/12	0.98 - 1.2	2.1	NA	15	N	680	IDEM	No	BSL
7440-43-9	CADMIUM	1.3	J	2.4	J	mg/kg	10SD070006	4/12	0.98 - 1.2	2.4	NA	3.7	N	12	IDEM	No	BSL
7440-70-2	CALCIUM	564		5920		mg/kg	10SD090006	12/12	---	5920	NA	NA		NA	IDEM	No	NUT
7440-47-3	CHROMIUM	9.0	J	65.7	J	mg/kg	10SD040006	12/12	---	65.7	NA	30(7)	C	430(7)	IDEM	Yes	ASL
7440-48-4	COBALT	6	J	51.8	J	mg/kg	10SD080006	12/12	---	51.8	NA	470	N	NA	IDEM	No	BSL
7440-50-8	COPPER	7.5	J	16.9	J	mg/kg	10SD080006	12/12	---	16.9	NA	290	N	13000	IDEM	No	BSL
7439-89-6	IRON	12100	J	71100	J	mg/kg	10SD040006	12/12	---	71100	NA	2300	N	NA	IDEM	Yes	ASL
7439-92-1	LEAD	13.3	J	37	J	mg/kg	10SD040006	12/12	---	37	NA	400(8)	N	400	IDEM	No	BSL
7439-95-4	MAGNESIUM	613		1590		mg/kg	10SD090006	8/12	487 - 607	1590	NA	NA		NA	IDEM	No	NUT
7439-96-5	MANGANESE	165	J	3900	J	mg/kg	10SD120006	12/12	---	3900	NA	180	N	NA	IDEM	Yes	ASL
7439-97-6	MERCURY	0.04	J	0.05	J	mg/kg	10SD040006	2/12	0.03 - 0.07	0.05	NA	2.3	N	55	IDEM	No	BSL
7440-02-0	NICKEL	7.5	J	44.6	J	mg/kg	10SD080006	12/12	---	44.6	NA	160	N	6900	IDEM	No	BSL
7440-62-2	VANADIUM	13.2	J	63.2	J	mg/kg	10SD040006	12/12	---	63.2	NA	55	N	NA	IDEM	Yes	ASL
7440-66-6	ZINC	36.5	J	301	J	mg/kg	10SD090006	12/12	---	301	NA	2300	N	100000	IDEM	No	BSL
MISCELLANEOUS PARAMETERS																	
	TOTAL ORGANIC CARBON	4000	J	22000	J	mg/kg	10SD010006	12/12	---	22000	NA	NA		NA	IDEM	No	NTX

TABLE 7-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 Values presented are sample-specific quantitation limits.
3 The maximum detected concentration is used for screening purposes.
4 No upgradient locations could be determined for surface water at SWMU 10. Therefore, no constituents were eliminated on the basis of background.
5 The risk-based soil COPC screening level for residential land use is presented. The value is based on a target Hazard Quotient of 0.1 for noncarcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (U.S. EPA, Region 9, November 2000).
6 The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or an ARAR/TBC(s).
7 Hexavalent chromium.
8 OSWER soil screening level for residential land use (U.S. EPA, July 1994).

Associated Samples:

10SD010006	10SD070006
10SD020006	10SD080006
10SD030006	10SD090006
10SD040006	10SD100006
10SD050006	10SD110006
10SD060006	10SD120006

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/to be considered.
C = Carcinogen.
CAS = Chemical abstract services.
COPC = Chemical of potential concern.
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001).
J = Estimated value.
N = Noncarcinogen.
NA = Not applicable/not available.
sat = Soil saturation concentration.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level/ARAR/TBC.

For Elimination as a COPC:
BKG = Within background levels.
BSL = Below COPC screening level/ARAR/TBC.
NTX = No toxicity information.
NUT = Essential nutrient.

Shaded cells indicate that the specified criterion or background level has been exceeded or that the chemical has been selected as a COPC.

TABLE 7-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface/ Subsurface Soil	Surface/ Subsurface Soil	Entire Site	Excavation/Construction Workers	Adult	Ingestion	On-site	Quant	Infrequent excavation activities may occur at the site and excavation/construction projects may occur in the future.
						Dermal	On-site	Quant	Infrequent excavation activities may occur at the site and excavation/construction projects may occur in the future.
		Air	Vapors and Particulates in Air - Entire Site	Excavation/Construction Workers	Adult	Inhalation	On-site	Qual	Exposure is evaluated qualitatively by a comparison of site data to U.S. EPA generic SSLs for transfers from soil to air.
	Surface Soil(2)	Surface Soil	Entire Site	Maintenance Workers	Adult	Ingestion	On-site	None	NSWC Crane is an active facility and maintenance activities, such as groundskeeping, may be performed at the site.
						Dermal	On-site	None	NSWC Crane is an active facility and maintenance activities, such as groundskeeping, may be performed at the site.
				Occupational Workers	Adult	Ingestion	On-site	None	SWMU 10 is currently an active site and workers may be exposed during work related activities.
						Dermal	On-site	None	SWMU 10 is currently an active site and workers may be exposed during work related activities.
				Trespassers	Adolescent	Ingestion	On-site	Quant(3)	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
						Dermal	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
					Adult	Ingestion	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
						Dermal	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
		Air	Vapors and Particulates in Air - Entire Site	Workers and Trespassers	Adult and Adolescent	Inhalation	On-site	Qual(4)	Exposure is evaluated qualitatively by a comparison of site data to U.S. EPA generic SSLs(5) for transfers from soil to air.
	Ground Water	Ground Water	Surficial Aquifer	Excavation/Construction Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
						Dermal	On-site	Quant	Excavation/construction activities may occur at the site and workers may be exposed by direct contact with ground water.
		Ground Water/Air	Surficial Aquifer	Maintenance Workers, Occupational Workers, and Trespassers	Adult and Adolescent	Ingestion	On-site	None	Direct contact with ground water does not occur under current land use. Shallow ground water is not expected to be used as a domestic water supply.
						Dermal	On-site	None	Direct contact with ground water does not occur under current land use. Shallow ground water is not expected to be used as a domestic water supply.
						Inhalation	On-site	None	Direct contact with ground water does not occur under current land use. Shallow ground water is not expected to be used as a domestic water supply.

TABLE 7-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Water	Surface Water	On-site Streams, Ponded Water and Draingeways	Construction/Excavation, Maintenance, and Occupational Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
						Dermal	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Trespassers	Adolescent	Ingestion	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
						Dermal	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
					Adult	Ingestion	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
						Dermal	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
		Air	On-site Streams, Ponded Water and Draingeways	Workers and Trespassers	Adult and Adolescent	Inhalation	On-site	None	Minimal exposure to vapors emitted from surface water is anticipated (i.e., so low such that it is not worth quantifying).
	Sediment	Sediment	On-site Streams, Ponded Water and Draingeways	Construction/Excavation, Maintenance, and Occupational Workers	Adult	Ingestion	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
						Dermal	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Trespasser	Adolescent	Ingestion	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
						Dermal	On-site	Quant	Although access to the base is controlled, once inside the base, access to the study areas is not limited by any physical constraints.
					Adult	Ingestion	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
						Dermal	On-site	None	Potential risks are assumed to be similar to adolescent trespassers. Risks for this receptor will be inferred using the calculated risks for the adolescent trespasser.
		Air	Vapors and Particulates in Air - Entire Site	Workers and Trespassers	Adult and Adolescent	Inhalation	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
Future	Surface Soil	Surface Soil	Entire Site	Recreational Users	Adult	Ingestion	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
						Dermal	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
				Residents	Child and Adult	Ingestion	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
		Air	Vapors and Particulates in Air - Entire Site	Recreational Users and Residents	Child and Adult	Inhalation	On-site	Qual	Exposure is evaluated qualitatively by a comparison of site data to U.S. EPA generic SSLs for transfers from soil to air.

TABLE 7-19

SELECTION OF EXPOSURE PATHWAYS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Ground Water	Ground Water	Surficial Aquifer	Recreational Users	Adult	Ingestion	On-site	None	Direct contact with ground water is not expected to occur for future recreational users.
						Dermal	On-site	None	Direct contact with ground water is not expected to occur for future recreational users.
				Residents	Child and Adult	Ingestion	On-site	Quant	Although it is unlikely that shallow ground water at the site would be used as a domestic water supply, this scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although it is unlikely that shallow ground water at the site would be used as a domestic water supply, this scenario is included to aid in future risk management decisions.
		Air	Vapors	Recreational Users	Adult	Inhalation	On-site	None	Minimal exposure is anticipated (i.e., so low that it is not worth quantifying).
				Resident	Child and Adult	Inhalation	On-site	Quant	Although it is unlikely that shallow ground water at the site would be used as a domestic water supply, this scenario is included to aid in future risk management decisions.
	Surface Water	Surface Water	On-site Streams, Ponded Water and Draingeways	Recreational Users	Adult	Ingestion	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
						Dermal	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
				Residents	Child and Adult	Ingestion	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
		Air	On-site Streams, Ponded Water and Draingeways	Recreational Users and Residents	Child and Adult	Inhalation	On-site	None	Minimal exposure to vapors emitted from surface water is anticipated (i.e., so low such that it is not worth quantifying).
	Sediment	Sediment	On-site Streams, Ponded Water and Draingeways	Recreational Users	Adult	Ingestion	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
						Dermal	On-site	Quant	This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future.
				Residents	Adult and Child	Ingestion	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
						Dermal	On-site	Quant	Although the scenario is unlikely, a residential scenario is included to aid in future risk management decisions.
		Air	On-site Streams, Ponded Water and Draingeways	Recreational Users and Residents	Child and Adult	Inhalation	On-site	None	Minimal exposure to vapors emitted from surface water is anticipated (i.e., so low that it is not worth quantifying).

Footnotes:
1 Surface/subsurface soil is defined as soil collected from 0 to 10 feet bgs; no exposure to soil at depths below 10 feet bgs is anticipated.
2 Surface soil is defined as soil collected from 0 to 2 feet below ground surface (bgs).
3 Quantitative.
4 Qualitative.
5 Soil Screening Levels (U.S. EPA, May 1996).

TABLE 7-20

EXPOSURE POINT CONCENTRATIONS (EPCs) FOR COPCs
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Chemical of Potential Concern	Exposure Point Concentration				
	Surface Soil[1]	Surface/ Subsurface Soil[1]	Surface Water[1]	Sediment[1]	Groundwater[1]
	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)
BENZO(A)ANTHRACENE	0.53[2]	0.53[2]	NA	NA	NA
BENZO(A)PYRENE	0.99[2]	0.99[2]	NA	NA	NA
BENZO(B)FLUORANTHENE	0.96[2]	0.96[2]	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	0.2[2]	0.2[2]	NA	NA	NA
2-AMINO-4,6-DINITROTOLUENE	0.32	0.28	0.00041[3]	NA	0.004
4-AMINO-4,6-DINITROTOLUENE	NA[4]	NA	0.00088	NA	0.0065
2,6-DINITROTOLUENE	NA	NA	NA	NA	0.00055
2,4,6-TRINITROTOLUENE	NA	NA	0.002	NA	0.016
HMX	NA	NA	NA	NA	0.24[3]
RDX	NA	NA	0.018[3]	NA	0.114
ALUMINUM	NA	NA	0.49	7430	7.13
ARSENIC	NA	NA	0.0007	19.8	0.0017
BERYLLIUM	NA	NA	NA	NA	0.0034
CADMIUM	NA	NA	NA	NA	0.00086
CHROMIUM	NA	NA	NA	38.3739	NA
COBALT	NA	NA	NA	NA	0.299[3]
IRON	NA	NA	0.71	48600	93.7[3]
MANGANESE	NA	NA	0.11	3690	21.8[3]
NICKEL	NA	NA	NA	NA	0.695[3]
THALLIUM	NA	NA	NA	NA	0.0006
VANADIUM	NA	NA	NA	39.2	NA
ZINC	NA	NA	NA	NA	1.66[3]

1 The exposure concentration is the 95% upper confidence limit (UCL) based on distribution of the data set (best fit of normal or lognormal), unless otherwise noted.
2 Because of the limited number of samples (i.e., less than 10 samples), the exposure concentration is set at the maximum detected concentration.
3 Maximum detected concentration is used because the UCL exceeeded the maximum.
4 NA - Not applicable. Chemical is not a chemical of potential concern for this medium.

TABLE 7-21

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURE
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Exposure Route	Construction Worker	Maintenance Worker	Occupational Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
HAZARD INDEX							
Ingestion of Groundwater	NA	NA	NA	NA	NA	3.8E+01	1.3E+02
Dermal Contact with Groundwater	1.6E+00	NA	NA	NA	NA	3.4E+00	1.0E+01
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Soil	NA	5.1E-04	5.3E-03	1.1E-03	8.9E-04	7.4E-03	6.9E-02
Dermal Contact with Surface Soil	NA	3.3E-04	3.5E-03	4.4E-04	6.8E-04	3.0E-03	1.4E-02
Incidental Ingestion of Surface/Subsurface Soil	1.3E-02	NA	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	4.8E-03	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	NA	1.6E-02	2.7E-03	1.1E-01	1.0E-01
Dermal Contact with Surface Water	NA	NA	NA	1.1E-02	3.8E-03	7.4E-02	7.6E-02
Incidental Ingestion of Sediment	NA	NA	NA	4.6E-02	3.7E-02	3.1E-01	2.9E+00
Dermal Contact with Sediment	NA	NA	NA	3.7E-02	2.5E-03	1.1E-02	5.1E-02
Total Hazard:	**1.6E+00**	**8.4E-04**	**8.7E-03**	**1.1E-01**	**4.8E-02**	**4.2E+01**	**1.5E+02**

TABLE 7-21

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURE
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

INCREMENTAL CANCER RISK

Exposure Route	Construction Worker	Maintenance Worker	Occupational Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
Ingestion of Groundwater	NA	NA	NA	NA	NA	1.5E-04	1.3E-04
Dermal Contact with Groundwater	1.4E-08	NA	NA	NA	NA	1.2E-06	6.9E-07
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Soil	NA	3.4E-07	3.5E-06	8.9E-07	2.6E-07	4.8E-06	1.1E-05
Dermal Contact with Surface Soil	NA	2.9E-07	3.0E-06	4.6E-07	2.6E-07	2.5E-06	2.9E-06
Incidental Ingestion of Surface/Subsurface Soil	4.0E-07	NA	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	1.9E-07	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	NA	5.4E-07	3.2E-08	2.9E-06	6.8E-07
Dermal Contact with Surface Water	NA	NA	NA	7.5E-08	9.4E-09	4.0E-07	1.0E-07
Incidental Ingestion of Sediment	NA	NA	NA	2.6E-06	7.7E-07	1.4E-05	3.3E-05
Dermal Contact with Sediment	NA	NA	NA	7.1E-06	1.8E-07	1.7E-06	2.0E-06
Total Risk:	**6.0E-07**	**6.3E-07**	**6.6E-06**	**1.2E-05**	**1.5E-06**	**1.7E-04**	**1.8E-04**

NOTES
NA - Not applicable; exposure route is not applicable for this receptor.
Chemical specific risks presented in Appendix G-3.

TABLE 7-22

CUMULATIVE RISK SUMMARY - CENTRAL TENDENCY EXPOSURE
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Exposure Route	Construction Worker	Maintenance Worker	Occupational Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
HAZARD INDEX							
Ingestion of Groundwater	NA	NA	NA	NA	NA	2.7E+01	5.8E+01
Dermal Contact with Groundwater	1.0E+00	NA	NA	NA	NA	1.5E+00	3.4E+00
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Soil	NA	1.3E-04	2.3E-03	2.7E-04	2.2E-04	3.7E-03	2.3E-02
Dermal Contact with Surface Soil	NA	1.7E-05	3.0E-04	2.7E-05	5.5E-05	3.7E-04	1.6E-03
Incidental Ingestion of Surface/Subsurface Soil	6.6E-03	NA	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	1.4E-03	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	NA	4.1E-03	6.7E-04	3.7E-02	3.4E-02
Dermal Contact with Surface Water	NA	NA	NA	2.9E-03	8.1E-04	2.6E-02	2.4E-02
Incidental Ingestion of Sediment	NA	NA	NA	1.1E-02	9.3E-02	1.0E-01	9.6E-01
Dermal Contact with Sediment	NA	NA	NA	3.7E-03	2.0E-04	9.1E-04	5.9E-03
Total Hazard:	**1.0E+00**	**1.4E-04**	**2.6E-03**	**2.2E-02**	**1.1E-02**	**2.8E+01**	**6.3E+01**

TABLE 7-22

CUMULATIVE RISK SUMMARY - CENTRAL TENDENCY EXPOSURE
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

INCREMENTAL CANCER RISK

Exposure Route	Construction Worker	Maintenance Worker	Occupational Worker	Adult Recreational User	Adolescent Trespasser	Future Adult Resident	Future Child Resident
Ingestion of Groundwater	NA	NA	NA	NA	NA	3.0E-05	1.9E-05
Dermal Contact with Groundwater	1.0E-08	NA	NA	NA	NA	2.2E-07	1.3E-07
Inhalation of Volatiles from Groundwater While Showering	NA	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Soil	NA	3.1E-08	5.6E-07	6.6E-08	6.6E-08	7.0E-07	1.2E-06
Dermal Contact with Surface Soil	NA	5.2E-09	9.5E-08	8.6E-09	2.1E-08	9.0E-08	1.1E-07
Incidental Ingestion of Surface/Subsurface Soil	2.0E-07	NA	NA	NA	NA	NA	NA
Dermal Contact with Surface/Subsurface Soil	5.4E-08	NA	NA	NA	NA	NA	NA
Incidental Ingestion of Surface Water	NA	NA	NA	4.1E-08	8.1E-09	2.8E-07	7.6E-08
Dermal Contact with Surface Water	NA	NA	NA	6.9E-09	2.3E-09	4.8E-08	1.2E-08
Incidental Ingestion of Sediment	NA	NA	NA	1.9E-07	1.9E-07	1.4E-06	3.6E-06
Dermal Contact with Sediment	NA	NA	NA	2.1E-07	1.4E-08	4.1E-08	7.6E-08
Total Risk:	**2.6E-07**	**3.6E-08**	**6.5E-07**	**5.3E-07**	**3.1E-07**	**3.3E-05**	**2.4E-05**

NOTES
NA - Not applicable; exposure route is not applicable for this receptor.
Chemical specific risks are presented in Appendix G-3.

TABLE 7-23

SUMMARY OF CONCLUSIONS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Chemical of Concern[1]	Impact on Human Receptors	Comments
SURFACE SOIL		
PAHs	Occupational worker ILCR = 6.3E-6, Residential ILCR = 2.1E-5	Total risks for soil are less than 1.0E-4 for all receptors. Concentrations of PAHs in soil are within levels occurring in soil in the U.S.
GROUND WATER		
2-Amino-4,6-dinitrotoluene	Adult resident HQ = 1.9, Child resident HQ = 6.5	Explosives were detected in soil, ground water, surface water, and sediment at SWMU 10. Elevated risks are based on the hypothetical future residential use of ground water. Risks under current land use, future industrial risks, and risks from other media are less than U.S. EPA benchmarks.
4-Amino-2,6-dinitrotoluene	Adult resident HQ = 3.0, Child resident HQ = 10	
2,4,6-Trinitrotoluene	Adult resident HQ = 0.88, Child resident HQ = 3.1, Residential ILCR = 8.5E-6	
RDX	Adult resident HQ = 1.1, Child resident HQ = 3.7, Residential ILCR = 2.2E-4	
HMX	Adult resident HQ = 0.13, Child resident HQ = 0.46	
Arsenic	Adult resident HQ = 0.16, Child resident HQ = 0.55, Residential ILCR = 4.5E-5	Risks for arsenic are based on the hypothetical future residential use of ground water. The maximum concentration in ground water (5.1 mg/L) is less than the current (50 ug/L) and recently proposed (10 ug/L) MCLs. In addition, the concentrations of arsenic in ground water samples are similar to the concentrations in the upgradient well.
Beryllium	Child resident HQ = 0.27	Elevated risks from exposure to beryllium are based on the hypothetical future residential use of ground water and only for the residential child. Particulate matter in the unfiltered samples may have caused ground water concentrations to be elevated. Beryllium was detected in 4 or 17 samples and only the maximum concentration exceeded the risk based screening level. The HQ for beryllium is less than the U.S. EPA benchmark for noncarcinogenic risks.
Iron	Adult resident HQ = 4.3, Child resident HQ = 15	Risks for iron are based on the hypothetical future residential use of ground water. Risks calculated for iron are not based on adverse health effects but rather on recommended daily allowances.
Manganese	Adult resident HQ = 28, Child resident HQ = 97, Construction worker HQ = 1.5	Risks for manganese are based on the hypothetical future residential use of ground water. Particulate matter in the unfiltered samples may have caused ground water concentrations to be elevated. The samples with the higher concentrations of manganese also contained elevated concentrations of dissolved solids (calcium and magnesium).
Nickel	Adult resident HQ = 0.98, Child resident HQ = 3.4	Risks for nickel are based on the hypothetical future residential use of ground water. Only the risk for the future child resident exceeds unity. Particulate matter in the unfiltered samples may have caused ground water concentrations to be elevated. All nickel concentrations in ground water are less than the IDEM closure level for default closure level ground water.

TABLE 7-23

SUMMARY OF CONCLUSIONS
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Chemical of Concern[1]	Impact on Human Receptors	Comments
Thallium	Adult resident HQ = 0.23, Child resident HQ = 0.82	Thallium was detected in 1 of 17 samples. Risks are based on the hypothetical future residential use of ground water. Particulate matter in the unfiltered samples may have caused ground water concentrations to be elevated. All thallium concentrations in ground water are less than the Federal MCL and the IDEM default closure level for ground water.
Zinc	Adult resident HQ = 0.15, Child resident HQ = 0.53	Risks from exposure to zinc are based on the hypothetical future residential use of ground water and the maximum detected concentration. Particulate matter in the unfiltered samples may have caused ground water concentrations to be elevated. All zinc concentrations in ground water are less than the Federal MCL and the IDEM default closure level for ground water.
SURFACE WATER		
Arsenic	Residential ILCR = 1.5E-6	Risks (>1.0E-6) for arsenic in surface water are based on a very conservative future residential land use scenario. Although an upgradient sample location could not be determined for SWMU 10, the concentrations of arsenic in SWMU 10 samples are within the range of concentrations in upgradient samples used for the other SWMUs. Risks from exposure to surface water are less than or within the U.S. EPA's target risk range for all receptors.
RDX	Residential ILCR = 2.6E-6	Elevated risks (>1.0E-6) for RDX in surface water are based on a very conservative future residential land use scenario. Risks from exposure to surface water are less than or within the U.S. EPA's target risk range for all receptors.
SEDIMENT		
Arsenic	Recreational User ILCR = 9.7E-6, Residential ILCR = 5.0E-5, Adult resident HQ = 0.1, Child resident HQ = 0.9	Elevated risks for arsenic in sediment are based on future land use scenarios. An upgradient sample location could not be determined for sediment at SWMU 10. The risks for future residents are overestimated based on potential residential exposure to sediment which assumes that future residents are assumed to be exposed 350 days/year. Risks from exposure to sediment are less than or within the U.S. EPA's target risk range for all receptors.
Iron	Adult resident HQ = 0.11, Child resident HQ = 1.0	Risks for iron are based on the hypothetical future residential exposure to sediment which is likely to considerably overestimated potential risks. The risks for future residents are overestimated based on potential residential exposure to sediment which assumes that future residents are assumed to be exposed 350 days/year.In addition, risks calculated for iron are not based on adverse health effects but rather on recommended daily allowances.
Manganese	Child resident HQ = 0.67	Elevated risks for manganese in sediment are based on future land use scenarios. An upgradient sample location could not be determined for sediment at SWMU 10. The risks for future residents are overestimated based on potential residential exposure to sediment which assumes that future residents are assumed to be exposed 350 days/year. Risks from exposure to sediment are less than or within the U.S. EPA's target risk range for all receptors.

HQ Hazard Quotient.
ILCR Incremental lifetime cancer risk.
1 Any carcinogenic chemical with a ILCR of greater than 1.0E-6 or a noncarcinogenic chemical contributing to target organ hazard indices (HI) greater than 1.0.

TABLE 7-24

ECOLOGICAL RISK SCREENING - SURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA
PAGE 1 OF 2

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Site Above Background Concentration?	Surface Soil COPC Screening Level (3)	Ecologcial Effects Quotient (4)	COPC Flag (5)	Rationale for Contaminant Deletion or Selection(5)
Semi-Volatiles (mg/kg)										
ACENAPHTHYLENE	1/1	0.47 J	0.47 J	10SB030002	0.47	---	682	0.0007	No	BSL
ANTHRACENE	1/1	0.11 J	0.11 J	10SB030002	0.11	---	1480	0.0001	No	BSL
BENZO(A)ANTHRACENE	1/1	0.53 J	0.53 J	10SB030002	0.53	---	5.21	0.10	No	BSL
BENZO(A)PYRENE	1/1	0.99 J	0.99 J	10SB030002	0.99	---	1.52	0.65	No	BSL
BENZO(B)FLUORANTHENE	1/1	0.96 J	0.96 J	10SB030002	0.96	---	59.8	0.0161	No	BSL
BENZO(G,H,I)PERYLENE	1/1	0.86 J	0.86 J	10SB030002	0.86	---	119	0.0072	No	BSL
BENZO(K)FLUORANTHENE	1/1	0.74 J	0.74 J	10SB030002	0.74	---	148	0.0050	No	BSL
CHRYSENE	1/1	0.56 J	0.56 J	10SB030002	0.56	---	4.73	0.12	No	BSL
DIBENZO(A,H)ANTHRACENE	1/1	0.2 J	0.2 J	10SB030002	0.2	---	18.4	0.0109	No	BSL
FLUORANTHENE	1/1	0.37 J	0.37 J	10SB030002	0.37	---	122	0.0030	No	BSL
INDENO(1,2,3-CD)PYRENE	1/1	0.61 J	0.61 J	10SB030002	0.61	---	109	0.0056	No	BSL
PHENANTHRENE	1/1	0.13 J	0.13 J	10SB030002	0.13	---	45.7	0.0028	No	BSL
PYRENE	1/1	0.39 J	0.39 J	10SB030002	0.39	---	78.5	0.0050	No	BSL
Explosives (mg/kg)										
2,4,6-Trinitrotoluene	1/10	0.529	0.53	10SB030002-REM	0.28	---	NA	NA	Yes	NTX
2-AMINO-4,6-DINITROTOLUENE	1/10	0.53	0.53	10SB090002	0.28	---	NA	NA	Yes	NTX
HMX	5/10	1.3	55	10SB050002	11.1	---	NA	NA	Yes	NTX
RDX	2/10	0.714	1.6	10SB030002	0.43	---	NA	NA	Yes	NTX
Inorganics (mg/kg)										
ALUMINUM	10/10	1530 J	12200 J	10SB050002	7258	NO	NA	NA	No	BKG
ARSENIC	10/10	0.87	9.3 J	10SB090002	4.0	NO	5.7	1.6	No	BKG
BARIUM	10/10	46.8 J	117 J	10SB050002	65.3	NO	1.04	113	No	BKG
BERYLLIUM	1/10	1 J	1 J	10SB050002	0.48	NO	1.06	0.94	No	BSL, BKG
CADMIUM	2/10	1 J	3.4 J	10SB020002	0.78	NO	0.002	1532	No	BKG
CALCIUM	10/10	960 J	249000 J	10SB080002	43552	YES	NA	NA	No	NT
CHROMIUM	10/10	6.4	22	10SB090002	11.1	NO	0.4	55	No	BKG
COBALT	10/10	1.5	9.7	10SB090002	4.9	NO	0.14	69	No	BKG
COPPER	10/10	2	12.3 J	10SB020002	8.5	NO	2.96	4.2	No	BKG
IRON	10/10	3420 J	26500 J	10SB090002	14092	NO	NA	NA	No	BKG
LEAD	10/10	4.2 J	25.1	10SB090002	11.9	NO	0.054	467	No	BKG
MAGNESIUM	10/10	1010 J	14700 J	10SB080002	3698	YES	NA	NA	No	NT
MANGANESE	10/10	78.1	674 J	10SB090002	204	NO	NA	NA	No	BKG
MERCURY	3/10	0.04	0.04	10SB050002, 10SB060002, 10SB090002	0.03	NO	0.073	0.55	No	BSL, BKG
NICKEL	10/10	6.4	15.7	10SB080002	9.4	NO	13.6	1.2	No	BKG
POTASSIUM	2/10	321 J	506 J	10SB050002	257	NO	NA	NA	No	NT, BKG
VANADIUM	10/10	4.4	26.6 J	10SB090002	17.1	NO	1.6	17	No	BKG

TABLE 7-24

ECOLOGICAL RISK SCREENING - SURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Site Above Background Concentration?	Surface Soil COPC Screening Level (3)	Ecologcial Effects Quotient (4)	COPC Flag (5)	Rationale for Contaminant Deletion or Selection(5)
ZINC	10/10	19.8 J	50 J	10SB090002	34.0	NO	6.6	7.6	No	BKG
Miscellaneous Parameters										
CATION EXCHANGE CAPACITY	2/2	1.5 J	10 J	10SB020002	5.8	---	NA	NA	No	NT
pH	2/2	8 J	8.5 J	10SB080002	8.3	---	NA	NA	No	NT
TOTAL ORGANIC CARBON	2/2	1600	1900	10SB020002	1750	---	NA	NA	No	NT

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 As presented in Table 3-14.
4 Refer to Section 3.4.5 for ecological effects quotient calculation.
5 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.

For Elimination as a COPC:
BKG = Below site background level.
BSL = Below COPC screening level.
NT = Nontoxic.

Definitions:
COPC = Chemical of potential concern.
NA = Not available.

Associated Samples

10SB010002	10SB060002
10SB020002	10SB070002
10SB030002	10SB080002
10SB040002	10SB090002
10SB050002	10SB100002

TABLE 7-25

ECOLOGICAL RISK SCREENING - SEDIMENT
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Sediment COPC Screening Level (3)	Ecological Effects Quotient (4)	COPC Flag (5)	Rationale for Contaminant Deletion or Selection(5)
Explosives (mg/kg)									
HMX	1/12	51	51	10SD070006	4.5	NA	NA	Yes	NTX
Inorganics (mg/kg)									
ALUMINUM	12/12	4430	9190	10SD080006	6670	NA	NA	Yes	NTX
ANTIMONY	3/12	1.4	2.2	10SD050006	0.86	NA	NA	Yes	NTX
ARSENIC	12/12	3.1 J	34.2 J	10SD040006	11.6	5.9	5.8	Yes	ASL
BARIUM	12/12	45.2 J	276 J	10SD120006	107	NA	NA	Yes	NTX
BERYLLIUM	5/12	1.4 J	2.1 J	10SD080006	1.0	NA	NA	Yes	NTX
CADMIUM	4/12	1.3 J	2.4 J	10SD070006	0.94	0.596	4.0	Yes	ASL
CALCIUM	12/12	564	5920	10SD090006	1865	NA	NA	No	NT
CHROMIUM	12/12	9 J	65.7 J	10SD040006	23.5	26	2.5	Yes	ASL
COBALT	12/12	6 J	51.8 J	10SD080006	20.9	50	1.04	Yes	ASL
COPPER	12/12	7.5 J	16.9 J	10SD080006	10.3	16	1.06	Yes	ASL
IRON	12/12	12100 J	71100 J	10SD040006	31517	NA	NA	Yes	NTX
LEAD	12/12	13.3 J	37 J	10SD040006	22.2	31	1.19	Yes	ASL
MAGNESIUM	8/12	613	1590	10SD090006	752	NA	NA	No	NT
MANGANESE	12/12	165 J	3900 J	10SD120006	1543	NA	NA	Yes	NTX
MERCURY	2/12	0.04 J	0.05 J	10SD040006	0.03	0.174	0.3	No	BSL
NICKEL	12/12	7.5 J	44.6 J	10SD080006	21.0	16	2.8	Yes	ASL
VANADIUM	12/12	13.2 J	63.2 J	10SD040006	28.3	NA	NA	Yes	NTX
ZINC	12/12	36.5 J	301 J	10SD090006	82.0	120	2.5	Yes	ASL
Miscellaneous Parameters (mg/kg)									
TOTAL ORGANIC CARBON	12/12	4000 J	22000 J	10SD010006	11008	NA	NA	No	NT

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.
No upgradient samples were collected.

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 As presented in Table 3-14.
4 Refer to Section 3.4.5 for ecological effects quotient calculation.
5 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.

For Elimination as a COPC:
BSL = Below COPC screening level.
NT = Nontoxic.

Definitions:
COPC = Chemical of potential concern.
NA = Not available.

Associated Samples

10SD010006	10SD040006	10SD070006	10SD100006
10SD020006	10SD050006	10SD080006	10SD110006
10SD030006	10SD060006	10SD090006	10SD120006

TABLE 7-26

ECOLOGICAL RISK SCREENING - SURFACE WATER
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA

Chemical	Frequency of Detection [1]	Minimum Concentration [1]	Maximum Concentration [1][2]	Location of Maximum Concentration	Average of All Results	Surface Water COPC Screening Level[3]	Ecological Effects Quotient[4]	COPC Flag[5]	Rationale for Contaminant Deletion or Selection[5]
Explosives (ug/L)									
2,4,6-TRINITROTOLUENE	3/12	1.6	4.4	10SW0701	1.1	NA	NA	Yes	NTX
2-AMINO-4,6-DINITROTOLUENE	1/12	0.41 J	0.41 J	10SW0401	0.4	NA	NA	Yes	NTX
4-AMINO-2,6-DINITROTOLUENE	3/12	0.96 J	1.4	10SW0701	0.7	NA	NA	Yes	NTX
HMX	7/12	6.4	22	10SW0701	8.1	NA	NA	Yes	NTX
RDX	7/12	1.9	18	10SW0701	4.2	NA	NA	Yes	NTX
Inorganics (ug/L)									
ALUMINUM	11/12	213 J	837 J	10SW0801	350	NA	NA	Yes	NTX
ARSENIC	12/12	0.24	1.8	10SW0901	0.5	53	0.034	No	BSL
BARIUM	12/12	24.1	86.4	10SW0901	40.2	5000	0.017	No	BSL
CALCIUM	12/12	6540	85900	10SW0901	23303	NA	NA	No	NT
COPPER	1/12	2	2	10SW0901	1.1	5	0.400	No	BSL
IRON	12/12	181 J	1120 J	10SW1101	510	NA	NA	Yes	NTX
MAGNESIUM	2/12	7560 J	11100 J	10SW0901	3638	NA	NA	No	NT
MANGANESE	10/12	25.7 J	125 J	10SW0801	48.8	NA	NA	Yes	NTX
SODIUM	10/12	5100 J	110000 J	10SW0901	18400	NA	NA	No	NT
ZINC	2/12	11.2	113	10SW0901	14.5	58.9	1.9	Yes	ASL
Filtered Inorganics (ug/L)									
ANTIMONY	1/12	1	1	10SW0101-F	0.5	31	0.032	No	BSL
ARSENIC	12/12	0.17	1.6	10SW0901-F	0.4	53	0.030	No	BSL
BARIUM	12/12	23.1	80.3	10SW0901-F	37.3	5000	0.016	No	BSL
CALCIUM	12/12	6360	80100	10SW0901-F	22520	NA	NA	No	NT
IRON	11/12	111	962	10SW1101-F	231	NA	NA	Yes	NTX
MAGNESIUM	2/12	7260 J	10400 J	10SW0901-F	3555	NA	NA	No	NT
MANGANESE	8/12	16.8	139	10SW1101-F	41.3	NA	NA	Yes	NTX
SODIUM	10/12	5280 J	106000 J	10SW0901-F	18144	NA	NA	No	NT
ZINC	2/12	10.3	102	10SW0901-F	13.5	58.9	1.732	Yes	ASL
Miscellaneous Parameters (ug/L)									
HARDNESS	12/12	27000	260000	10SW0901	74000	NA	NA	No	NT
NITRATE	12/12	0.09	1.6	10SW0901	0.4	NA	NA	No	NT
TOTAL SUSPENDED SOLIDS	10/12	3000 J	50000 J	10SW0901	12100	NA	NA	No	NT

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.
No upgradient samples were collected.

Footnotes:
1 Only the original of duplicate sample was used for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 As presented in Table 3-15.
4 Refer to Section 3.4.5 for ecological effects quotient calculation.
5 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.

For Elimination as a COPC:
BSL = Below COPC screening level.
NT = Nontoxic.

Definitions:
COPC = Chemical of potential concern.
NA = Not available.

Associated Samples

10SW0101	10SW0301-F	10SW0601	10SW0801-F	10SW1101
10SW0101-F	10SW0401	10SW0601-F	10SW0901	10SW1101-F
10SW0201	10SW0401-F	10SW0701	10SW0901-F	10SW1201
10SW0201-F	10SW0501	10SW0701-F	10SW1001	10SW1201-F
10SW0301	10SW0501-F	10SW0801	10SW1001-F	

TABLE 7-27

CHEMICALS OF POTENTIAL CONCERN RETAINED FOR FOOD-CHAIN MODELING
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

Parameters	Media		
	Surface Water	Sediment	Surface Soil
Energetics			
2,4,6-Trinitrotoluene	X		X
2-Amino-4,6-dinitrotoluene	X		X
4-Amino-2,6-dinitrotoluene	X		
HMX	X	X	X
RDX	X		X
Inorganics			
Arsenic		X	
Cadmium		X	
Chromium		X	
Copper		X	
Lead		X	
Nickel		X	
Zinc	X	X	

COPCs retained in surface water and sediment were used to evaluate potential risk to piscivorous receptors.

COPCs retained in surface soil were used to evaluate potential risk to terrestrial wildlife.

TABLE 7-28

STEP 3A EVALUATION FOR RISKS TO PLANTS AND INVERTEBRATES
SURFACE SOIL COPCs
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Screening Level (mg/kg)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation[3]				Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						Alternate Benchmarks Talmage et al. (1999)					
						Plant	Earthworm	Microbial Processes	Other Step 3a Factors Considered in Evaluation		
Explosives											
2,4,6-Trinitrotoluene	1/10	0.53	NA	NA	NA	30	140	NA	- Single detected concentration is less than plant and earthworm benchmarks. - Benchmarks are based on LOECs but detection at site is also less than NOEC.	Acceptable	No
2-Amino-4,6-dinitrotoluene	1/10	0.53	NA	NA	NA	80	NA	80	- Single detected concentration is less than plant and microbe benchmarks. - Microbe benchmark was used as a surrogate for earthworms.	Acceptable	No
HMX	5/10	55	NA	NA	NA	NA	280[4]	NA	- Maximum detected concentration is less than LOEC for earthworms. - All detections are in industrial area with little ecological habitat. - Area surrounding SWMU 10 is heavily vegetated so HMX does not appear to be impacting plants in areas where vegetation is expected.	Acceptable	No
RDX	2/10	1.6	NA	NA	NA	100	95[4]	NA	- Maximum detection is less than plant benchmark. - Maximum detected concentration is less than LOEC for earthworms.	Acceptable	No

Footnotes:
1 Maximum EEQ = Maximum detection divided by the screening level.
2 Number of samples with concentrations greater than the screening level.
3 See Section 7.7.6.1.1 for a more detailed Step 3a evaluation.
4 LOEC for earthworms from other literature sources (not from Talmage et al., 1999).

Acronyms:
COPC = Chemical of Potential Concern
EEQ = Ecological Effects Quotient
NA = Not Available or Not Applicable
LOEC = Lowest Observed Effects Concentration
NOEC = No Observed Effects Concentration

TABLE 7-29

STEP 3A EVALUATION FOR RISKS TO BENTHIC ORGANISMS
SEDIMENT COPCs
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Screening Level (mg/kg)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation						Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						Alternate Benchmarks					Other Step 3a Factors Considered in Evaluation[3]		
						Consensus-based TEC	ER-L	Canadian LEL	TEL	AET			
Energetics													
HMX	1/12	51	NA	NA	NA	NA	NA	NA	NA	NA	- Single detection is less than no effects level for sediment invertebrates	Acceptable	No
Inorganics													
Aluminum	12/12	9,190	NA	NA	NA	NA	NA	NA	25,500	NA	- Maximum concentration is less than the TEL	Acceptable	No
Antimony	3/12	2.2	NA	NA	NA	NA	2	NA	NA	NA	- Maximum concentration only slightly exceeds the ER-L; all other detections are less than the ER-L	Acceptable	No
Arsenic	12/12	34.2	5.9	5.8	10	9.79	NA	NA	NA	NA	- Maximum concentration is greater than the PEC; risks to benthic invertebrates probable - Other detected concentrations are less than the PEC or the TEC; possible risks to benthic invertebrates - Surface soil concentrations are within background concentrations so it is likely that the arsenic in the sediment is not related to site activities	Acceptable	No
Barium	12/12	276	NA	NA	NA	NA	NA	NA	NA	48	- Maximum concentration is greater than the AET - It is likely that the barium in the sediment is not related to site activities; potential risks not site-related	Acceptable	No
Beryllium	5/12	2.1	NA	NA	NA	NA	NA	NA	NA	NA	- No toxicity data are available for beryllium - It is likely that the berylium in the sediment is not related to site activities; potential risks not site-related	Acceptable	No
Cadmium	4/12	2.4	0.596	4.0	4	0.99	NA	NA	NA	NA	- Maximum detected concentration is greater than the TEC but is less than the PEC; possible risks to benthic invertebrates - It is likely that the cadmium in the sediment is not related to site activities; potential risks not site-related	Acceptable	No
Chromium	12/12	65.7	26	2.5	4	31.6	NA	NA	NA	NA	- Maximum detected concentration is greater than the TEC but is less than the PEC; possible risks to benthic invertebrates - It is likely that the chromium in the sediment is not related to site activities; potential risks not site-related	Acceptable	No
Cobalt	12/12	51.8	50	1.0	1	NA	NA	NA	NA	NA	- Maximum concentration only slightly exceeds EDQL; risks to benthic invertebrates unlikely - It is likely that the cobalt in the sediment is not related to site activities; potential risks not site-related	Acceptable	No
Copper	12/12	16.9	16	1.1	1	31.6	NA	NA	NA	NA	-Maximum concentration is less than the TEC	Acceptable	No
Iron	12/12	71,100	NA	NA	NA	NA	NA	20,000	NA	NA	- Maximum concentration is greater than the SEL; risks to benthic invertebrates probable - It is likely that the iron in the sediment is not related to site activities; potential risks not site-related	Acceptable	No

TABLE 7-29

STEP 3A EVALUATION FOR RISKS TO BENTHIC ORGANISMS
SEDIMENT COPCs
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA
PAGE 2 OF 2

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Screening Level (mg/kg)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation						Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						Alternate Benchmarks					Other Step 3a Factors Considered in Evaluation[3]		
						Consensus-based TEC	ER-L	Canadian LEL	TEL	AET			
Lead	12/12	37	31	1.2	2	35.8	NA	NA	NA	NA	- Only the maximum concentration slightly greater than the TEC; all other detections are less than the TEC - Risk to benthic invertebrates unlikely	Acceptable	No
Manganese	12/12	3,900	NA	NA	NA	NA	NA	460	NA	NA	- Maximum concentration is greater than the SEL; risks to benthic invertebrates probable - It is likely that the manganese in the sediment is not related to site activities; potential risks not site-related	Acceptable	No
Nickel	12/12	44.6	16	2.8	6	22.7	NA	NA	NA	NA	- Maximum detected concentration is greater than the TEC but is less than the PEC; possible risks to benthic invertebrates - It is likely that the nickel in the sediment is not related to site activities; potential risks not site-related	Acceptable	No
Vanadium	12/12	63.2	NA	NA	NA	NA	NA	NA	NA	57	- Only the maximum concentration is greater than the AET - It is likely that the nickel in the sediment is not related to site activities; potential risks not site-related	Acceptable	No
Zinc	12/12	301	120	2.5	1	121	NA	NA	NA	NA	- Maximum detected concentration is greater than the TEC but is less than the PEC; possible risks to benthic invertebrates - It is likely that the zinc in the sediment is not related to site activities; potential risks not site-related	Acceptable	No

Footnotes:
1 Maximum EEQ = Maximum detection divided by the screening level.
2 Number of samples with concentrations greater than the screening level.
3 See Section 7.7.6 for a more detailed Step 3a Evaluation.

Acronyms:
EDQL = Ecological Data Quality Level
AET = Apparent Effects Threshold
COPC = Chemical of Potential Concern
EEQ = Ecological Effects Quotient
ER-L = Effects Range-Low
LEL = Lowest Effects Level
NA = Not Available or Not Applicable
PEC = Probable Effects Concentration
SEL - Severe Effects Level
TEC = Threshold Effects Concentration

TABLE 7-30

STEP 3A EVALUATION FOR RISKS TO AQUATIC ORGANISMS
SURFACE WATER COPCs
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration (ug/L)	Screening Level (ug/L)	Maximum EEQ[1]	Number of Samples > Screening Level[2]	Step 3a Evaluation					Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
						WQC		ORNL Aquatic Chronic	SCV	Other Step 3a Factors Considered in Evaluation[3]		
						Chronic	Acute					
Explosives												
2,4,6-Trinitrotoluene	3/12	4.4	NA	NA	NA	NA	NA	NA	90	- Maximum detection is less than SCV.	Acceptable	No
2-Amino-4,6-Dintrotoluene	1/12	0.41	NA	NA	NA	NA	NA	NA	20	- Only detection is less than TSCV.	Acceptable	No
4-Amino-2,6-Dinitrotoluene	3/12	1.4	NA	NA	NA	NA	NA	NA	NA	- Maximum detection is less than SCV for 2-ADNT.	Acceptable	No
HMX	7/12	22	NA	NA	NA	NA	NA	NA	330	- Maximum detection is less than SCV.	Acceptable	No
RDX	7/12	18	NA	NA	NA	NA	NA	NA	190	- Maximum detection is less than SCV.	Acceptable	No
Inorganics												
Aluminum	11/12	837	NA	NA	NA	87	750	NA	NA	- Not detected in filtered sample which is the bioavalable portion.	Acceptable	No
Iron	12/12	1120	NA	NA	NA	1,000	NA	NA	NA	- Maximum detection in the filtered sample is less than the chronic WQC.	Acceptable	No
Iron (filtered)	11/12	962	NA	NA	NA	1,000	NA	NA	NA			
Manganese	10/12	125	NA	NA	NA	NA	NA	120	NA	- Maximum detection just slightly greater than ORNL chronic benchmark - Maximum detection much less than tolerance value of 1500 ug/L (tolerance level from the U.S. EPA Gold Book).	Acceptable	No
Manganese (filtered)	8/12	139	NA	NA	NA	NA	NA	120	NA			
Zinc	2/12	113	58.9	1.9	1	248[4]	248[4]	NA	NA	- Maximum detection in the filtered sample is less than the chronic WQC.	Acceptable	No
Zinc (filtered)	2/12	102	58.9	1.7	1	248[4]	248[4]	NA	NA			

Footnotes:
1 Maximum EEQ = Maximum detection divided by the screening level.
2 Number of samples with concentrations greater than the screening level.
3 See Section 7.7.6 for a more detailed Step 3a Evaluation.
4 Calculated using hardness concentration of 260 mg/L in sample 10SW0901.

EEQ = Ecological Effects Quotient
NA = Not Available or Not Applicable
WQC = U.S. EPA Water Quality Criteria
LCV = Lowest Chronic Value
SCV = Seconday Chronic Value
ORNL = Oak Ridge National Laboratory

TABLE 7-31

TERRESTRIAL WILDLIFE MODEL-MAXIMUM EEQS
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

Parameter	Meadow Vole EEQ_{NOAEL}	Meadow Vole EEQ_{LOAEL}	Short-Tailed Shrew EEQ_{NOAEL}	Short-Tailed Shrew EEQ_{LOAEL}	American Robin EEQ_{NOAEL}	American Robin EEQ_{LOAEL}	N. Bobwhite Quail EEQ_{NOAEL}	N. Bobwhite Quail EEQ_{LOAEL}
Energetics								
2,4,6-trinitrotoluene	3.4E-03	3.4E-04	1.3E-02	1.3E-03				
2-amino-4,6-dinitrotoluene								
HMX	3.3E+01	1.3E+01	1.4E+01	5.6E+00				
RDX	6.7E-03	1.3E-03	7.6E-02	1.5E-02				
Inorganics								
Zinc	6.6E-03	3.3E-03	3.4E-02	1.7E-02	1.0E+01	1.1E+00	1.9E-01	2.1E-02

Notes:
- Blank spaces indicate that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- Cells are shaded if the EEQ is greater than 1.0

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

TABLE 7-32

TERRESTRIAL WILDLIFE MODEL-AVERAGE EEQS
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

Parameter	Meadow Vole EEQ_{NOAEL}	Meadow Vole EEQ_{LOAEL}	Short-Tailed Shrew EEQ_{NOAEL}	Short-Tailed Shrew EEQ_{LOAEL}	American Robin EEQ_{NOAEL}	American Robin EEQ_{LOAEL}
Energetics						
HMX	5.2E+00	2.1E+00	1.4E+00	5.7E-01		
Inorganics						
Zinc	9.7E-04	4.8E-04	4.0E-03	2.0E-03	1.7E+00	1.9E-01

Notes:

- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicate that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

TABLE 7-33

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-MAXIMUM CONCENTRATIONS
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

Parameters	Raccoon NOAEL	Raccoon LOAEL	Belted Kingfisher NOAEL	Belted Kingfisher LOAEL	Little Brown Bat NOAEL	Little Brown Bat LOAEL
Energetics						
2,4,6-TRINITROTOLUENE	3.4E-03	3.4E-04			9.2E-06	9.2E-07
2-AMINO-4,6-DINITROTOLUENE						
4-AMINO-2,6-DINITROTOLUENE						
HMX	1.0E+00	4.1E-01			1.9E-03	7.4E-04
RDX	8.1E-02	1.6E-02			2.2E-04	4.4E-05
Inorganics						
ARSENIC	1.6E+04	1.6E+03	2.5E-01	8.3E-02	1.5E+01	1.5E+00
CADMIUM	1.4E+01	1.4E+00			1.5E-01	1.5E-02
CHROMIUM	1.0E+02	2.5E+01			6.3E-02	1.6E-02
COPPER	3.1E+00	2.4E+00	7.9E-03	6.0E-03	2.2E-02	1.7E-02
LEAD	2.9E+01	2.9E+00	7.4E-01	7.4E-02	2.3E-02	2.3E-03
NICKEL	7.3E+00	3.6E+00	1.4E-02	9.8E-03	2.3E-02	1.1E-02
ZINC	6.3E+00	3.1E+00	2.5E-01	2.8E-02	6.3E-02	3.2E-02

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available

EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

TABLE 7-34

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-AVERAGE CONCENTRATIONS
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

Parameter	Raccoon NOAEL	Raccoon LOAEL	Little Brown Bat NOAEL	Little Brown Bat LOAEL
Energetics				
HMX	2.7E-01	1.1E-01	3.4E-04	1.4E-04
Inorganics				
ARSENIC	4.5E+03	4.5E+02	5.6E-01	5.6E-02
CADMIUM	4.5E+00	4.5E-01	2.4E-03	2.4E-04
CHROMIUM	3.0E+01	7.5E+00	2.6E-03	6.5E-04
COPPER	1.3E+00	1.0E+00	1.8E-03	1.4E-03
LEAD	1.2E+01	1.2E+00	7.2E-04	7.2E-05
NICKEL	2.2E+00	1.1E+00	9.3E-04	4.6E-04
ZINC	2.1E+00	1.1E+00	3.6E-03	1.8E-03

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

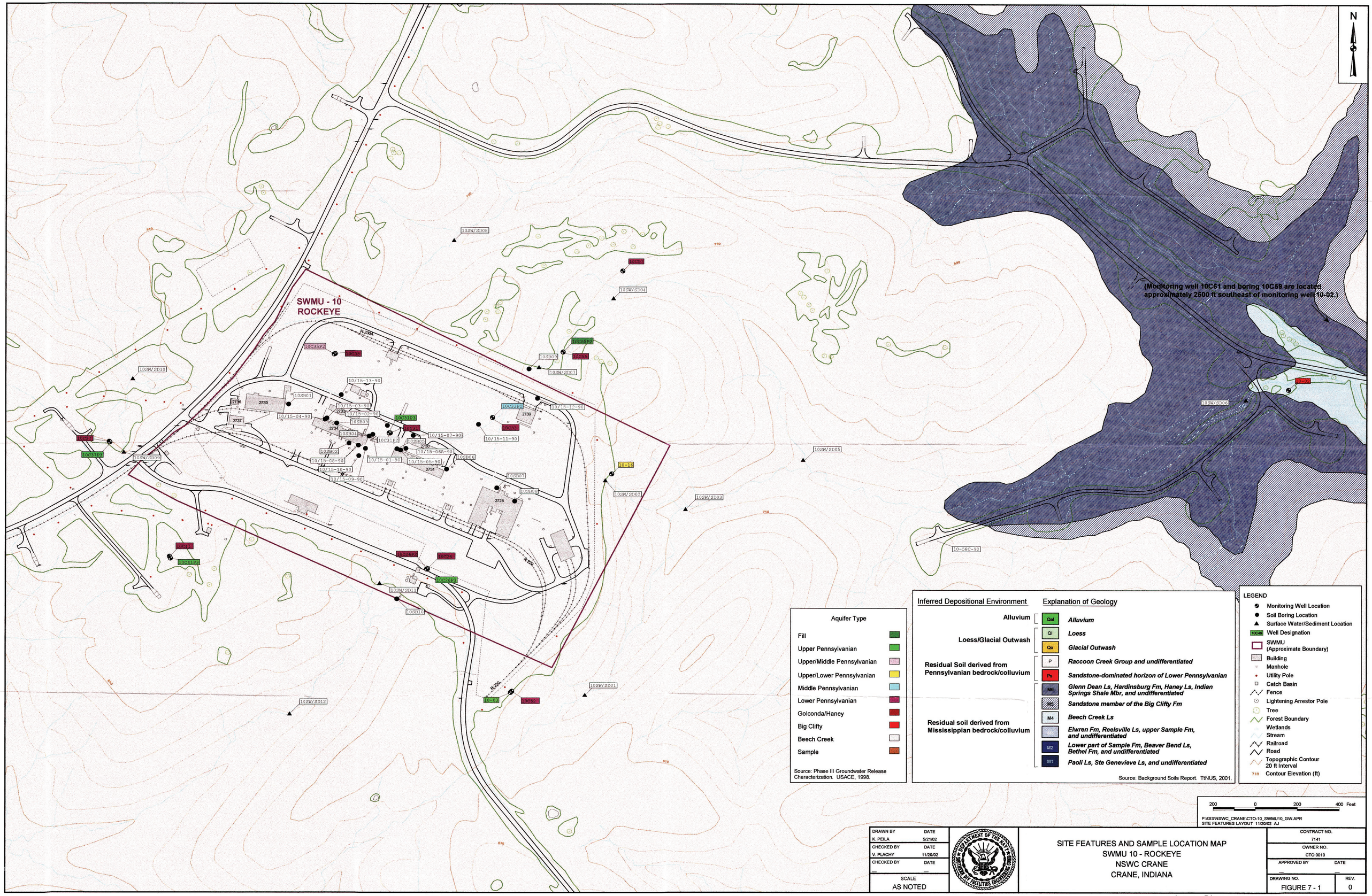
TABLE 7-35

STEP 3A EVALUATION FOR RISKS TO WILDLIFE
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection[1]	Maximum Detected Concentration (mg/kg)[1]	Average Concentration (mg/kg)[1]	EEQs Using Average Exposure Values				Basis of Wildlife Toxicity Reference Value	Other Step 3a Factors Considered in Evaluation[2]	Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?
				NOAEL		LOAEL					
				EEQ > 1.0	Species	EEQ > 1.0	Species				
Insectivorous/Herbivorous Wildlife											
2,4,6-trinitrotoluene	1/10	0.53	0.28	None	NA	None	NA	NA	- NOAEL EEQ is less than 1.0.	Acceptable	No
2-amino-4,6-dinitrotoluene	1/10	0.53	0.28	None	NA	None	NA	NA	- NOAEL EEQ is less than 1.0.	Acceptable	No
HMX	1/10	55	11.1	5.2	Vole	2.1	Vole	No significant increase in mortality was observed among mice consuming 30 mg/kg-day HMX, but a significant increase in mortality was observed among mice consuming 75 mg/kg-day.	- Little ecological habitat in area with detections of HMX in surface soil.	Acceptable	No
RDX	5/10	1.6	0.43	None	NA	None	NA	NA	- NOAEL EEQ is less than 1.0.	Acceptable	No
Zinc	10/10	50	34.0	1.7	Robin	None	NA	Egg hatchability <20% of controls (LOAEL)	- Dose from surface soil exposure route makes responsible for EEQ>1.0. - Dose from surface water exposure route makes up less than 0.1 of the EEQ. - Zinc concentrations in surface oil are within background concentrations. - Risks from zinc are within background risks.	Acceptable	No
Piscivorous Wildlife											
2,4,6-trinitrotoluene[3]	3/12	0.0044	0.0011	None	NA	None	NA	NA	- NOAEL EEQ is less than 1.0.	Acceptable	No
HMX	1/12	51	4.5	None	NA	None	NA	NA	- NOAEL EEQ is less than 1.0.	Acceptable	No
RDX[3]	7/12	0.018	0.0042	None	NA	None	NA	NA	- NOAEL EEQ is less than 1.0.	Acceptable	No
Arsenic	12/12	34.2	11.6	4500	Raccoon	450	Raccoon	NA	- Waterbodies are very small with few fish; not likely to support a significant amount of the diet for raccoons, if any. - Unlikely that metals in sediment are related to site activities. - Doses are likely overestimated because default bioaccumulation factors of 1.0 were used to estimate tissue concentrations in food items for the raccoon because bioaccumulation factors for metals are not available.	Acceptable	No
Cadmium	4/12	2.4	0.94	4.5	Raccoon	None	NA	NA		Acceptable	No
Chromium	12/12	65.7	23.5	30	Raccoon	7.5	Raccoon	NA		Acceptable	No
Copper	12/12	16.9	10.3	1.3	Raccoon	1.0	Raccoon	NA		Acceptable	No
Lead	12/12	37	22.2	12	Raccoon	1.2	Raccoon	NA		Acceptable	No
Nickel	12/12	44.6	21	2.2	Raccoon	1.1	Raccoon	NA		Acceptable	No
Zinc	12/12	301	82	2.1	Raccoon	1.1	Raccoon	NA		Acceptable	No

Footnotes:
1 These columns present the FOD and concentrations for soil (for insectivorous/herbivorous wildlife) or sediment (for piscivorous wildlife), except as noted in footnote 3.
2 See Section 7.7.6.2 for a more detailed Step 3a evaluation.
3 2,4,6-trinitrotoluene and RDX were detected in the surface water but not the sediment. Values given are surface water values in mg/L.

EEQ = Ecological Effects Quotient
NA = Not available or not applicable
NOAEL = No Observable Adverse Effect Level
LOAEL = Lowest Observable Adverse Effect Level



DRAWN BY K. PEILA	DATE 5/21/02
CHECKED BY V. PLACHY	DATE 11/20/02
CHECKED BY	DATE
SCALE AS NOTED	

SITE FEATURES AND SAMPLE LOCATION MAP
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

CONTRACT NO. 7141	
OWNER NO. CTO 0010	
APPROVED BY	DATE
DRAWING NO. FIGURE 7 - 1	REV. 0

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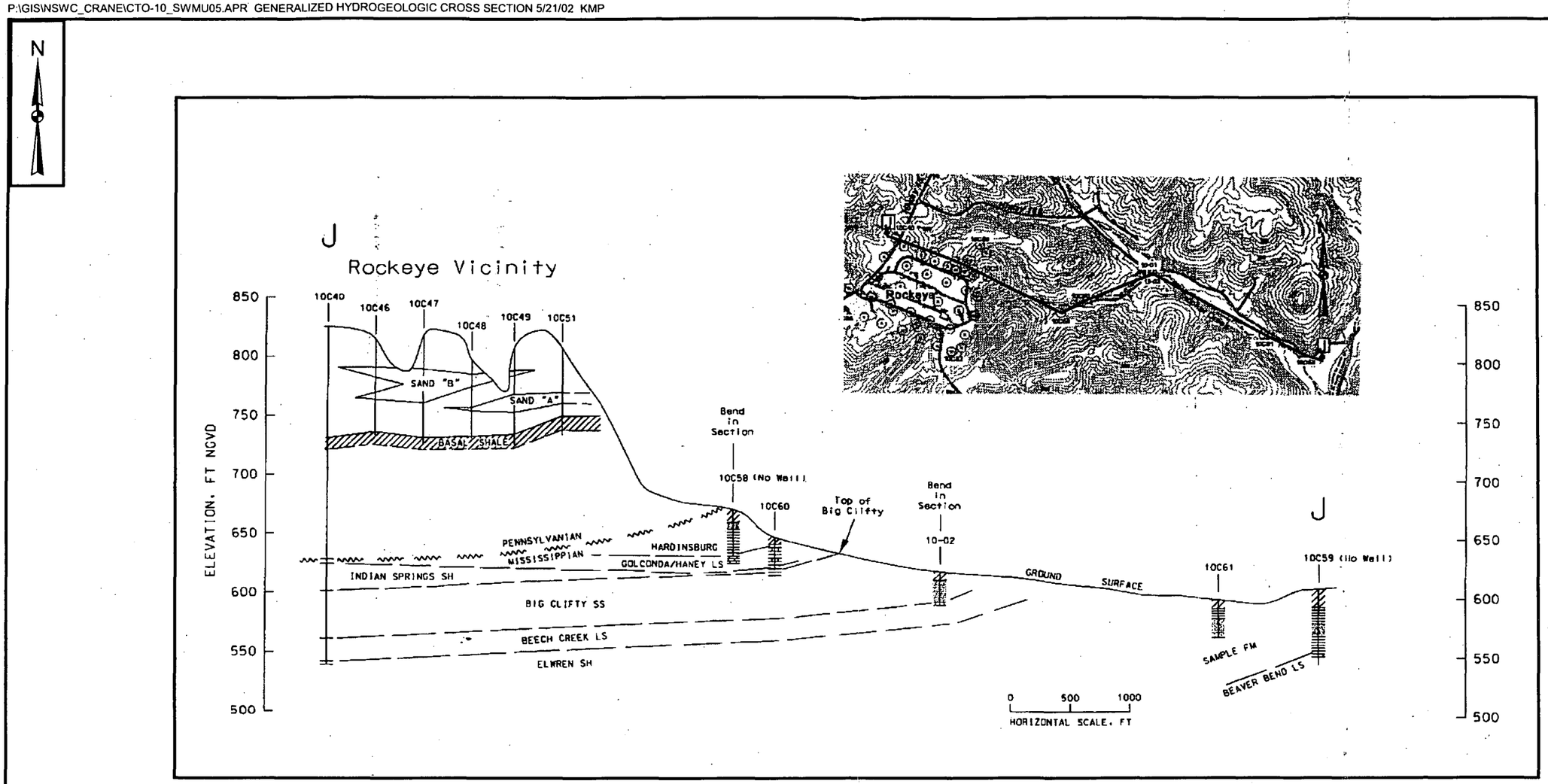

Note: this figure was reprinted from USACE, 1998.

CONTRACT NO. 7141

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 7 - 2

REV _

GENERALIZED HYDROGEOLOGIC CROSS SECTION
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

DRAWN BY K. PEILA DATE 5/21/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

P:\GIS\NSWC_CRANE\CTO-10_SWMU05.APR ISOCHORES OF SANDSTONES A, B, & C FOR ROCKEYE 5/21/02 KMP

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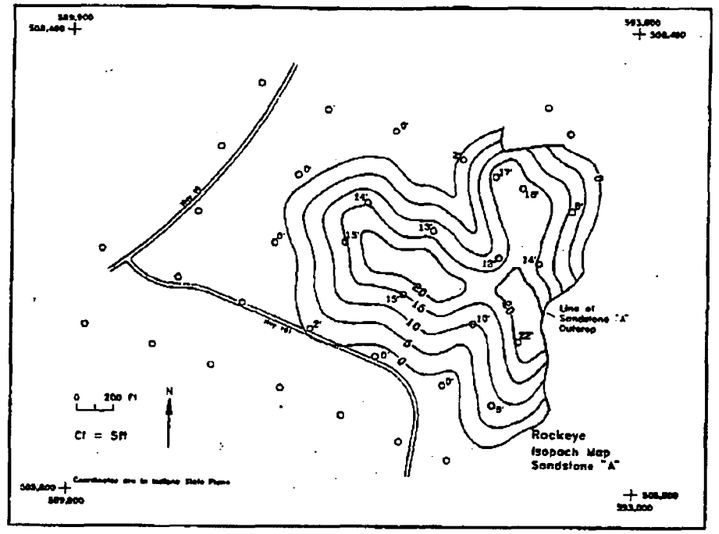


Figure 1. Isochore of sandstone "A", Rockeye Facility.
Note: this figure was reprinted from USACE, 1998.

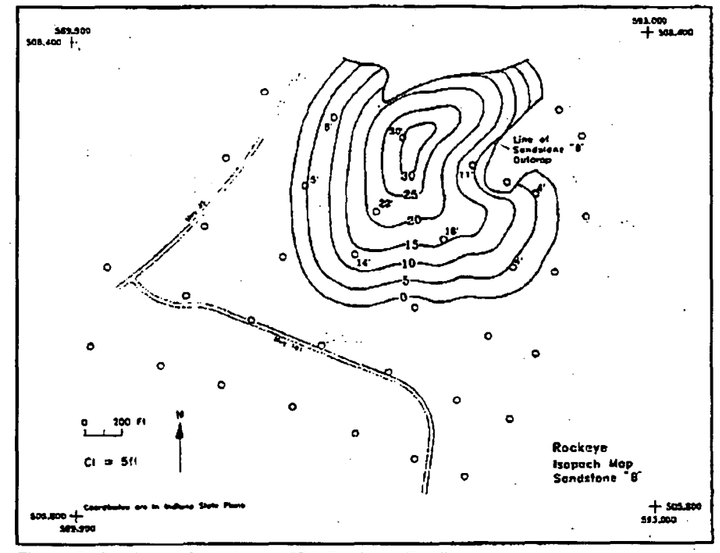


Figure 2. Isochore of sandstone "B", Rockeye Facility.
Note: this figure was reprinted from USACE, 1998.

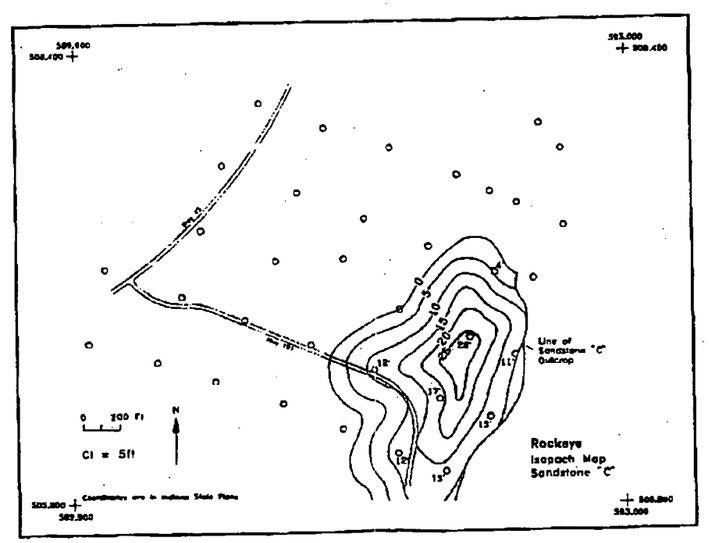


Figure 3. Isochore of sandstone "C", Rockeye Facility.
Note: this figure was reprinted from USACE, 1998.

CONTRACT NO. 7141

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 7 - 3

REV _

ISOPACH OF SANDSTONE UNITS A, B & C
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

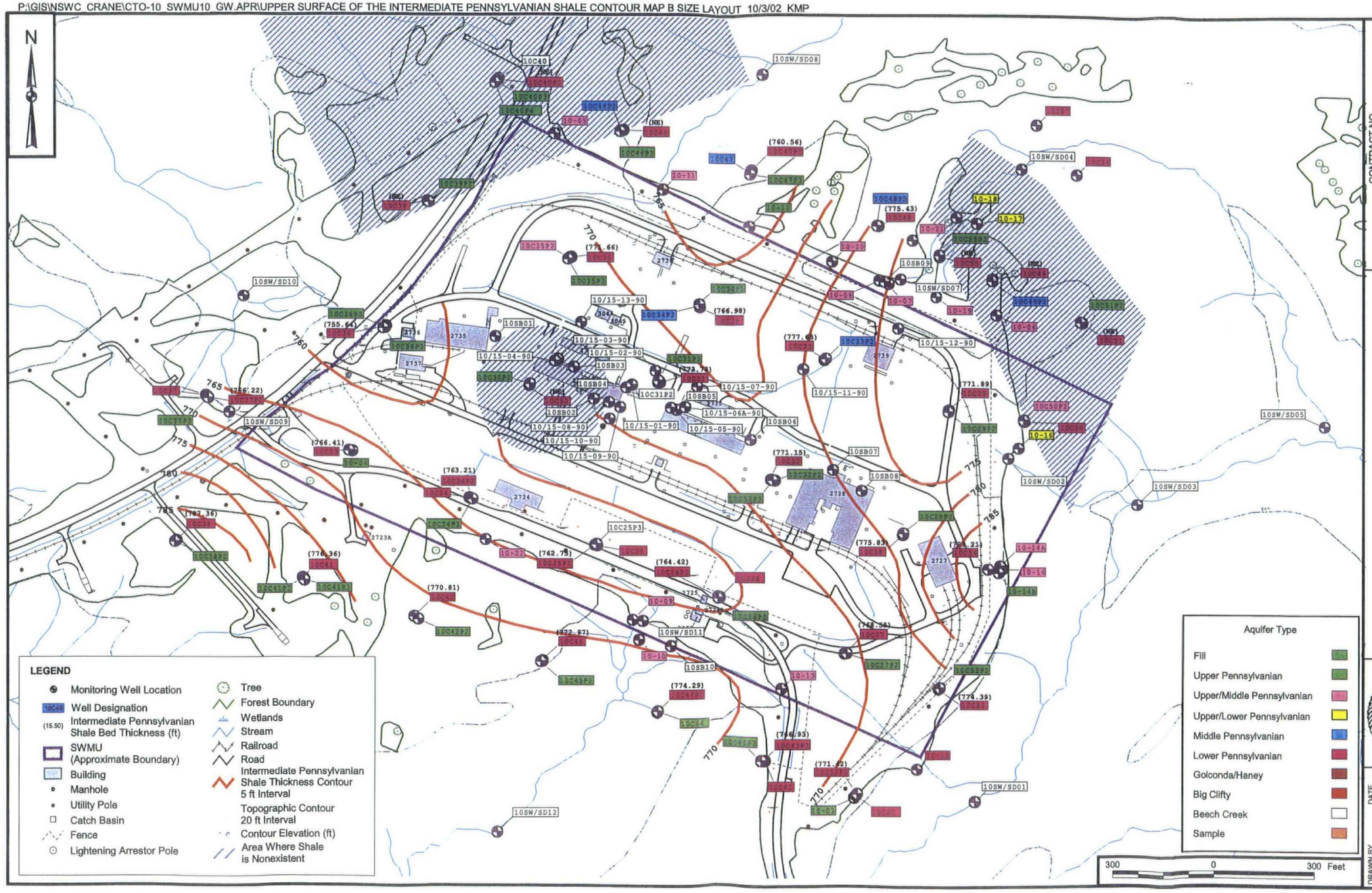
DRAWN BY K. PEILA DATE 5/21/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

P:\GIS\NSWC_CRANE\CTO-10_SWMU10_GW.APR\UPPER SURFACE OF THE INTERMEDIATE PENNSYLVANIAN SHALE CONTOUR MAP B SIZE LAYOUT 10/3/02 KMP



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APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 7 - 4

REV -

UPPER SURFACE OF THE INTERMEDIATE PENNSYLVANIAN SHALE CONTOUR MAP
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

DRAWN BY K. PEILA DATE 5/22/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

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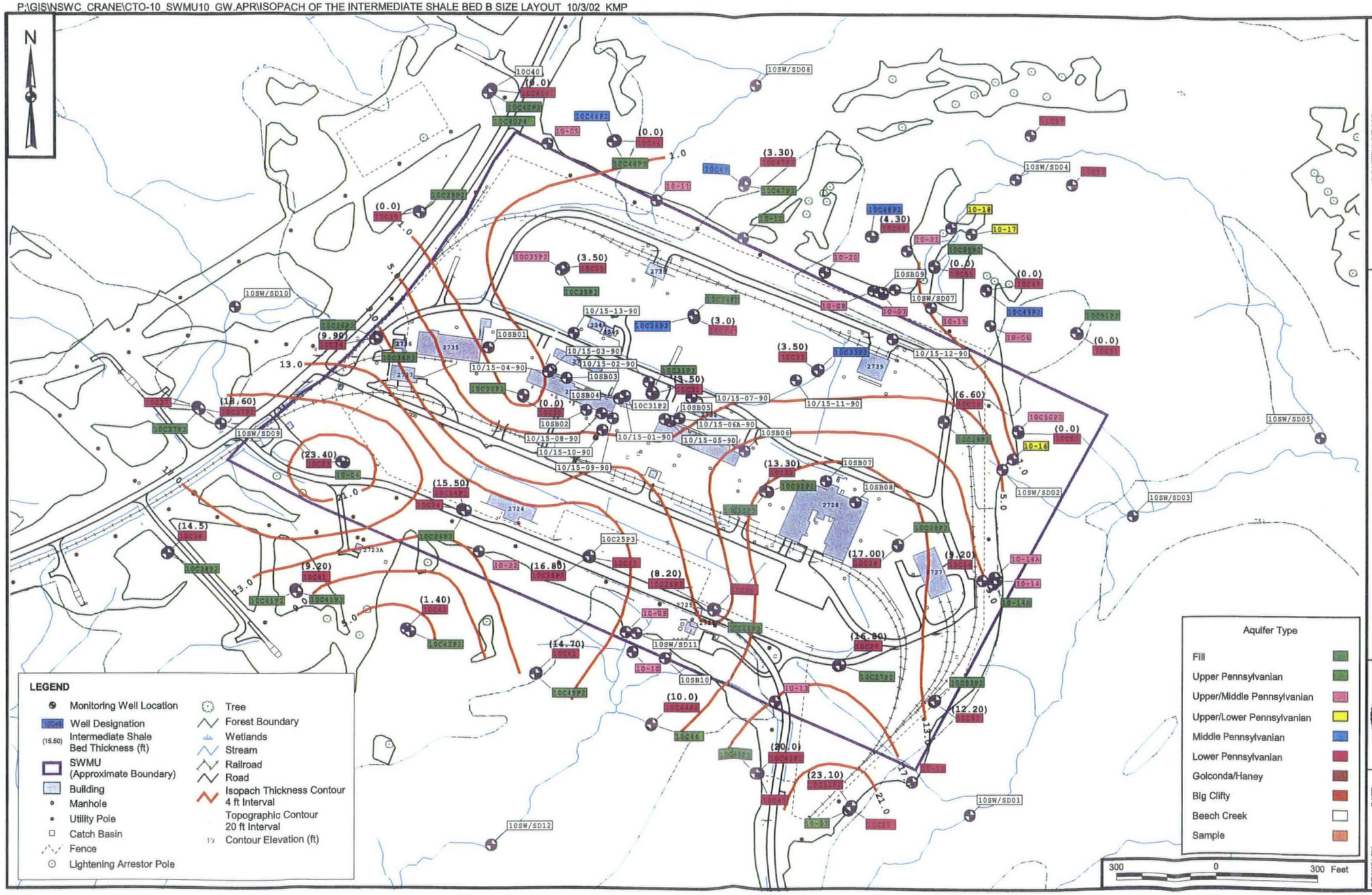

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APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 7 - 5

REV -

ISOPACH OF THE INTERMEDIATE SHALE BED
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

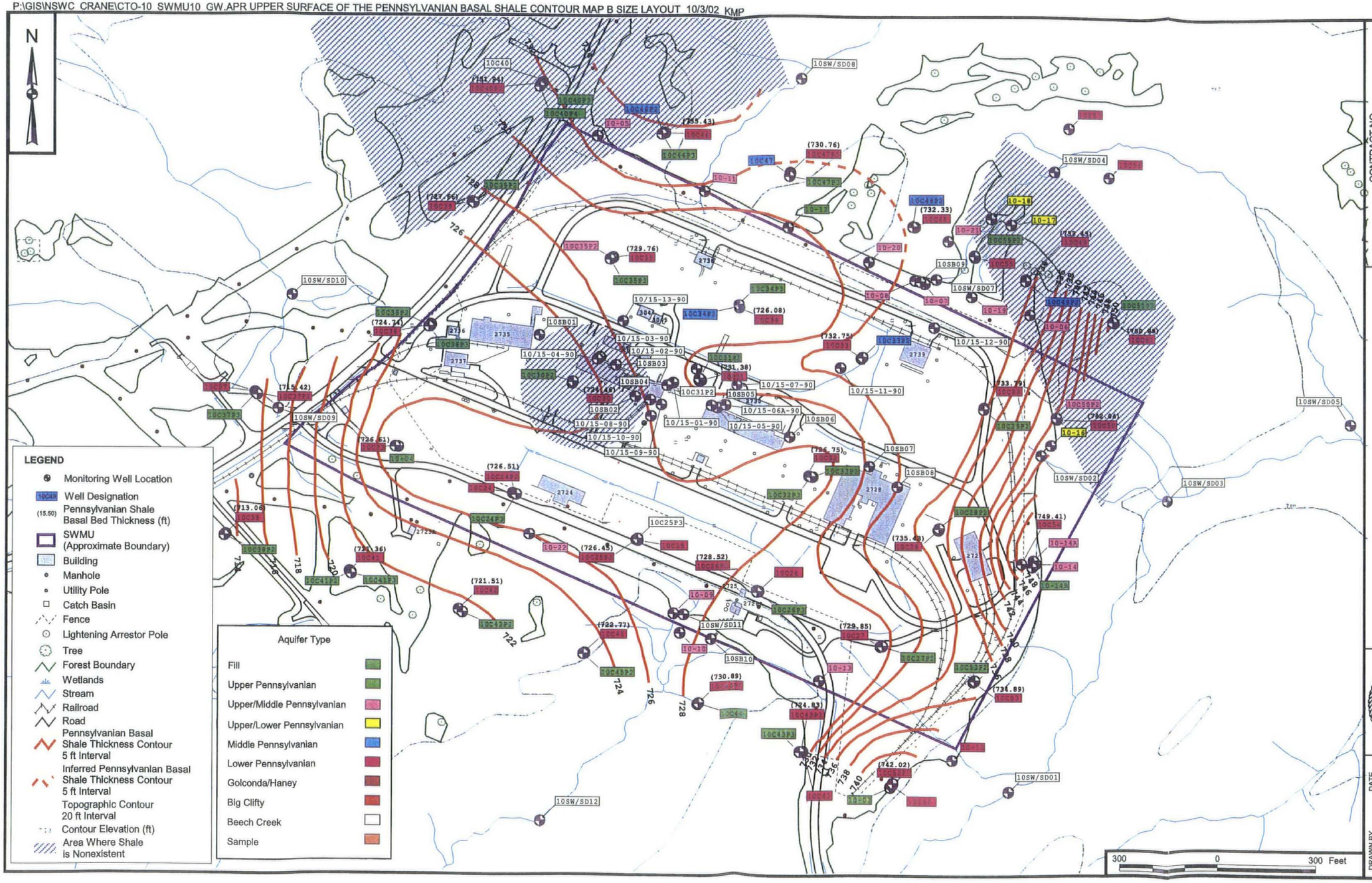
DRAWN BY K. PEILA DATE 5/22/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

P:\GIS\NSWC_CRANE\CTO-10_SWMU10_GW.APR UPPER SURFACE OF THE PENNSYLVANIAN BASAL SHALE CONTOUR MAP B SIZE LAYOUT 10/3/02 KMP



CONTRACT NO. 7141

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 7 - 6

REV -

UPPER SURFACE OF THE PENNSYLVANIAN BASAL SHALE CONTOUR MAP
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

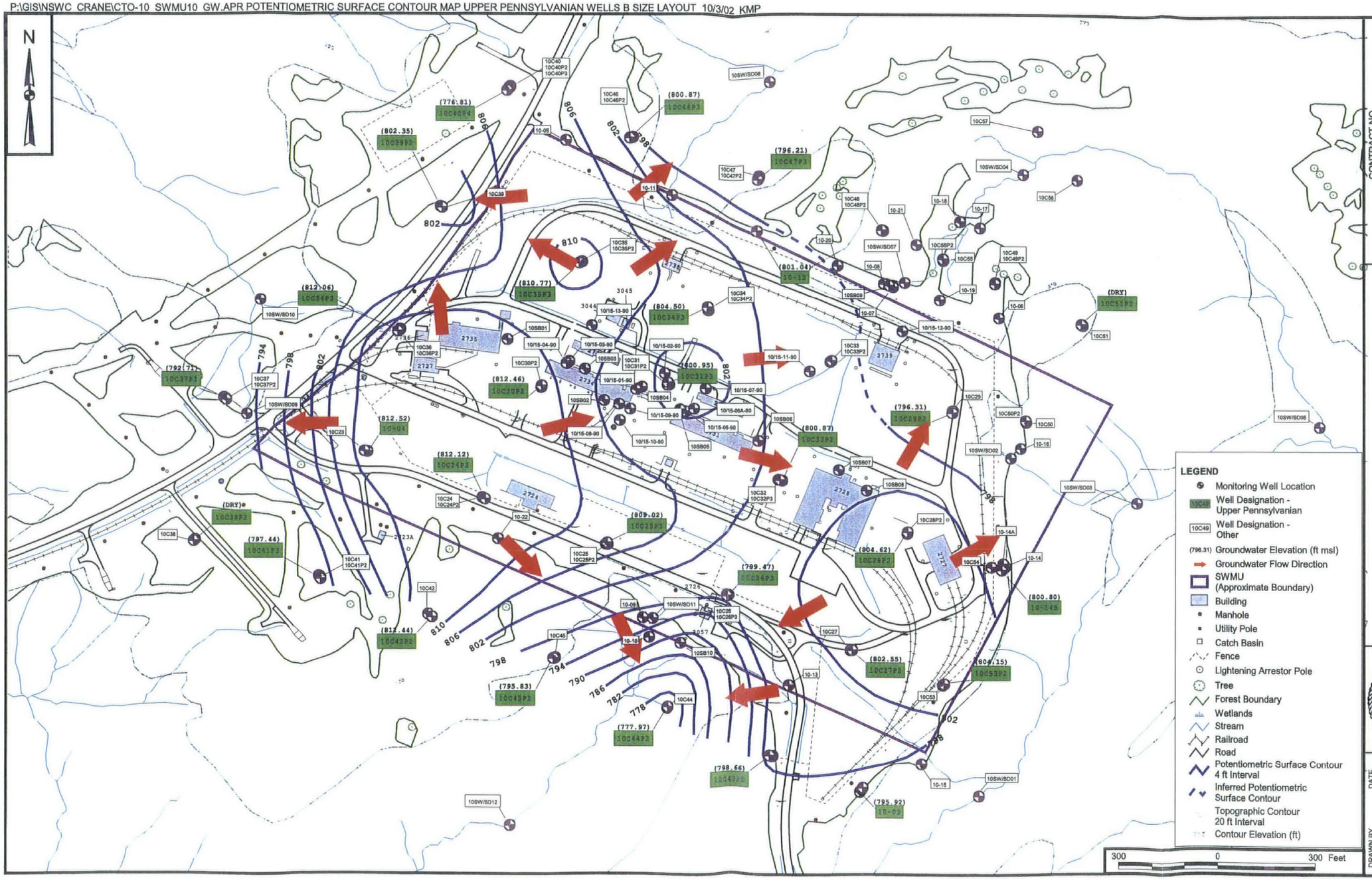
DRAWN BY A. JANOCHA DATE 12/04/01

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

P:\GIS\NSWC CRANE\CTO-10 SWMU10 GW.APR POTENTIOMETRIC SURFACE CONTOUR MAP UPPER PENNSYLVANIAN WELLS B SIZE LAYOUT 10/3/02 KMP



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APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 7 - 7 REV -

POTENTIOMETRIC SURFACE CONTOUR MAP
UPPER PENNSYLVANIAN WELLS
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

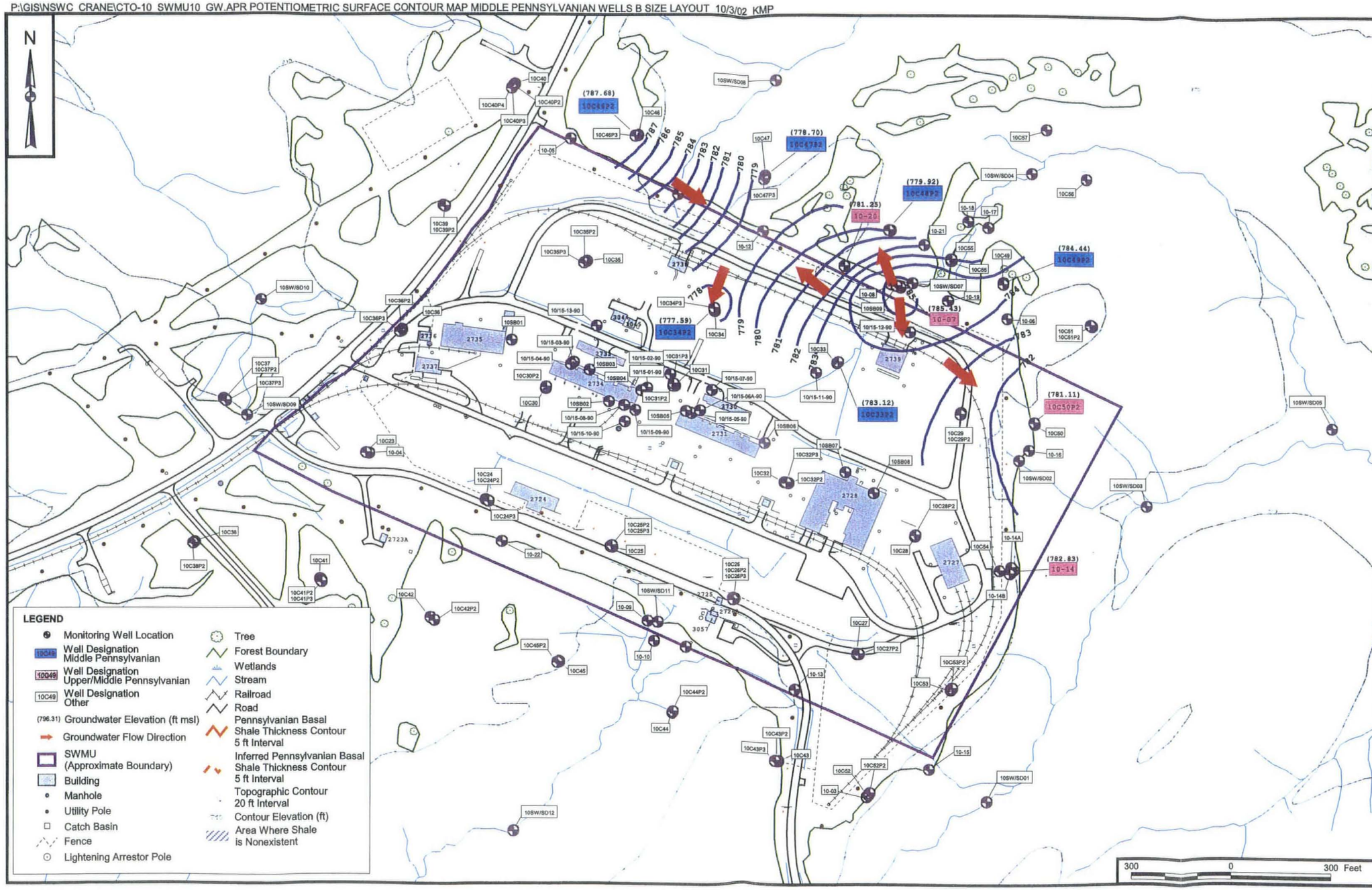
DRAWN BY A. JANOCHA DATE 12/04/01

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

P:\GIS\NSWC CRANE\CTO-10 SWMU10 GW.APR POTENTIOMETRIC SURFACE CONTOUR MAP MIDDLE PENNSYLVANIAN WELLS B SIZE LAYOUT 10/3/02 KMP



CONTRACT NO. 7141

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 7 - 8 REV -

POTENTIOMETRIC SURFACE CONTOUR MAP
MIDDLE PENNSYLVANIAN WELLS
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

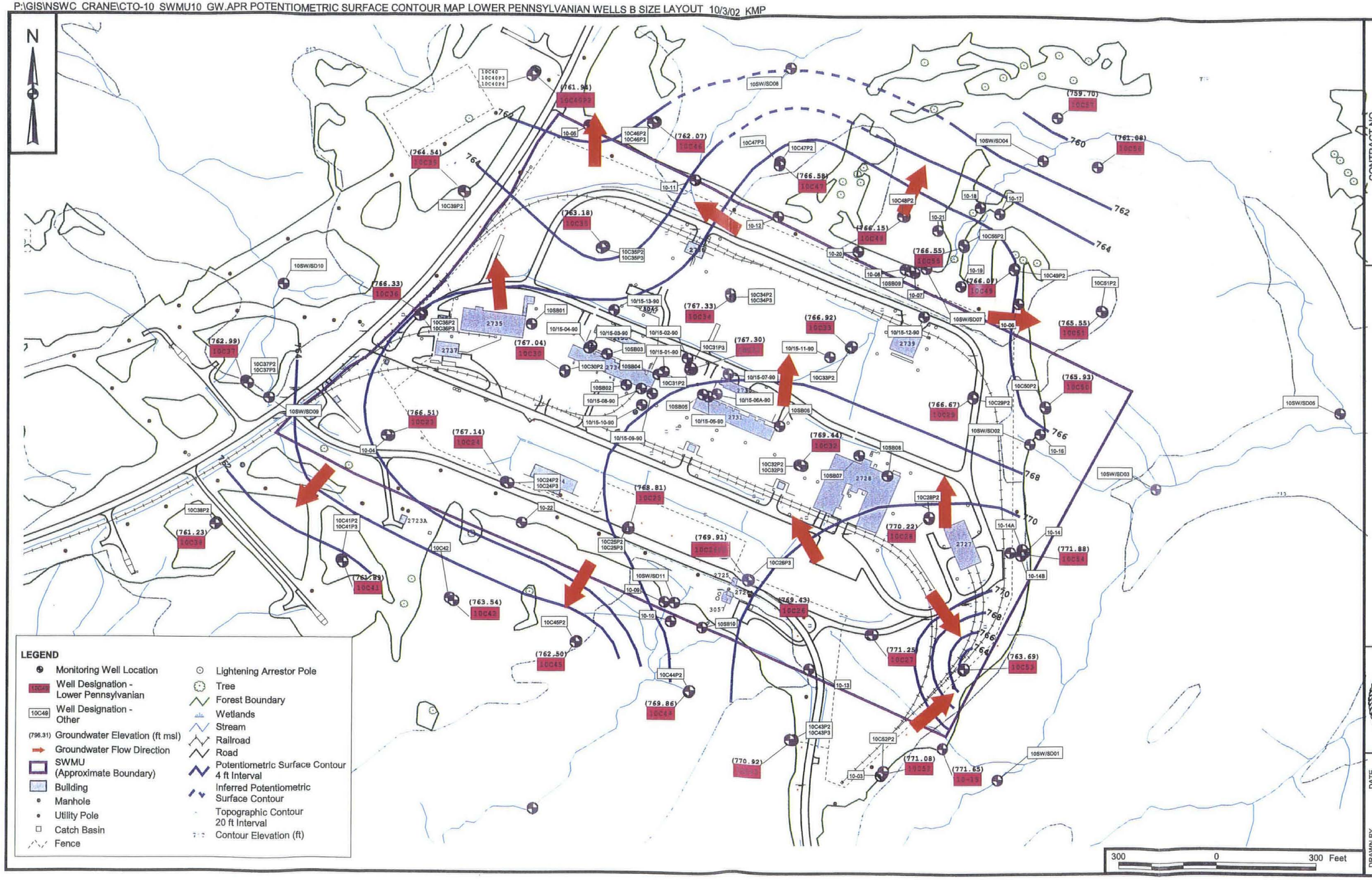
DRAWN BY A. JANOCHA DATE 12/04/01

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

P:\GIS\NSWC CRANE\CTO-10 SWMU10 GW.APR POTENTIOMETRIC SURFACE CONTOUR MAP LOWER PENNSYLVANIAN WELLS B SIZE LAYOUT 10/3/02 KMP



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APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 7 - 9

REV –

POTENTIOMETRIC SURFACE CONTOUR MAP
LOWER PENNSYLVANIAN WELLS
SWMU 10 - ROCKEYE
NSWC CRANE, INDIANA

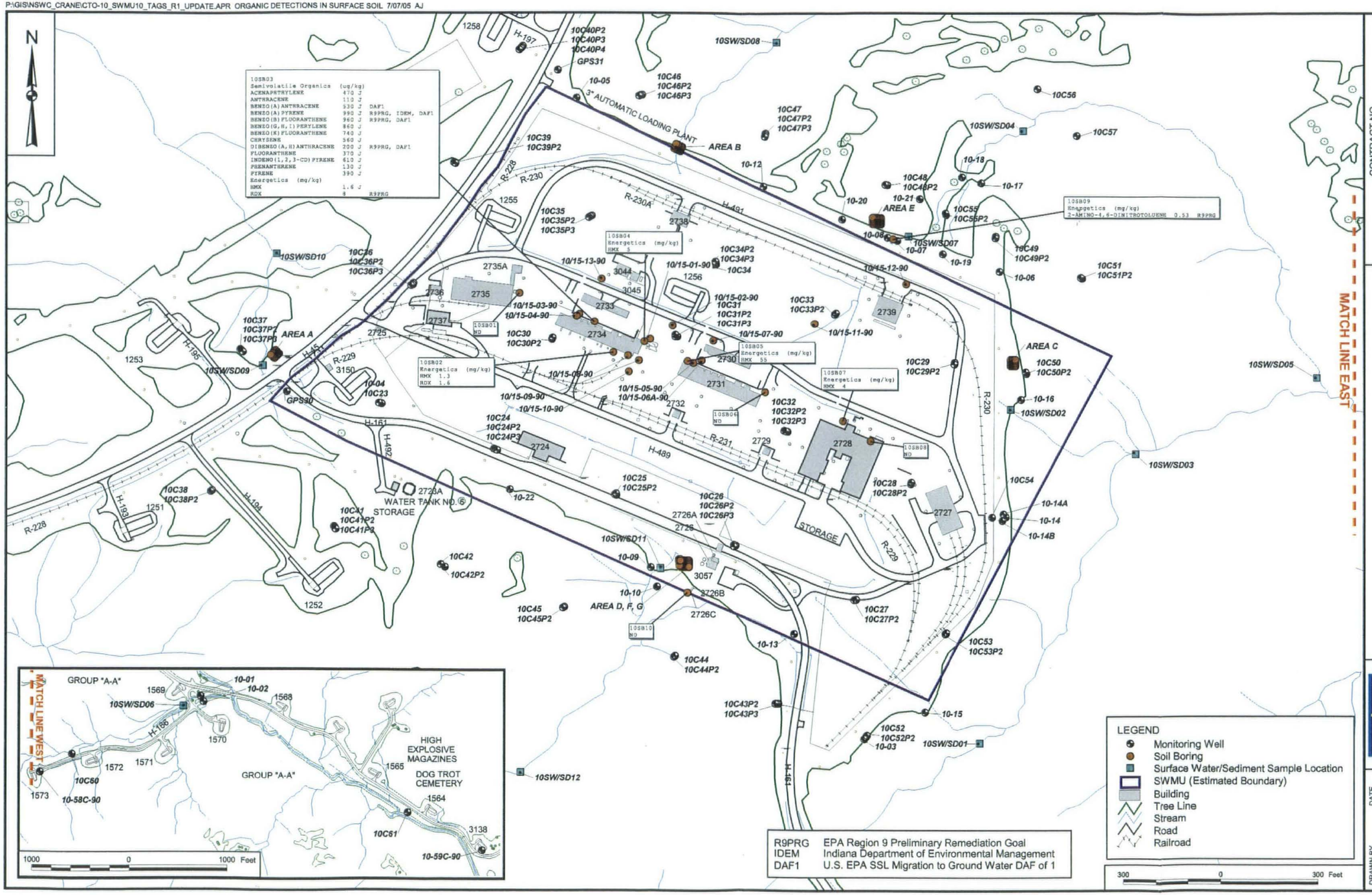
DRAWN BY A. JANOCHA DATE 12/04/01

CHECKED BY ___ DATE ___

COST/SCHED-AREA ___

SCALE AS NOTED

P:\GIS\NSWC_CRANE\CTO-10_SWMU10_TAGS_R1_UPDATE.APR ORGANIC DETECTIONS IN SURFACE SOIL 7/07/05 AJ



CONTRACT NO. 7141

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 7 - 10

REV 1

ORGANIC DETECTIONS IN SURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY K. PEILA DATE 5/10/02

CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

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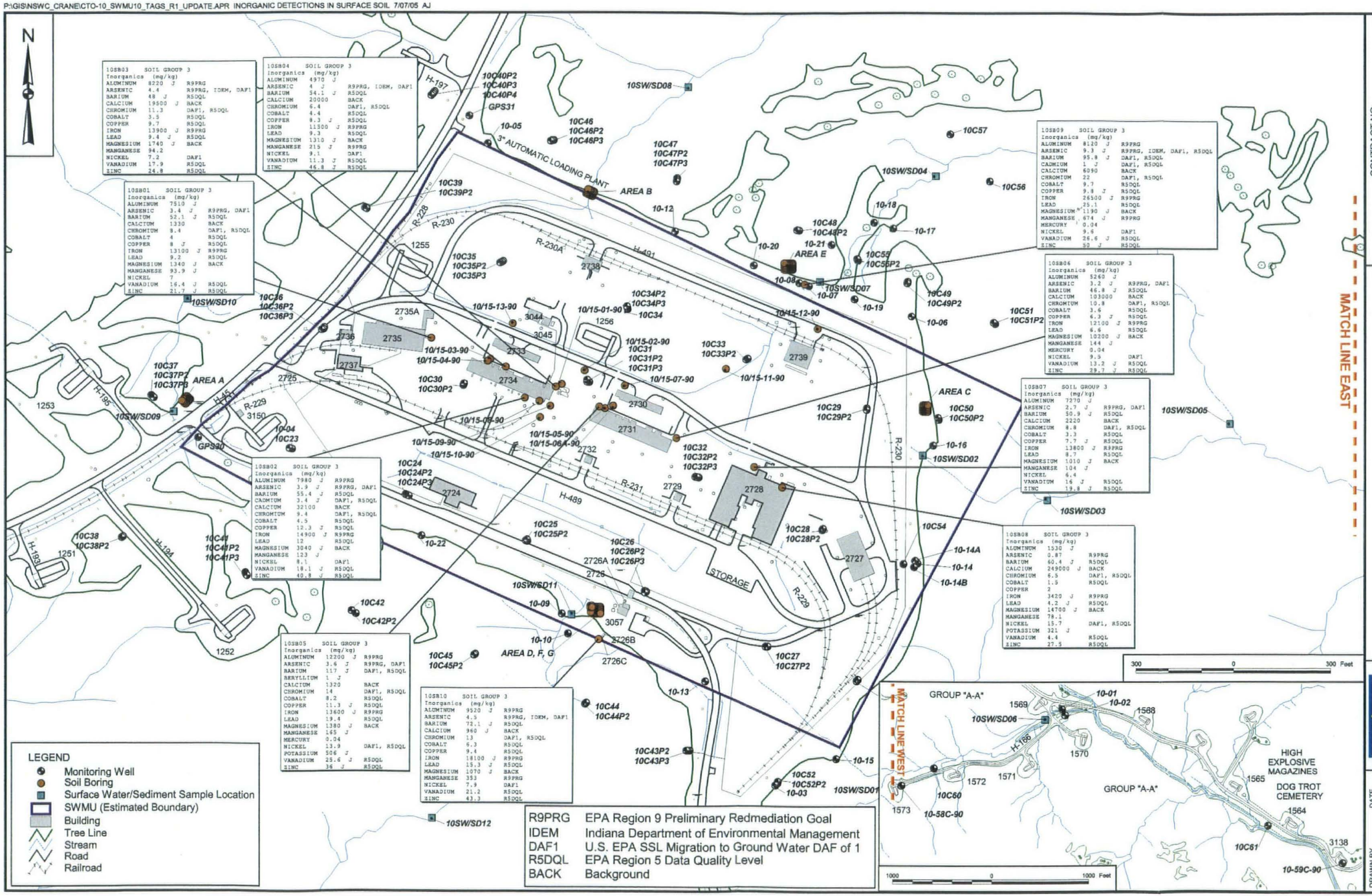


CONTRACT NO. 7141

APPROVED BY ____ DATE ____

APPROVED BY ____ DATE ____

DRAWING NO. FIGURE 7 - 11

REV 1

INORGANIC DETECTIONS IN SURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

NAVFAC

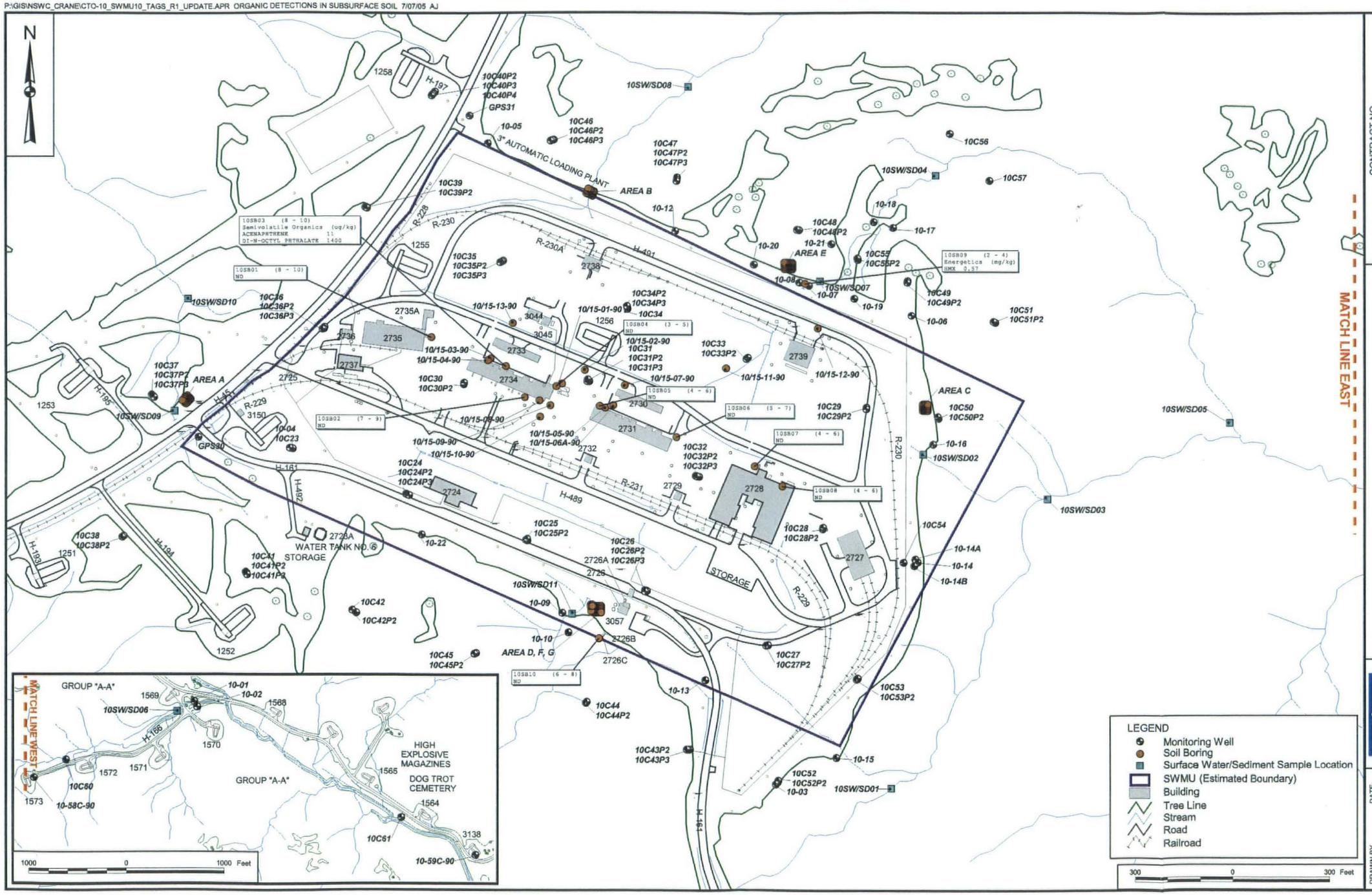
DRAWN BY K. PEILA DATE 5/10/02

CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

P:\GIS\NSWC_CRANE\CTO-10_SWMU10_TAGS_R1_UPDATE.APR ORGANIC DETECTIONS IN SUBSURFACE SOIL 7/07/05 AJ



CONTRACT NO. 7141

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 7 - 12

REV 1

ORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY K. PEILA DATE 5/10/02

CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

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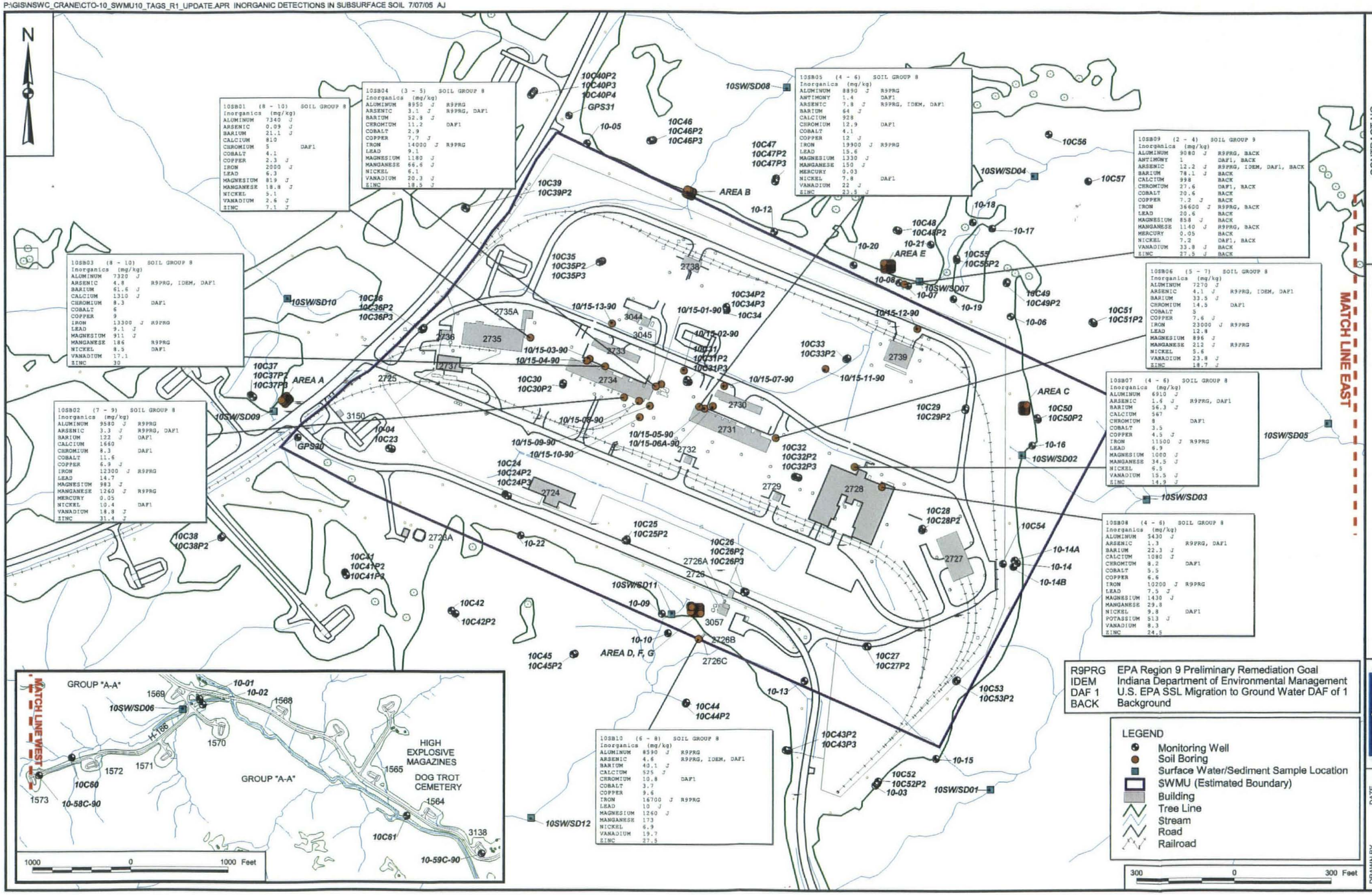

10SB01 (8 - 10) SOIL GROUP 8

Inorganics (mg/kg)		
ALUMINUM	7340 J	
ARSENIC	0.09 J	
BARIUM	21.1 J	
CALCIUM	810	
CHROMIUM	5	DAF1
COBALT	4.1	
COPPER	2.3 J	
IRON	2000 J	
LEAD	6.3	
MAGNESIUM	819 J	
MANGANESE	18.8 J	
NICKEL	5.1	
VANADIUM	2.6 J	
ZINC	7.1 J	

10SB04 (3 - 5) SOIL GROUP 8

Inorganics (mg/kg)		
ALUMINUM	8950 J	R9PRG
ARSENIC	3.1 J	R9PRG, DAF1
BARIUM	52.8 J	
CHROMIUM	11.2	DAF1
COBALT	2.9	
COPPER	7.7 J	
IRON	14000 J	R9PRG
LEAD	9.1	
MAGNESIUM	1180 J	
MANGANESE	66.6 J	
NICKEL	6.1	
VANADIUM	20.3 J	
ZINC	18.5 J	

10SB05 (4 - 6) SOIL GROUP 8

Inorganics (mg/kg)		
ALUMINUM	8890 J	R9PRG
ANTIMONY	1.4	DAF1
ARSENIC	7.8 J	R9PRG, IDEM, DAF1
BARIUM	64 J	
CALCIUM	928	
CHROMIUM	12.9	DAF1
COBALT	4.1	
COPPER	12 J	
IRON	19900 J	R9PRG
LEAD	15.6	
MAGNESIUM	1330 J	
MANGANESE	150 J	
MERCURY	0.03	
NICKEL	7.8	DAF1
VANADIUM	22 J	
ZINC	23.5 J	

10SB09 (2 - 4) SOIL GROUP 9

Inorganics (mg/kg)		
ALUMINUM	9080 J	R9PRG, BACK
ANTIMONY	1	DAF1, BACK
ARSENIC	12.2 J	R9PRG, IDEM, DAF1, BACK
BARIUM	78.1 J	BACK
CALCIUM	998	BACK
CHROMIUM	27.6	DAF1, BACK
COBALT	20.6	BACK
COPPER	7.2 J	BACK
IRON	36600 J	R9PRG, BACK
LEAD	20.6	BACK
MAGNESIUM	858 J	BACK
MANGANESE	1140 J	R9PRG, BACK
MERCURY	0.05	BACK
NICKEL	7.2	DAF1, BACK
VANADIUM	33.8 J	BACK
ZINC	27.5 J	BACK

10SB03 (8 - 10) SOIL GROUP 8

Inorganics (mg/kg)		
ALUMINUM	7320 J	
ARSENIC	4.8	R9PRG, IDEM, DAF1
BARIUM	61.6 J	
CALCIUM	1310 J	
CHROMIUM	8.3	DAF1
COBALT	6	
COPPER	9	
IRON	13300 J	R9PRG
LEAD	9.1 J	
MAGNESIUM	911 J	
MANGANESE	186	R9PRG
NICKEL	8.5	DAF1
VANADIUM	17.1	
ZINC	30	

10SB06 (5 - 7) SOIL GROUP 8

Inorganics (mg/kg)		
ALUMINUM	7270 J	
ARSENIC	4.1 J	R9PRG, IDEM, DAF1
BARIUM	33.5 J	
CHROMIUM	14.5	DAF1
COBALT	5	
COPPER	7.6 J	
IRON	23000 J	R9PRG
LEAD	12.8	
MAGNESIUM	896 J	
MANGANESE	212 J	R9PRG
NICKEL	5.6	
VANADIUM	23.8 J	
ZINC	18.7 J	

10SB02 (7 - 9) SOIL GROUP 8

Inorganics (mg/kg)		
ALUMINUM	9580 J	R9PRG
ARSENIC	3.3 J	R9PRG, DAF1
BARIUM	122 J	DAF1
CALCIUM	1660	
CHROMIUM	8.3	DAF1
COBALT	11.6	
COPPER	6.9 J	
IRON	12300 J	R9PRG
LEAD	14.7	
MAGNESIUM	983 J	
MANGANESE	1260 J	R9PRG
MERCURY	0.05	
NICKEL	10.4	DAF1
VANADIUM	18.8 J	
ZINC	31.4 J	

10SB07 (4 - 6) SOIL GROUP 8

Inorganics (mg/kg)		
ALUMINUM	6910 J	
ARSENIC	1.6 J	R9PRG, DAF1
BARIUM	56.3 J	
CALCIUM	567	
CHROMIUM	8	DAF1
COBALT	3.5	
COPPER	4.5 J	
IRON	11500 J	R9PRG
LEAD	6.9	
MAGNESIUM	1000 J	
MANGANESE	34.5 J	
NICKEL	6.5	
VANADIUM	15.5 J	
ZINC	14.9 J	

10SB08 (4 - 6) SOIL GROUP 8

Inorganics (mg/kg)		
ALUMINUM	5430 J	
ARSENIC	1.3	R9PRG, DAF1
BARIUM	22.3 J	
CALCIUM	1080 J	
CHROMIUM	8.2	DAF1
COBALT	5.5	
COPPER	6.6	
IRON	10200 J	R9PRG
LEAD	7.5 J	
MAGNESIUM	1430 J	
MANGANESE	29.8	
NICKEL	9.8	DAF1
POTASSIUM	513 J	
VANADIUM	8.3	
ZINC	24.5	

10SB10 (6 - 8) SOIL GROUP 8

Inorganics (mg/kg)		
ALUMINUM	8590 J	R9PRG
ARSENIC	4.6	R9PRG, IDEM, DAF1
BARIUM	40.1 J	
CALCIUM	525 J	
CHROMIUM	10.8	DAF1
COBALT	3.7	
COPPER	9.6	
IRON	16700 J	R9PRG
LEAD	10 J	
MAGNESIUM	1260 J	
MANGANESE	173	
NICKEL	6.9	
VANADIUM	19.7	
ZINC	27.5	

R9PRG	EPA Region 9 Preliminary Remediation Goal
IDEM	Indiana Department of Environmental Management
DAF 1	U.S. EPA SSL Migration to Ground Water DAF of 1
BACK	Background

LEGEND
- Monitoring Well
- Soil Boring
- Surface Water/Sediment Sample Location
- SWMU (Estimated Boundary)
- Building
- Tree Line
- Stream
- Road
- Railroad

CONTRACT NO. 7141

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APPROVED BY ____ DATE ____

DRAWING NO. FIGURE 7 - 13

REV 1

INORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 10 - ROCKEYE
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMEY DATE 9/12/02

CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

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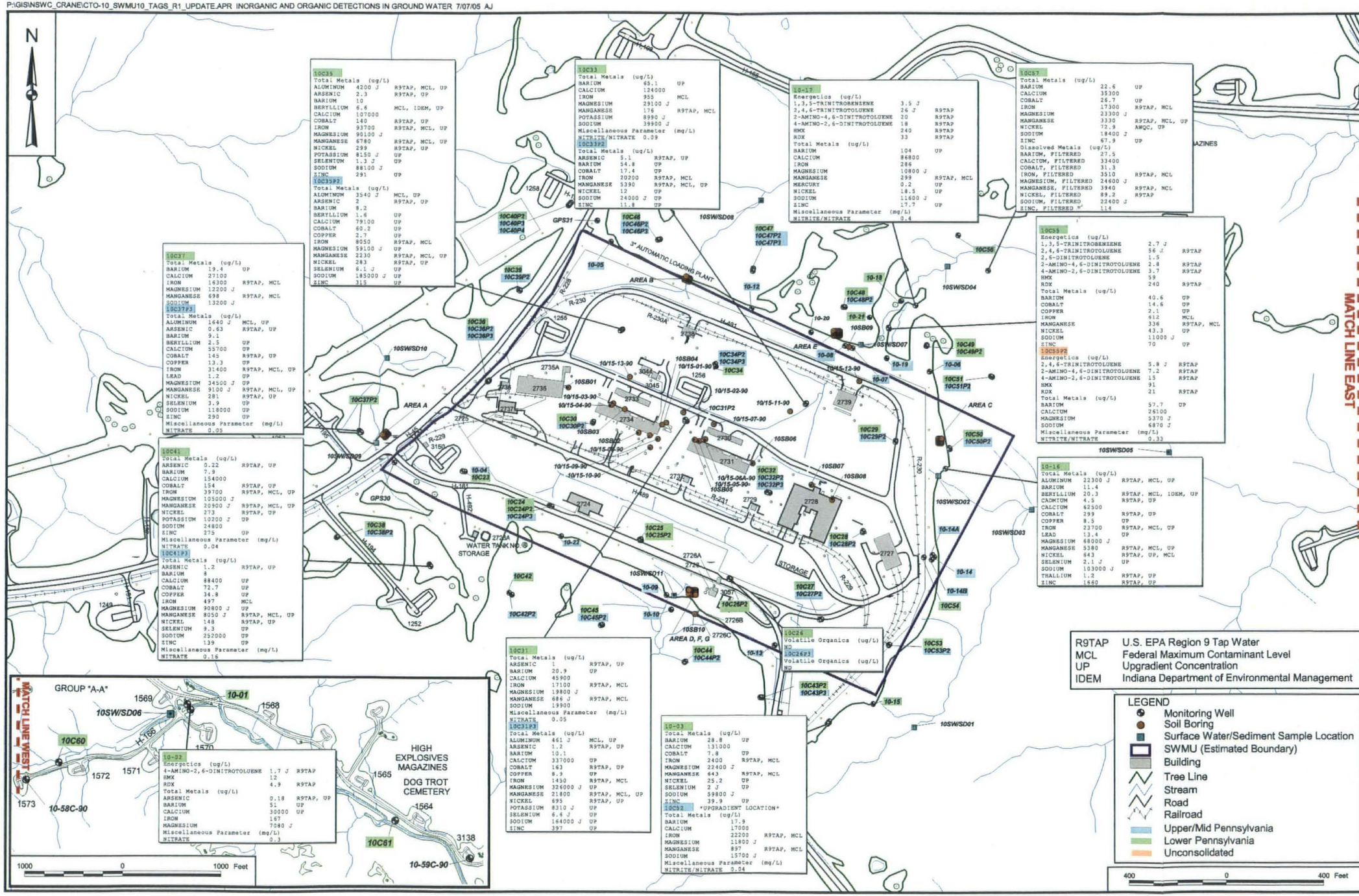

CONTRACT NO. N4267

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 7 - 14

REV 1

INORGANIC AND ORGANIC DETECTIONS IN GROUND WATER SWMU 10 - ROCKEYE NSWC CRANE CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMEY	DATE 9/12/02	CHECKED BY T. JOHNSTON	DATE 7/15/05
COST/SCHED-AREA	—	SCALE AS NOTED	

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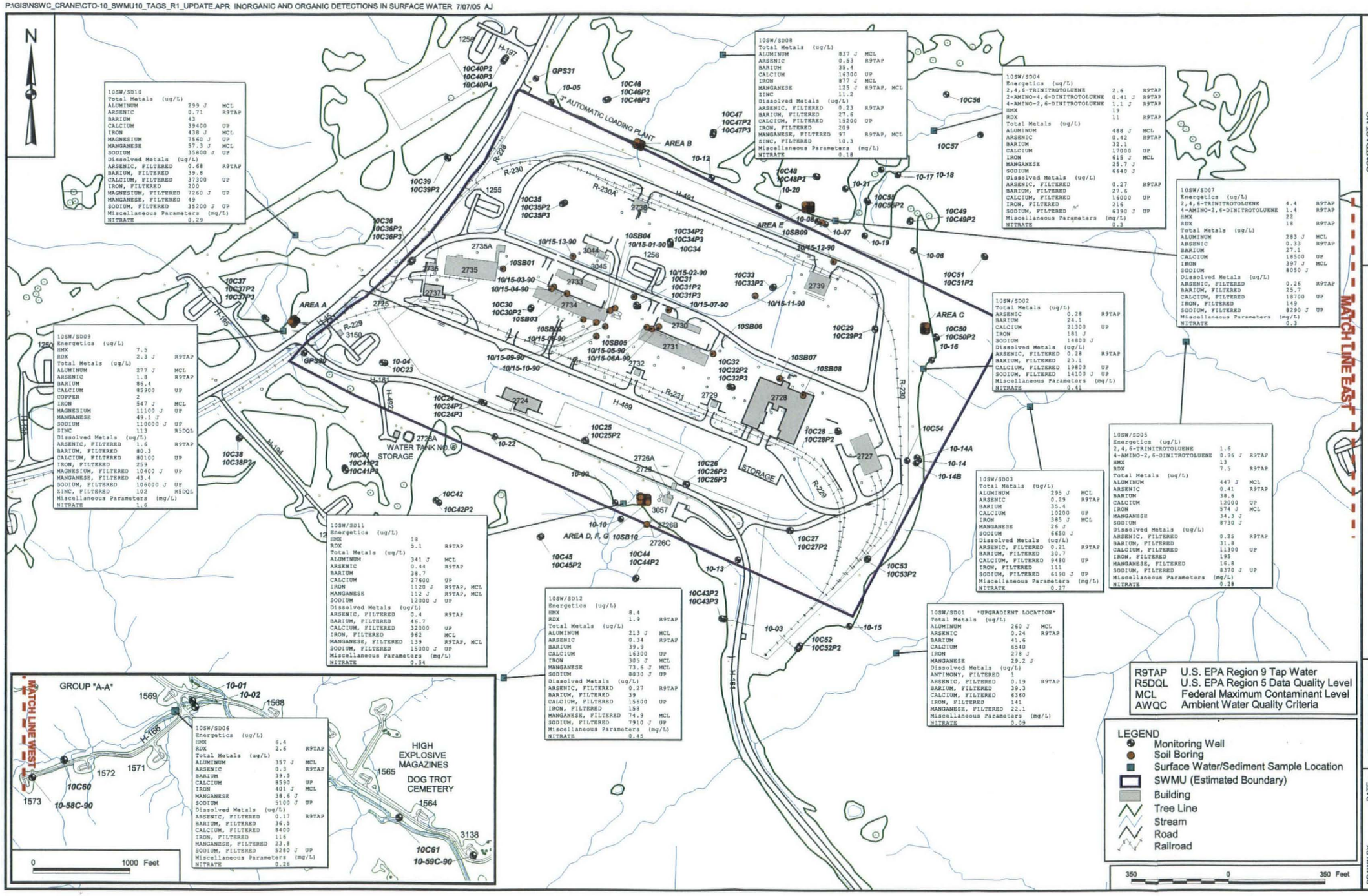

R9TAP U.S. EPA Region 9 Tap Water
R5DQL U.S. EPA Region 5 Data Quality Level
MCL Federal Maximum Contaminant Level
AWQC Ambient Water Quality Criteria

LEGEND
- Monitoring Well
- Soil Boring
- Surface Water/Sediment Sample Location
- SWMU (Estimated Boundary)
- Building
- Tree Line
- Stream
- Road
- Railroad

CONTRACT NO. N4267
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 7 - 15
REV 1

INORGANIC AND ORGANIC DETECTIONS IN SURFACE WATER
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMEY DATE 9/12/02
CHECKED BY T. JOHNSTON DATE 7/15/05
COST/SCHED-AREA
SCALE AS NOTED

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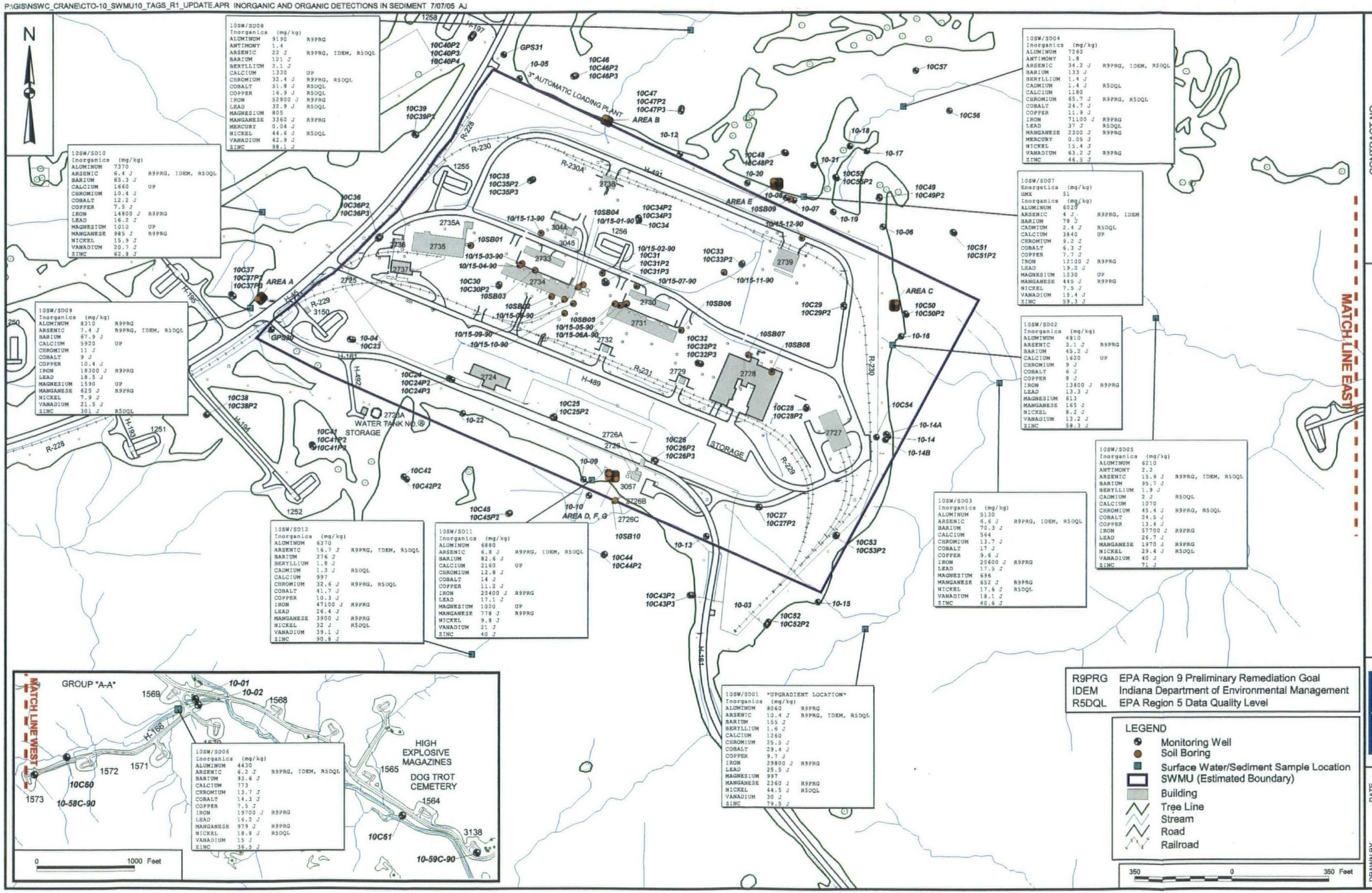


10SW/SD08

Inorganics (mg/kg)		
ALUMINUM	9190	R9PRG
ANTIMONY	1.4	
ARSENIC	22 J	R9PRG, IDEM, R5DQL
BARIUM	121 J	
BERYLLIUM	2.1 J	
CALCIUM	1330	UP
CHROMIUM	32.4 J	R9PRG, R5DQL
COBALT	51.8 J	R5DQL
COPPER	16.9 J	R5DQL
IRON	52800 J	R9PRG
LEAD	32.9 J	R5DQL
MAGNESIUM	805	
MANGANESE	3360 J	R9PRG
MERCURY	0.04 J	
NICKEL	44.6 J	R5DQL
VANADIUM	42.9 J	
ZINC	98.1 J	

10SW/SD10

Inorganics (mg/kg)		
ALUMINUM	7370	
ARSENIC	6.4 J	R9PRG, IDEM, R5DQL
BARIUM	65.3 J	
CALCIUM	1660	UP
CHROMIUM	10.4 J	
COBALT	12.2 J	
COPPER	7.5 J	
IRON	14800 J	R9PRG
LEAD	16.2 J	
MAGNESIUM	1010	UP
MANGANESE	985 J	R9PRG
NICKEL	15.9 J	
VANADIUM	20.7 J	
ZINC	62.8 J	

10SW/SD09

Inorganics (mg/kg)		
ALUMINUM	8310	R9PRG
ARSENIC	7.4 J	R9PRG, IDEM, R5DQL
BARIUM	67.9 J	
CALCIUM	5920	UP
CHROMIUM	11 J	
COBALT	9 J	
COPPER	10.4 J	
IRON	18300 J	R9PRG
LEAD	18.5 J	
MAGNESIUM	1590	UP
MANGANESE	625 J	R9PRG
NICKEL	7.9 J	
VANADIUM	21.5 J	
ZINC	301 J	R5DQL

10SW/SD12

Inorganics (mg/kg)		
ALUMINUM	6370	
ARSENIC	16.7 J	R9PRG, IDEM, R5DQL
BARIUM	276 J	
BERYLLIUM	1.8 J	
CADMIUM	1.3 J	R5DQL
CALCIUM	997	
CHROMIUM	32.6 J	R9PRG, R5DQL
COBALT	41.7 J	
COPPER	10.3 J	
IRON	47100 J	R9PRG
LEAD	26.4 J	
MANGANESE	3900 J	R9PRG
NICKEL	32 J	R5DQL
VANADIUM	39.1 J	
ZINC	90.8 J	

10SW/SD11

Inorganics (mg/kg)		
ALUMINUM	6880	
ARSENIC	6.8 J	R9PRG, IDEM, R5DQL
BARIUM	82.6 J	
CALCIUM	2160	UP
CHROMIUM	12.8 J	
COBALT	14 J	
COPPER	11.2 J	
IRON	20400 J	R9PRG
LEAD	17.1 J	
MAGNESIUM	1020	UP
MANGANESE	778 J	R9PRG
NICKEL	9.8 J	
VANADIUM	21 J	
ZINC	40 J	

10SW/SD06

Inorganics (mg/kg)		
ALUMINUM	4430	
ARSENIC	6.2 J	R9PRG, IDEM, R5DQL
BARIUM	93.6 J	
CALCIUM	773	
CHROMIUM	13.7 J	
COBALT	14.3 J	
COPPER	7.5 J	
IRON	19700 J	R9PRG
LEAD	16.2 J	
MANGANESE	979 J	R9PRG
NICKEL	18.8 J	R5DQL
VANADIUM	15 J	
ZINC	36.5 J	

10SW/SD01 *UPGRADIENT LOCATION*

Inorganics (mg/kg)		
ALUMINUM	8060	R9PRG
ARSENIC	10.4 J	R9PRG, IDEM, R5DQL
BARIUM	155 J	
BERYLLIUM	1.6 J	
CALCIUM	1260	
CHROMIUM	25.5 J	
COBALT	29.4 J	
COPPER	9.7 J	
IRON	29800 J	R9PRG
LEAD	25.5 J	
MAGNESIUM	997	
MANGANESE	2360 J	R9PRG
NICKEL	44.5 J	R5DQL
VANADIUM	30 J	
ZINC	79.5 J	

10SW/SD04

Inorganics (mg/kg)		
ALUMINUM	7260	
ANTIMONY	1.8	
ARSENIC	34.2 J	R9PRG, IDEM, R5DQL
BARIUM	133 J	
BERYLLIUM	1.4 J	
CADMIUM	1.4 J	R5DQL
CALCIUM	1180	
CHROMIUM	65.7 J	R9PRG, R5DQL
COBALT	24.7 J	
COPPER	11.9 J	
IRON	71100 J	R9PRG
LEAD	37 J	R5DQL
MANGANESE	2300 J	R9PRG
MERCURY	0.05 J	
NICKEL	15.4 J	
VANADIUM	63.2 J	R9PRG
ZINC	46.5 J	

10SW/SD07

Energetics (mg/kg)		
HMX	51	
Inorganics (mg/kg)		
ALUMINUM	6020	
ARSENIC	4 J	R9PRG, IDEM
BARIUM	78 J	
CADMIUM	2.4 J	R5DQL
CALCIUM	3840	UP
CHROMIUM	9.2 J	
COBALT	6.3 J	
COPPER	7.7 J	
IRON	12100 J	R9PRG
LEAD	19.2 J	
MAGNESIUM	1230	UP
MANGANESE	445 J	R9PRG
NICKEL	7.5 J	
VANADIUM	15.4 J	
ZINC	59.3 J	

10SW/SD02

Inorganics (mg/kg)		
ALUMINUM	4810	
ARSENIC	3.1 J	R9PRG
BARIUM	45.2 J	
CALCIUM	1620	UP
CHROMIUM	9 J	
COBALT	6 J	
COPPER	8 J	
IRON	13800 J	R9PRG
LEAD	13.3 J	
MAGNESIUM	613	
MANGANESE	165 J	
NICKEL	8.2 J	
VANADIUM	13.2 J	
ZINC	58.3 J	

10SW/SD05

Inorganics (mg/kg)		
ALUMINUM	6210	
ANTIMONY	2.2	
ARSENIC	15.9 J	R9PRG, IDEM, R5DQL
BARIUM	95.7 J	
BERYLLIUM	1.9 J	
CADMIUM	2 J	R5DQL
CALCIUM	1070	
CHROMIUM	45.4 J	R9PRG, R5DQL
COBALT	24.5 J	
COPPER	13.4 J	
IRON	57700 J	R9PRG
LEAD	26.7 J	
MANGANESE	1970 J	R9PRG
NICKEL	29.4 J	R5DQL
VANADIUM	40 J	
ZINC	71 J	

10SW/SD03

Inorganics (mg/kg)		
ALUMINUM	5130	
ARSENIC	6.6 J	R9PRG, IDEM, R5DQL
BARIUM	70.3 J	
CALCIUM	564	
CHROMIUM	13.7 J	
COBALT	17 J	
COPPER	9.6 J	
IRON	20600 J	R9PRG
LEAD	17.5 J	
MAGNESIUM	696	
MANGANESE	652 J	R9PRG
NICKEL	17.6 J	R5DQL
VANADIUM	18.1 J	
ZINC	40.6 J	

R9PRG	EPA Region 9 Preliminary Remediation Goal
IDEM	Indiana Department of Environmental Management
R5DQL	EPA Region 5 Data Quality Level

LEGEND
- Monitoring Well
- Soil Boring
- Surface Water/Sediment Sample Location
- SWMU (Estimated Boundary)
- Building
- Tree Line
- Stream
- Road
- Railroad

CONTRACT NO. 7141

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 7 - 16 REV 1

INORGANIC AND ORGANIC DETECTIONS IN SEDIMENT
SWMU 10 - ROCKEYE
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMEY DATE 9/12/02

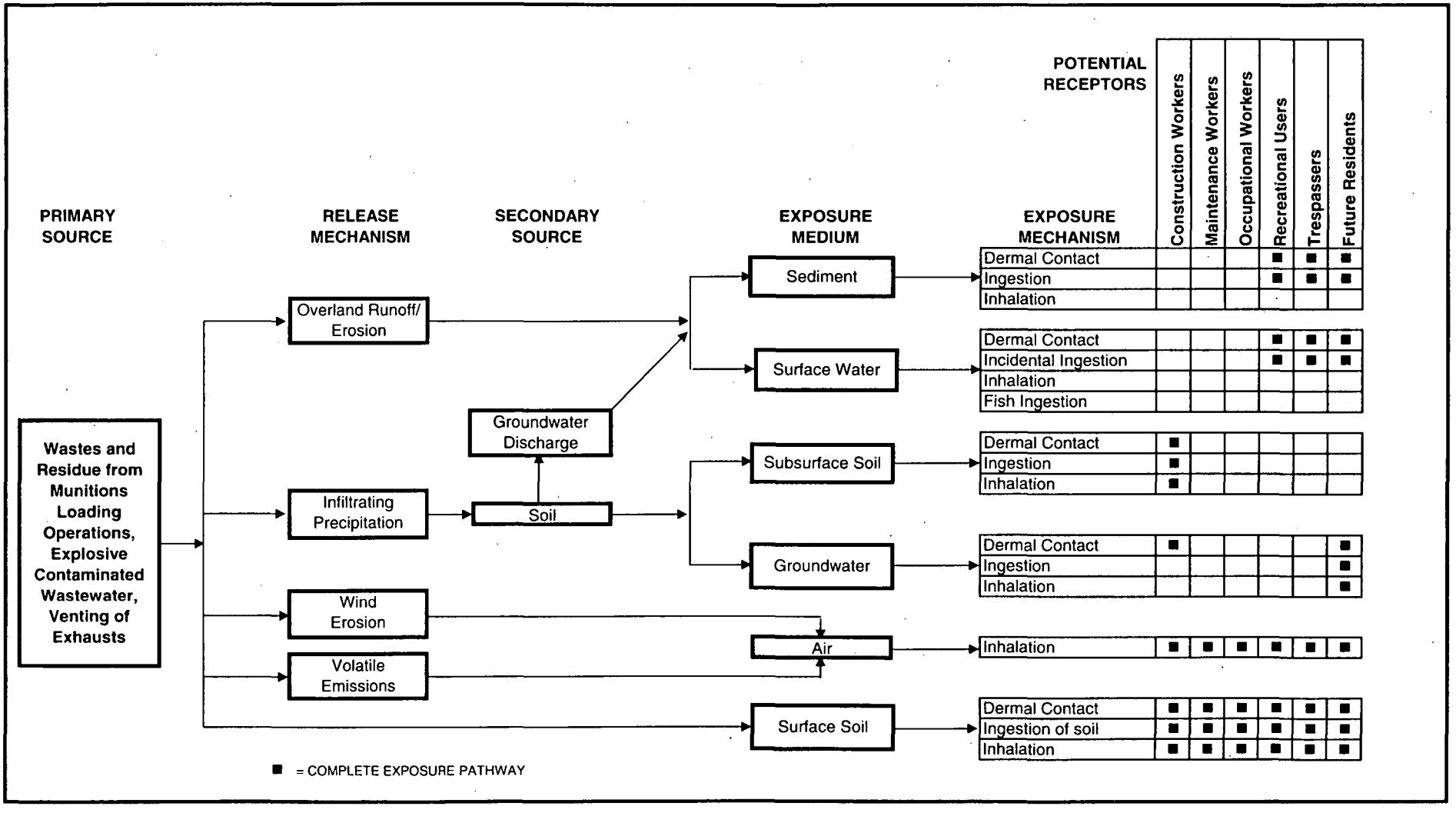
CHECKED BY T. JOHNSTON DATE 7/15/05

COST/SCHED-AREA

SCALE AS NOTED

FIGURE 7-17

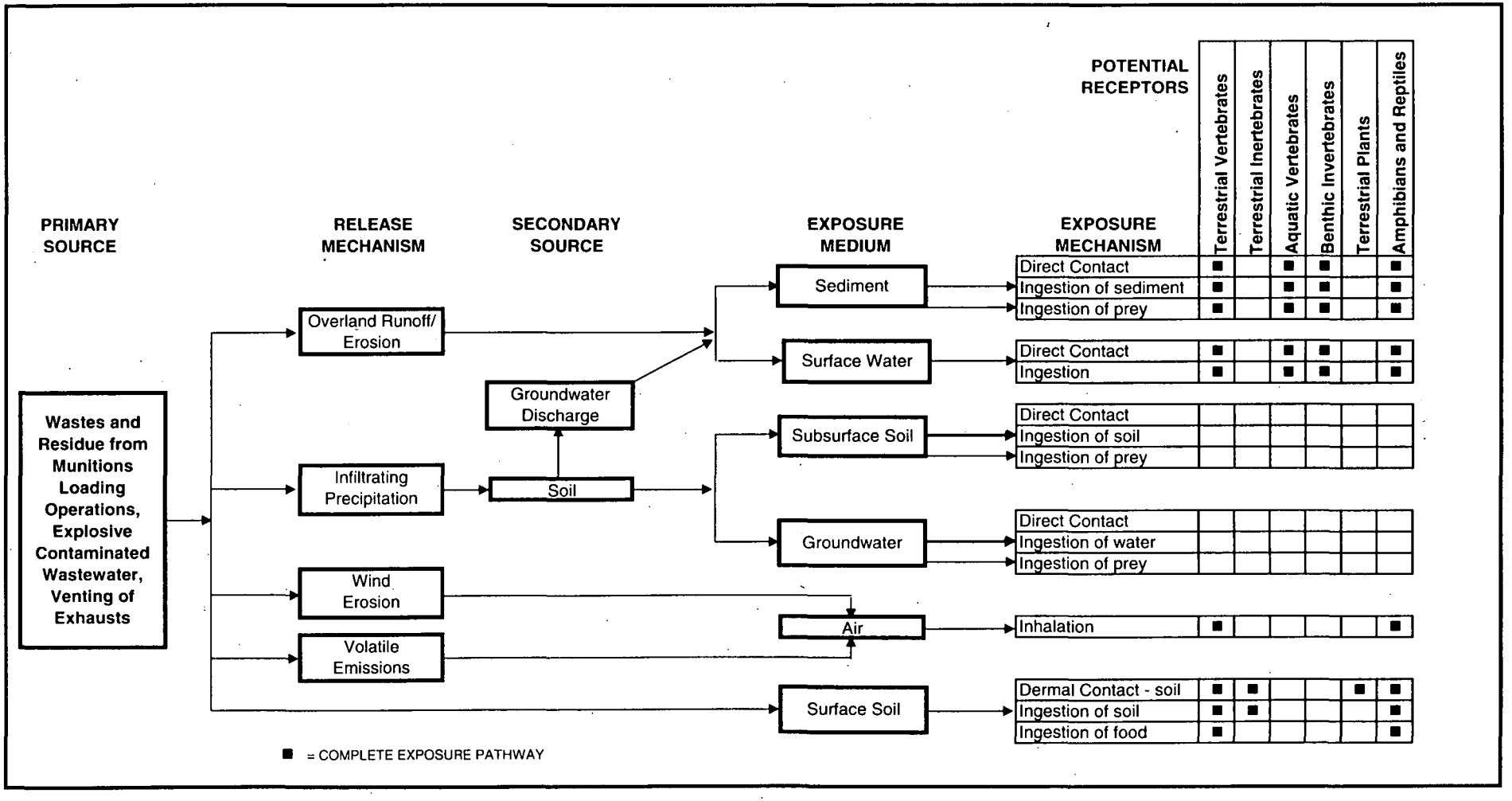
HUMAN HEALTH CONCEPTUAL SITE MODEL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA



Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

FIGURE 7-18

ECOLOGICAL CONCEPTUAL SITE MODEL
SWMU 10 - ROCKEYE
NSWC CRANE, CRANE, INDIANA



Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

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