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# Resource Conservation and Recovery Act Facility Investigation Report

for

# SWMU 03 - Old Jeep Trail/ Little Sulphur Creek

## Naval Surface Warfare Center Crane Division

Crane, Indiana

Volume I of II - Text

NAVFAC
Naval Facilities Engineering Command

## Southern Division Naval Facilities Engineering Command

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# RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT FOR SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK

NAVAL SURFACE WARFARE CENTER
CRANE DIVISION
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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# ACRONYM LIST

| | |
|---|---|
| %D | Percent Difference |
| %R | Percent Recovery |
| %RSD | Percent Relative Standard Deviation |
| µg/kg | Micrograms per Kilogram |
| µg/L | Micrograms per Liter |
| 2,4-D | 2,4-Dinitrotoluene |
| 2-ADNT | 2-Amino-4,6 – dinitrotoluene |
| 4-ADNT | 4-Amino-2,6 - dinitrotoluene |
| ABG | Ammunition Burning Grounds |
| AET | Apparent Effects Threshold |
| amsl | Above Mean Sea Level |
| ANOVA | Analysis of Variance |
| ASTM | American Society for Testing and Materials |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| AUF | Area Use Factor |
| AWQC | Ambient Water Quality Criteria |
| B&R | Brown & Root |
| BAFs | Bioaccumulation Factors |
| BC/BC | Big Clifty Sandstone/Beech Creek Limestone |
| BCF | Bioconcentration Factor |
| BERA | Baseline Ecological Risk Assessment |
| bgs | Below Ground Surface |
| BSAF | Biota Sediment Accumulation Factor |
| BTAG | Biological Technical Assistance Group |
| btor | Below top of riser |
| CAAA | Crane Army Ammunition Activity |
| CCCRA | Current Contamination Conditions Risk Assessment |
| CCME | Canadian Council of Ministers of the Environment |
| CCU | Continuing Calibration Verification |
| CDD | Chlorinated Dibenzo-p-dioxins |
| CDF | Chlorinated Dibenzofurans |
| CDI | Chronic Daily Intake |
| CEC | Cation Exchange Capacity |

| | |
|---|---|
| CFR | Code of Federal regulations |
| CLEAN | Comprehensive Long-Term Environmental Act Navy |
| CLP | Contract Laboratory Program |
| CMS | Corrective Measures Study |
| COC | Chemical of Concern |
| COPC | Chemical of Potential Concern |
| CRAVE | Carcinogenic Risk Assessment Verification Endeavor |
| CRQL | Contract-Required Quantitation Limit |
| CSF | Cancer Slope Factor |
| CSM | Conceptual Site Model |
| CTE | Central Tendency Exposure |
| CTO | Contract Task Order |
| $DA_{event}$ | Absorbed Dose per Event |
| DBG | Dye Burial Grounds |
| DCE | Dichlorooctane |
| DI | Deionized |
| DL | Detection limit |
| DNAPL | Dense Non-Aqueous-Phase Liquid |
| DNB | Dinitrobenzene |
| DNT | Dinitrotoluene |
| DO | Dissolved Oxygen |
| DOE | Department of Energy |
| DON | Department of Navy |
| DPT | Direct-Push Technology |
| DQI | Data Quality Indicators |
| DRMO | Defense Reutilization and Marketing Operations |
| EC | Effects Concentration |
| ECO-SSL | Ecological Soil Screening Level |
| EDQL | Ecological Data Quality Level |
| EEQ | Ecological Effects Quotient |
| EOD | Explosive Ordnance Disposal |
| EPA | Environmental Protection Agency |
| EPC | Exposure-Point Concentration |
| EPT | Ephemeroptera, Plecoptera, Trichoptera |
| ERA | Ecological Risk Assessment |
| ER-L | Effects Range-Low |

| | |
|---|---|
| ER-M | Effects Range-Medium |
| EU | Exposure Unit |
| FAQs | Frequently Asked Questions |
| $F_{oc}$ | Fraction of Organic Carbon |
| FOL | Field Operations Leader |
| FSP | Field Sampling Plan |
| $ft^3/s$ | cubic feet per second |
| G-H | Golconda-Haney |
| gpm | Gallons per Minute |
| g/g-day | gram of food or water per gram of body weight per day |
| HA | Hand Auger |
| HASP | Health and Safety Plan |
| HDPE | High-Density Polyethylene |
| HEAST | Health Effects Assessment Summary Tables |
| HHRA | Human Health Risk Assessment |
| HI | Hazard Index |
| HMX | Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine |
| HQ | Hazard Quotient |
| ICSAB | Interference Check Sample A and B |
| ICP | Inductively Coupled Plasma |
| ICV | Initial Calibration Verification |
| IDEM | Indiana Department of Environmental Management |
| IDL | Instrument Detection Limit |
| IDW | Investigation-Derived Waste |
| IEUBK | Integrated Exposure Uptake Biokinetic |
| ILCR | Incremental Lifetime Cancer Risk |
| IRIS | Integrated Risk Information System |
| $K_d$ | Soil-Water Distribution Coefficient |
| $K_{oc}$ | Organic Carbon-Water Partition Coefficient |
| $K_{ow}$ | Octanol-Water Partition Coefficient |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| $LD_{50}$ | Lethal Dose for 50 percent of Test Animals |
| LEL | Low Effects Level |
| LOAEL | Lowest-Observed-Adverse-Effect Level |
| LOEC | Lowest-Observed-Effects Concentration |

| | |
|---|---|
| LSC | Little Sulphur Creek |
| MATC | Maximum Acceptable Toxicant Concentration |
| MCL | Maximum Contaminant Level |
| MDL | Method detection limit |
| mg/kg | Milligrams per kilogram |
| mg/L | Milligrams per liter |
| MI | Mobility Index |
| mL | Milliliters |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NAD | Naval Ammunition Depot |
| NAD27 | 1927 North American Datum |
| NAPL | Non-Aqueous-Phase Liquid |
| NAVFAC | Naval Facilities |
| NCEA | National Center for Environmental Assessment |
| NEESA | Naval Energy and Environmental Support Activity |
| ng/kg | Nanograms per Kilogram |
| NGVD29 | 1929 National Geodetic Vertical Datum |
| NOAA | National Oceanic and Atmospheric Administration |
| NOAEC | No-Observed-Adverse-Effects Concentration |
| NOAEL | No-Observed-Adverse-Effects Level |
| NOEC | No-Observed-Effects Concentration |
| NSWC | Naval Surface Warfare Center |
| NTU | Nephelometric Turbidity Unit |
| NWSC | Naval Weapons Support Center |
| OJT | Old Jeep Trail |
| 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 |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| PAN | Pesticide Action Network |
| PCA | Tetrachloroethane |
| PCB | Polychlorinated Biphenyl |
| PCDD | Polychlorinated Dibenzo-p-Dioxin |
| PCDF | Polychlorinated Dibenzofuran |

| | |
|---|---|
| PCE | Tetrachloroethene |
| PEC | Probable Effects Concentration |
| PEL | Probable Effects Level |
| PEP | Propellants, Explosives, and Pyrotechnics |
| PID | Photoionization Detector |
| PPE | Personal Protective Equipment |
| PRG | Preliminary Remediation Goal |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RAGS | Risk Assessment Guidance for Superfund |
| RBC | Risk-Based Criteria |
| RBTL | Risk-Based Target Limit |
| RCRA | Resource Conservation and Recovery Act |
| RCS | Release Characterization Study |
| RDA | Recommended Daily Allowance |
| RDX | Hexahydro-1,3,5-trinitro-1,3,5-triazine |
| RfDs | Reference Doses |
| RFI | RCRA Facility Investigation |
| RISC | Risk-Integrated System of Cleanups |
| RL | Reporting limit |
| RME | Reasonable Maximum Exposure |
| RPD | Relative Percent Difference |
| RRF | Relative Response Factor |
| S | Solubility |
| SCS | Soil Conservation Service |
| SCV | Secondary Chronic Value |
| SD | Standard Deviation |
| SDG | Sample Delivery Group |
| SEL | Severe Effects Level |
| SERA | Screening-level Ecological Risk Assessment |
| SMCL | Secondary Maximum Contaminant Level |
| SOP | Standard Operating Procedure |
| SOUTHDIV | Southern Division |
| SQB | Sediment Quality Benchmarks |
| SQG | Soil Quality Guideline |

| | |
|---|---|
| SSLs | Sediment Screening Levels |
| SSSLs | Surface Soil Screening Levels |
| SVOC | Semivolatile Organic Compounds |
| SWDA | Safe Water Drinking Act |
| SWSL | Surface Water Screening Levels |
| SWMU | Solid Waste Management Unit |
| TAL | Target Analyte List |
| TCA | Trichloroethane |
| TCDD | Tetrachlorodibenzo-p-dioxin |
| TCE | Trichloroethylene |
| TEF | Toxicity Equivalence Factor |
| TEL | Threshold Effects Level |
| TEQ | Toxicity Equivalent |
| TNB | 1,3,5 - Trinitrobenzene |
| TNT | 2,4,6-Trinitrotoluene |
| TOC | Total Organic Carbon |
| TOM | Task Order Manager |
| TRVs | Toxicity Reference Value |
| TRW | Technical Review Workgroup |
| TSS | Total Suspended Solids |
| TtNUS | Tetra Tech NUS, Inc. |
| UCL | Upper 95 Percent Confidence Limit |
| USACE | U.S. Army Corps of Engineers |
| USDA | U.S. Department of Agriculture |
| UST | Underground Storage Tank |
| U.S. EPA | U.S. Environmental Protection Agency |
| UXO | Unexploded Ordnance |
| VOA | Volatile Organic Analysis |
| VOC | Volatile Organic Compound |
| VP | Vapor Pressure |
| WQS | Water-Quality Standards |
| WRS | Wilcoxon-Rank Sum |

# EXECUTIVE SUMMARY

This report documents the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of the Old Jeep Trail (OJT) and Little Sulphur Creek (LSC), both located at Solid Waste Management Unit (SWMU) 03, Ammunition Burning Ground (ABG), which is located at the Naval Surface Warfare Center (NSWC), Crane, Indiana. Tetra Tech NUS, Inc. (TtNUS) prepared this report for the Department of the Navy (Navy) Southern Division (SOUTHDIV) Naval Facilities (NAVFAC) Engineering Command under Contract Task Order (CTO) 159, Comprehensive Long-Term Environmental Action Navy (CLEAN) 3, Contract Number N62467-94-D-0888. Unless otherwise indicated, all RFI fieldwork and the development of the baseline human health and ecological risk were conducted in accordance with the Quality Assurance Project Plan (QAPP) at SWMU 03 (TtNUS, 2001b)], and the Work Plan and Field Sampling Plan addendum (TtNUS, 2000b), which was written to govern the collection and analysis of 33 additional soil samples. This RFI report describes the nature and extent of contamination, summarizes the fate and transport of contaminants, and presents human health and ecological risk assessments.

## SWMU 03 DESCRIPTION

The Main Treatment Area at the ABG has been used for thermal treatment of munitions since the 1940's, with the largest quantities of materials treated from 1956 to 1960. There are several separate burning areas within the ABG Main Treatment Area. Prior to the use of current steel pans, explosives, propellants, and materials contaminated with explosives and propellants were spread and ignited on concrete pads or in earthen pits. These pads and pits were reportedly located in the area now occupied by the clay-lined steel burn pans. Prior to approximately 1985, pink water sludge resulting from explosives and related chemicals was placed and burned in an unlined pit on the site. The ABG Main Treatment Area is still used to destroy munitions at NSWC Crane under a RCRA permit issued by the U.S. EPA Region 5.

Associated with the ABG is an area designated as the OJT, which lies in the valley of LSC. The OJT was used from the mid-1970s through 1983. Materials were treated primarily at two areas within the OJT - the burn area and the burn pit. The exact size, shape, and locations of these two areas are unknown. Reportedly, open burning also took place along the length of the OJT. The OJT has not been used for munitions treatment since 1983 and has since revegetated; however, the area is still used as a vehicle route.

The LSC receives overland runoff from the ABG Main Treatment Area and the Old Jeep Trail. In the past the Main Treatment Area was not vegetated and contaminated soils eroded into LSC. Ground water underlying the Main Treatment Area is contaminated with explosives, chlorinated organic compounds, and metals. Ground water from both the Main Treatment Area and the Old Jeep Trail discharges into LSC as spring water.

Multiple environmental investigations and surveys have been conducted at the ABG, the OJT, and LSC. There is a large collection of geological, hydrogeological, hydrological, geochemical, and water-quality data available. A multi-phased Release Characterization Study (RCS) was conducted by the U.S. Army Corps of Engineers Waterways Experiment Station (USACEWES) between 1990 and 1993. From 1995 to 1997, additional soil, surface water, sediment, spring, and ground water samples were collected to supplement the 1990-1993 samples. Some of the pre-1993 data was determined to be insufficient for risk assessment by the EPA because its quality was unknown, therefore the data were used only in a qualitative manner for this investigation. All of the 1995-1997 data were found to be acceptable and were used for this investigation, as necessary.

## PHASE III RFI PROGRAM

The most recent investigation, which is the subject of this report, was a Phase III RFI. The objectives of this investigation were to:

- Establish the nature and extent of contamination.
- Evaluate human health risks through a baseline risk assessment.
- Estimate risks to the environment through an ecological risk assessment.

It has already been determined that a Corrective Measures Study (CMS) is necessary to address soil and ground water contamination at the ABG Main Treatment Area. The purpose of this RFI was to determine whether contamination from the OJT and LSC should also be addressed in that CMS.

Following is a brief description of the field and analytical program for the OJT and LSC.

The sampling and analysis program for the OJT and LSC was developed based on the chemical categories represented by the list of detected chemicals of interest that were identified during various historical site investigations, plus the knowledge of site operations and physical setting of the site. Soil, sediment, surface water, and ground water samples were collected and analyzed for various combinations of 40 Code of Federal Regulations (CFR) Part 264 Appendix IX constituents [volatile

organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and metals], as well as explosives and miscellaneous inorganics. Select surface water samples were analyzed for total and dissolved metals, and total dissolved solids (TSS); sediment samples were analyzed for total organic carbon (TOC) to assist in assessing the potential risks for ecological receptors. Additionally, soil characteristic parameters [cation exchange capacity (CEC), pH, and TOC] were collected to determine the potential fate and transport of contaminants at the site (and the potential for risks outside the site boundaries). Sediment samples were divided into shallow sediment (0 to 6 inches) and deep sediment (6 to12 inches). Surface water samples were divided into low flow and high flow samples. This particular site also contains seven fresh water springs. Samples were collected and analyzed to detect movement of contaminants associated with the spring system, as necessary.

## NATURE AND EXTENT OF CONTAMINATION

Chlorinated solvents were found to be most prevalent in ground water with the maximum concentrations detected in a south-centrally located well (03-07). The concentrations of chlorinated solvents from wells sampled further downgradient from 03-07 decrease with distance. Polycyclic Aromatic Hydrocarbons (PAHs) were generally found in greatest concentrations in soils near the burn area and burn pit, suggesting that they are operationally related contaminants. Energetics were widely detected throughout the OJT and LSC, and primarily near the burn pit and burn area in all soils. Pesticides and PCBs were not analyzed in subsurface soils or ground water, and no pesticides were detected in surface soil, deep sediment, or high-flow and low-flow surface water. The pesticide Methoxychlor was detected at a concentration that was slightly greater than the risk-based screening level in one sample in shallow sediment. These observations indicate that pesticides and PCBs are probably not site-related contaminants or that any pesticide release was very limited. Herbicides were detected at the OJT and LSC, but low concentrations are consistent with general herbicide use rather than an indication of being operationally related. Metals were detected at concentrations exceeding naturally occurring concentrations at the OJT and LSC, particularly in the burn pit and burn area. The locations of relatively high metal concentrations appear to represent small, contaminated areas that should have little effect on receptor exposures.

## HUMAN HEALTH RISK ASSESSMENT

The human receptors evaluated for the OJT and LSC were the construction worker, maintenance worker, occupational worker, adolescent trespasser, off-site residents, recreational users, and future adult and child residents. Human exposure pathways for the OJT and LSC that were evaluated were surface soil, subsurface soil, ground water, surface water (high- and low-flow), and sediment (surface and deeper).

Two exposure units of different sizes were evaluated. These units were the 1-acre exposure unit described in the Quality Assurance Project Plan (QAPP) which encompasses the burn are/burn pit, and the entire 6-acre OJT/LSC study area.

## ECOLOGICAL RISK ASSESSMENT

An ecological risk assessment was conducted at the OJT and LSC. The ecological receptors that were evaluated in the assessment included:

- Those directly exposed to chemicals in the surface water, sediment, and surface soil (i.e., plants, invertebrates in soil and sediment, and aquatic organisms), and

- Those indirectly exposed to chemicals via the food chain (i.e., through the ingestion of plants, fish, and invertebrates).

Several chemicals were eliminated as COPCs because they were not detected at concentrations greater than background concentrations. 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. Note that the use of background concentrations to select chemicals as COPCs was done in accordance with the approved QAPP for SWMU 03 (TtNUS, April 2001); however, based on current U.S. EPA and Navy guidance, background will not be used to select chemicals as COPCs for future ERAs at NSWC Crane.

## CONCLUSIONS

The project decision rules presented in Section 1 of the QAPP indicate the levels of risk at which the implementation of a Corrective Measures Study (CMS) would be required. For example, unless mitigating circumstances exist, an incremental lifetime cancer risk in excess of $1 \times 10^{-4}$ would trigger a CMS (see Table 1-23 of the QAPP, TtNUS, 2001b). If the human health risks were less than $1 \times 10^{-4}$, no further action would be required. Based on evaluation of the data obtained during this investigation, consideration of site operational history, data generated during past investigations, and results of the baseline human health risk assessment and ecological risk assessment for the OJT and LSC, the following conclusions were reached:

- The soils, ground water, surface water, and sediment data collected during the RFI were adequate to support the development of baseline human health and ecological risk assessments for the OJT and LSC.

- Under current land use, no significant potential human health risks are expected for exposures to soil, sediment, surface water, or ground water.

- Under future land use, noncarcinogenic risks exceeding a Hazard Index (HI) of 1.0 and/or incremental lifetime carcinogenic risks exceeding 1E-04 were identified for on-site child and adult residents using surface water as a potable water source, mainly as a result of samples collected from location 03SWSD17. This location is downstream of Spring A, which is a direct conduit for contaminant transport from the ABG. 2-Amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and RDX were the major contributors to the elevated risks for surface water. A summary of the major contributors to risks at OJT/LSC is provided in Table ES-1.

- Under future land use, noncarcinogenic risks exceeding a Hazard Index (HI) of 1.0 and/or incremental lifetime carcinogenic risks exceeding 1E-04 were calculated for occupational workers, child recreational users, and on-site child and adult residents using ground water as a potable water source. Tetrachloroethane, trichloroethene, and 2-amino-4,6-dinitrotoluene were the major contributors to the elevated risks for ground water. A summary of the major contributors to risks at OJT/LSC is provided in Table ES-1.

- Unacceptable exposure of the future child resident to surface soils was identified, primarily as a result of high lead concentrations at surface soil sampling location 03SB24.

- Several chemicals were retained as COPCs in the initial ecological screening process in surface soil due to exceedances of direct contact, risk-based COPC screening levels, or because no current media specific EDQLs are available. During the Step 3a evaluation, no chemicals initially selected as COPCs were retained for further evaluation. Table ES-1 presents a summary of the risk results. The majority of elevated detections were found at locations 03SS22 and 03SS24. Both of these sample locations are in the southern burn pit/area along the fringe of the road where the habitat for plants and invertebrates is poor. Based on the field sheets and boring logs, the surface soil sample (0 to 2 feet) from 03SS24 consisted of a clayey silt, sand, gravel (top 1.5 feet) and silty clay (bottom 0.5 foot), and trace ash, while the surface soil sample (0-2 feet) from 03SS22 consisted of sand and gravel (top 0.4 foot) and clay with trace silt and sand (bottom 1.6 feet). Ash and burnt materials/cinders were found in the subsurface soil immediately below the surface soil samples. Therefore, it is not likely that a large earthworm population would inhabit this area because of the large amount of sand and gravel in the soil. It does not appear that plants are being adversely impacted because herbaceous plants are

present along the road. Significant impacts to plants and invertebrates, therefore, are not expected because the poor habitat would limit the numbers of receptors that would inhabit this area, especially earthworms. Although risks to plants and invertebrates from COPCs in the soil are possible, the potential risks from chemicals initially selected as COPCs are not great enough to warrant further evaluation.

- Several chemicals were retained as COPCs in the initial ecological screening process in sediment and surface water due to exceedances of direct contact, risk-based COPC screening levels, or because no current media specific EDQLs are available. During the Step 3a evaluation, no chemicals initially selected as COPCs were retained for further evaluation. Table ES-1 presents a summary of the risk results. Currently, the highest contamination concentrations in LSC are in areas where the creek is intermittent and there is little viable aquatic habitat, and chemicals present in the perennial portion of LSC do not appear to be adversely impacting aquatic receptors. Various aquatic insects, fish, crayfish, frogs, and salamanders were observed in the perennial portion of LSC during a June 2004 site visit. Additional uncertainties associated with risk are described in Section 8.7.

- Chemicals detected in the surface soil, sediment, and surface water that are considered persistent, bioaccumulative, and toxic (PBT) were retained as COPCs for evaluation in terrestrial wildlife food chain models. During the Step 3a evaluation, no PBT chemicals were retained for further evaluation because NOAEL-based EEQs using the average exposure assumptions were near or less than 1.0. Table ES-1 presents a summary of the risk results. In the herbivorous/insectivorous models, only lead in the American robin model had a NOAEL EEQ of significance (EEQ = 24) using the average exposure scenario; however, the EPC used in the model was elevated due to the maximum concentration detected at location 03SS24. This location is not likely to support earthworms due to the poor habitat in and surrounding the former Burn Pit. The NOAEL EEQ excluding location 03SS24 is 0.6. Several metals had NOAEL-based EEQs greater than 1.0 using the average exposure assumptions in the piscivorous mammal food chain model. However, LSC is small and is not likely capable of supporting 100% of the raccoon's diet, especially considering the large home range of this wildlife receptor. When an area use factor (AUF) of 10% is applied to the food chain models, NOAEL-based EEQs are less than 1.0.

- A CMS should be implemented to evaluate remedial alternatives to reduce the identified unacceptable risks. This CMS should consider all sources of contamination at the ABG, the OJT, and LSC because ground water, surface water, and sediment flow from the ABG toward the OJT and LSC.

TABLE ES-1

SUMMARY OF RECEPTOR-SPECIFIC HUMAN RISKS, AND HAZARDS AND ECOLOGICAL RISKS, AND RECOMMENDATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Receptor Population | Environmental Media | Overall Carcinogenic Risk (Human) | Overall Hazard Index (Human) | Lead Exposure[1] | Overall Risk (Ecological)[4] | Critical Pathways & Chemicals of Concern | Recommendations |
|---|---|---|---|---|---|---|---|
| Current/Future Trespasser (Adolescent) | Surface Soil, Surface Water and Sediment | 5E-07 | 0.04 | No unacceptable exposure to lead[2] | N/A | N/A | NFA |
| Current/Future Off-Site Resident (Child) | Surface Water | 9E-06 | 1 | No unacceptable exposure to lead[2] | N/A | N/A | NFA |
| Current/Future Off-Site Resident (Adult) | Surface Water | 1E-05 | 0.3 | No unacceptable exposure to lead[2] | N/A | N/A | NFA |
| Current/Future Off-Site Resident (Lifelong) | Surface Water | 2E-05 | N/A | No unacceptable exposure to lead[2] | N/A | N/A | NFA |
| Future Construction Worker (Adult) | Soil and Ground Water | 4E-07 | 0.5 | No unacceptable exposure to lead[3] | N/A | N/A | NFA |
| Future Maintenance Worker (Adult) | Surface Soil, Surface Water, and Sediment | 1E-07 | 0.02 | N/A | N/A | N/A | NFA |
| Future Occupational Worker (Adult) | Surface Soil and Ground Water | 1E-04 | 2 | No unacceptable exposure to lead[3] | N/A | Ingestion of ground water (trichloroethene) | Proceed to CMS |

TABLE ES-1

SUMMARY OF RECEPTOR-SPECIFIC HUMAN RISKS, AND HAZARDS AND ECOLOGICAL RISKS, AND RECOMMENDATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Receptor Population | Environmental Media | Overall Carcinogenic Risk (Human) | Overall Hazard Index (Human) | Lead Exposure[1] | Overall Risk (Ecological)[4] | Critical Pathways & Chemicals of Concern | Recommendations |
|---|---|---|---|---|---|---|---|
| Future Recreational User (Child) | Surface Soil, Ground Water, Surface Water, and Sediment | 3E-05 | 2 | No unacceptable exposure to lead[2] | N/A | Ingestion of ground water (trichloroethene) | Proceed to CMS |
| Future Recreational User (Adult) | Surface Soil, Ground Water, Surface Water, and Sediment | 2E-05 | 0.5 | No unacceptable exposure to lead[2] | N/A | N/A | NFA |
| Future Recreational User (Lifelong) | Surface Soil, Ground Water, Surface Water, and Sediment | 5E-05 | N/A | No unacceptable exposure to lead[2] | N/A | N/A | NFA |
| Future On-Site Resident (Child) 1 Acre Exposure Unit | Surface Soil, Surface Water, and Sediment | 2.E-04 | 33 | Blood lead >10 ug/dL for surface soil; <10 ug/dL for sediment. Surface water was evaluated qualitatively | N/A | Incidental ingestion and dermal contact with surface soil (2,4,6-trinitrotoluene; RDX; lead) Ingestion of surface water (2-amino-4,6-dinitrotoluene; 4-amino-2,6-dinitrotoluene; RDX) | Proceed to CMS |
| Future On-Site Resident (Child) 6 Acre Exposure Unit | Surface Soil, Surface Water, and Sediment | 6.E-05 | 11 | No unacceptable exposure to lead[2] | N/A | Ingestion of surface water (2-amino-4,6-dinitrotoluene; 4-amino-2,6-dinitrotoluene; RDX) | Proceed to CMS |

TABLE ES-1

SUMMARY OF RECEPTOR-SPECIFIC HUMAN RISKS, AND HAZARDS AND ECOLOGICAL RISKS, AND RECOMMENDATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Receptor Population | Environmental Media | Overall Carcinogenic Risk (Human) | Overall Hazard Index (Human) | Lead Exposure[1] | Overall Risk (Ecological)[4] | Critical Pathways & Chemicals of Concern | Recommendations |
|---|---|---|---|---|---|---|---|
| Future On-Site Resident (Child) 1 Acre Exposure Unit | Surface Soil, Ground Water, and Sediment | 5.E-04 | 45 | N/A | N/A | Incidental ingestion and dermal contact with surface soil (2,4,6-trinitrotoluene) Ingestion of ground water (trichloroethene; 4-amino-2,6-dinitrotoluene) | Proceed to CMS |
| Future On-Site Resident (Child) 6 Acre Exposure Unit | Surface Soil, Ground Water, and Sediment | 3.E-04 | 23 | N/A | N/A | Ingestion of ground water (trichloroethene; 4-amino-2,6-dinitrotoluene) | Proceed to CMS |
| Future On-Site Resident (Adult) 1 Acre Exposure Unit | Surface Soil, Surface Water, and Sediment | 1.E-04 | 5 | No unacceptable exposure to lead[2] | N/A | Incidental ingestion of surface soil (2,4,6-trinitrotoluene) Ingestion of surface water (4-amino-2,6-dinitrotoluene) | Proceed to CMS |
| Future On-Site Resident (Adult) 6 Acre Exposure Unit | Surface Soil, Surface Water, and Sediment | 7.E-05 | 3 | No unacceptable exposure to lead[2] | N/A | Ingestion of surface water (4-amino-2,6-dinitrotoluene) | Proceed to CMS |
| Future On-Site Resident (Adult) 1 Acre Exposure Unit | Surface Soil, Ground Water, and Sediment | 4.E-04 | 9 | N/A | N/A | Incidental ingestion of surface soil (2,4,6-trinitrotoluene) Ingestion of ground water (trichloroethene) | Proceed to CMS |
| Future On-Site Resident (Adult) 6 Acre Exposure Unit | Surface Soil, Ground Water, and Sediment | 4.E-04 | 7 | N/A | N/A | Ingestion of ground water (trichloroethene) | Proceed to CMS |

TABLE ES-1

SUMMARY OF RECEPTOR-SPECIFIC HUMAN RISKS, AND HAZARDS AND ECOLOGICAL RISKS, AND RECOMMENDATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Receptor Population | Environmental Media | Overall Carcinogenic Risk (Human) | Overall Hazard Index (Human) | Lead Exposure[1] | Overall Risk (Ecological)[4] | Critical Pathways & Chemicals of Concern | Recommendations |
|---|---|---|---|---|---|---|---|
| Future On-Site Resident (Lifelong) 1 Acre Exposure Unit | Surface Soil, Surface Water, and Sediment | 3.E-04 | N/A | No unacceptable exposure to lead[2] | N/A | Incidental ingestion and dermal contact with surface soil (RDX) Ingestion of surface water (RDX) | Proceed to CMS |
| Future On-Site Resident (Lifelong) 6 Acre Exposure Unit | Surface Soil, Surface Water, and Sediment | 1.E-04 | N/A | No unacceptable exposure to lead[2] | N/A | Ingestion of surface water (RDX) | NFA |
| Future On-Site Resident (Lifelong) 1 Acre Exposure Unit | Surface Soil, Ground Water, and Sediment | 9.E-04 | N/A | N/A | N/A | Incidental ingestion and dermal contact with surface soil (RDX) Ingestion of ground water (1,1,2,2-trichloroethane; trichloroethene) | Proceed to CMS |
| Future On-Site Resident (Lifelong) 6 Acre Exposure Unit | Surface Soil, Ground Water, and Sediment | 7.E-04 | N/A | N/A | N/A | Ingestion of ground water (1,1,2,2-trichloroethane; trichloroethene) | Proceed to CMS |
| Terrestrial Plants and Invertebrates | Surface Soil | N/A | N/A | N/A | low | N/A | NFA |
| Aquatic Organisms | Surface Water and Sediment | N/A | N/A | N/A | low | N/A | NFA |

TABLE ES-1

SUMMARY OF RECEPTOR-SPECIFIC HUMAN RISKS, AND HAZARDS AND ECOLOGICAL RISKS, AND RECOMMENDATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Receptor Population | Environmental Media | Overall Carcinogenic Risk (Human) | Overall Hazard Index (Human) | Lead Exposure[1] | Overall Risk (Ecological)[4] | Critical Pathways & Chemicals of Concern | Recommendations |
|---|---|---|---|---|---|---|---|
| Mammals and Birds | Surface Soil and Surface Water[5] | N/A | N/A | N/A | **American Robin**<br>Lead: 24 (all samples);<br>0.6 (excluding sample 03SS24) | Incidental ingestion of surface soil through worms by birds (lead) | NFA |
| Mammals and Birds | Sediment and Surface Water[5] | N/A | N/A | N/A | **Raccoon**<br>AUF-100%<br>Copper: 2.76<br>Selenium: 1.99<br>Zinc: 1.55<br>AUF-10%<br>Copper: 0.276<br>Selenium: 0.199<br>Zinc: 0.155 | Incidental ingestion of sediment through fish and invertebrates by piscivirous mammals (copper, selenium, zinc) | NFA |

1 The IEUBK model was used for evaluating child exposures and the Adult Lead Model was used for evaluating adult exposures. Refer to Section 7.0.
2 This receptor evaluated for exposure to lead in surface water only.
3 This worker evaluated for exposure to lead in soil only.
4 The LOAEL average is shown because it was used in defining the risk drivers at SWMÚ 03.
5 Ingestion of surface water is included in the food-chain models for evaluating risks from soil and sediment. However, the surface water component does not contribute appreciably to the overall risks to birds or mammals.

N/A = Not applicable
NFA = No further action
CMS = Corrective Measures Study
AUF = Area use factor

# 1.0 INTRODUCTION

This RFI Report was prepared for the NSWC Crane facility, located in Crane, Indiana, through the U.S. Navy Southern Division NAVFAC Engineering Command under CTO 0159, for the CLEAN 3, Contract Number N62467-94-D-0888. This report presents the results of an investigation of the OJT, also know as Jeep Trail 25, and of LSC.

The OJT is an inactive area that is adjacent to and down-valley (south-southeast) of the ABG. The ABG is designated as RCRA SWMU 03/10. Open burning of explosives and explosives-contaminated materials took place at the ABG and two general areas at the Jeep Trail site. In one portion of the OJT, the Burn Area, empty bomb casings were burned, using black powder, to remove any explosive residues. In the second area (the Burn Pit), explosive-contaminated materials, including small munitions items and components, solvent-contaminated rags, and packaging material, were burned using wood dunnage in a pit. Ash was periodically removed from the pit and taken to the main ABG treatment area for disposal. The pit was closed by removal of ash and backfilling with dirt. The term "pit" may be a misnomer because it may have been more of a natural topographic depression than an excavated pit. Former operations at the OJT were directly associated with operations at the ABG; the operational history of the OJT is presented in greater detail in Section 1.2.4. Due to the close proximity of the ABG to the OJT Area and LSC, a significant amount of information gathered previously for the ABG is discussed in the current document. Because of its relationship to the ABG, the OJT area is considered to be an extension of SWMU 03/10. LSC is a small stream whose headwaters originate in channels on the north, west, and south of the ABG. These ephemeral channels run through the ABG area and converge on the eastern side of the ABG. From the ABG, LSC runs southeastward through the OJT area and then southward to the NSWC Crane property boundary. Based on previous samples collected from LSC and springs located in the LSC valley, the stream and springs have been impacted by releases from ABG and possibly OJT (Murphy, 1994; Murphy and Wade, 1998a).

The following RCRA RFI reports were prepared previously by the U.S. Army Corps of Engineers (USACE) for the ABG and approved by the U.S. Environmental Protection Agency (U.S. EPA):

- Phase III Ground Water Release Characterization (Murphy, 1994)
- Phase II Release Assessment for Surface Water (Murphy and Wade, 1998a)
- Part 2 Phase III Soils Study (Albertson et al., 1998)

## 1.1 PURPOSE OF THIS REPORT

The purpose of this RFI Report is to present and interpret the results of the investigations for the OJT/LSC areas and to evaluate the potential human health and ecological risks associated with these two areas. The risk assessments were performed using the data collected during the recent field investigations (2001-2002).

This Phase III investigation was conducted in accordance with applicable RCRA corrective action requirements, including the need for RFIs to be conducted at the NSWC Crane. Investigation requirements are specified in the NSWC Crane RCRA hazardous waste management permit, originally issued by the U.S. EPA on December, 29 1989 and renewed on September 14, 1995 (U.S. EPA, 1995), and in approval letters issued by U.S. EPA Region 5 for two RFIs conducted at the ABG (SWMU 03/10). The approval letters were issued by U.S. EPA Region 5 (U.S. EPA, 1999e, 1999f) for two final reports (Phase II Release Assessment for Surface Water and Phase III Ground water Release Characterization) cited above. This current investigation provides data on select organic and inorganic chemical concentrations in surface soils, subsurface soils, sediment, surface water, and ground water in the OJT area and LSC. Although some samples were taken within the ABG area during this investigation, these samples were used to assess the impact of surface soil washout into Little Sulphur Creek. This investigation addresses potential risks associated with the OJT and LSC only.

### 1.1.1 Project Objectives

The objective of this RFI was to conduct the site characterization and environmental sampling activities necessary to complete the RFI, including a baseline human health risk assessment (HHRA) and a screening-level ecological risk assessment (SERA). The plan was to establish the nature and extent of contamination and to complete the risk assessments, then draw conclusions concerning whether further activities are warranted at the site.

A decision has already been made to perform a CMS for the contaminated soils and ground water (including OJT and LSC) (U.S. EPA, 1999e, 1999f). The identification and evaluation of remedial alternatives will be performed in this CMS.

### 1.1.2 Project Problem Statement

Because operationally related chemical releases occurred at the ABG and OJT, human and ecological receptors could be exposed to unacceptable health risks. The health risks are expected to be confined

primarily to aqueous and solid media because only minimal airborne release pathways (e.g., occasional minor resuspension of dust or release of volatile chemicals) are anticipated.

The degree of risk to a human or ecological receptor is determined based on the nature of contamination and the frequency, duration, and nature of exposure to contaminants. Consequently, it is important to understand where receptors could be exposed to the contaminants. This requires that the extent of contamination be established. In this context, extent was established relative to numerical risk-based criteria. A risk evaluation was conducted for human and ecological receptors in contaminated areas to determine whether risks posed by exposure of those receptors to site contaminants are unacceptable. Plausible land use scenarios were considered when identifying the receptors that could be at risk.

### 1.1.3 Organization of the Report

This report was prepared in the following format, standard for an RFI Report. Section 1.0 of the report is the introduction, including the project scope, objectives, background information, site geology, and hydrogeology. Section 2.0 describes field sampling activities and procedures associated with the data collection described in the approved QAPP (TtNUS, 2001b). Section 3.0 is a summary of the data evaluation procedures and a summary of data quality for the data collected as part of this investigation. Section 4.0 describes the procedures and results of selecting the chemicals of potential concern (COPCs). Section 5.0 presents an evaluation of the nature and extent of contamination detected at OJT/LSC. Section 6.0 presents a discussion on the fate and transport of the COPCs and other chemicals or parameters germane to that discussion. Sections 7.0 and 8.0 present the human health and ecological risk evaluations, respectively. Section 9.0 presents the overall project conclusions and recommendations that were formulated after review of all the data collected at OJT/LSC. Supporting documentation for this report is attached as Appendices A through I. Although this investigation focuses on the OJT area and LSC, information concerning the ABG is provided where appropriate to provide perspective on OJT/LSC.

## 1.2 BACKGROUND

### 1.2.1 Facility Location and Description

NSWC Crane is located in a rural, sparsely populated region of south-central Indiana, approximately 75 miles southwest of Indianapolis, 60 miles northwest of Louisville, Kentucky and immediately east of Burns City and Crane Village, Indiana (Figure 1-1). NSWC Crane encompasses approximately 62,463 acres or approximately 98 square miles of the northern portion of Martin County and smaller portions of Greene, Daviess, and Lawrence Counties.

The ABG and OJT are located in a remote hilly area in the eastern portion of the installation along Little Sulphur Creek (Figure 1-2). The OJT area is located in the valley of LSC, approximately one-half mile south-southeast of the ABG on Jeep Trail 25. These areas lie within the Sulphur Creek drainage basin, which is one of five main drainage basins that carry surface water off the installation (Figure 1-2).

Photographs of the ABG, the OJT area, and the LSC watershed are included in Figure 1-3. The locations and direction of view for these photographs are presented in Figures 1-4, 1-5, and 1-6 for the ABG, OJT area, and LSC, respectively. The photographs are referred to throughout the remainder of the report.

### 1.2.2 History of NSWC Crane Ownership and Operations

NSWC Crane provides materiel, technical, and logistical support to the Navy for equipment, weapons systems, and expendable and non-expendable ordnance items. Early in 1940, Congress passed the first supplemental National Defense Appropriation Act. This act provided $5 million for new inland ammunition production facilities, $3 million of which were earmarked to build a Navy ammunition depot at Burns City on the site of the White River Project. Factors weighing in favor of the Burns City site were a remote location that was free of congested areas, hilly terrain ideal for magazine construction and camouflage, Lake Greenwood that could supply water for the facility, and the distance from the eastern seaboard, which minimized the danger of enemy attack.

The facility was commissioned on December 1, 1941 as the Naval Ammunition Depot (NAD), Burns City. Its initial mission was to prepare, load, renovate, receive, store, and issue all types of ammunition, including pyrotechnics and illuminating projectiles, and act as a principal supply source at a most critical time during the early days of World War II. In May 1943, the depot was renamed the Naval Ammunition Depot, Crane, in honor of Commodore William Montgomery Crane, the Navy's first chief of the Bureau of Ordnance. The name changed again in 1975 to the Naval Weapons Support Center (NWSC) Crane to reflect the facility's growing involvement in high-technology weapons systems. In 1977, the Secretary of Defense combined all conventional ammunition acquisition under the responsibility of a single service. The ammunition production and storage function was given to the Army, and the Crane Army Ammunition Activity (CAAA) was established as a Crane tenant to accomplish this task for Naval ammunition. In 1992, based on changing missions and alignment, the facility name was changed to NSWC Crane.

The Army has assumed ordnance production, storage, and related responsibilities under the single-service management directive. All environmental activities on the installation, including permitting activities, remain the responsibility of the Navy. Although ordnance production and storage are still on

base, Crane serves a modern and sophisticated Navy as a recognized leader in diverse and highly technical product lines, such as microwave devices, acoustic sensors, small arms, microelectronics technology, and more. The Army currently exists as a tenant activity on the base, as do other major branches of the Department of Defense, the U.S. Coast Guard (Department of Transportation), and the Defense Reutilization and Marketing Operations (DRMO).

### 1.2.3 Operational History of the ABG

The ABG has been used for thermal treatment of munitions since the 1940s. The burning ground is used extensively to destroy unwanted materials contaminated with explosives, bulk explosives and propellants, rocket motors, pyrotechnic candles, flares, organic solvents, detonators, and fuse materials. Several separate burning areas are located within the site proper.

The largest quantities of materials were treated at the main treatment area (Figures 1-3a, 1-3b, and 1-4) from 1956 to 1960, when 15,000 pounds per day of smokeless powder were flashed. In the same period, about 46,000 pounds per day of high explosives were burned. The area is also used to flash the residue from bombs and projectiles after they have been subjected to melt-out or drill-out operations to remove the bulk of the explosive (Murphy, 1994).

Prior to the construction and use of steel pans (lined and unlined) for open burning operations, explosives and propellants and materials contaminated with explosives and propellants were spread and ignited on pads or in pits at the main treatment area of the ABG. These burn pads and pits were reportedly located in the area now occupied by the clay-lined steel burn pans (Figure 1-3a).

Three unlined surface impoundments (no longer present) were used to remove liquids from otherwise combustible sludges resulting from the blending and loading of munitions. In 1982, each impoundment was modified to include a liner and leachate collection system. Each of the impoundments was approximately 40 feet in diameter. Two impoundments held 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and breakdown compounds in water from a facility munitions plant (Rockeye) and other locations within NSWC Crane. A third impoundment held phosphorus compounds. The three impoundments have been replaced by dewatering units (Figure 1-3a). The impoundments are now empty and are scheduled for closure.

Two empty underground storage tanks (USTs) were used to store runoff and leachate from the three former impoundments. One tank was located immediately east of the phosphorus impoundment. The

other tank contained runoff from the two adjacent TNT and RDX impoundments. The tanks were removed in 1994 and are currently undergoing closure pursuant to a RCRA closure plan.

The "ash pile" area (see Figure 1-4) was the site of a former stockpile of burn residue. The pile was removed between July 1986 and February 1987, pursuant to a RCRA closure plan. The pile consisted of approximately 12,290 pounds of burn residue.

Prior to approximately 1985, pink water sludge was placed and burned in an unlined pit in the location of the pink water tanks. This flashing process was relocated to the burn pads in approximately 1985. The pink color of the water and sludge is caused by the presence of explosives and related chemicals.

The former primer burn box was used for thermal treatment of ammunition components (for example, small impact-sensitive primers) and pyrotechnic munitions. The burn box has been decommissioned, and these activities are now performed at the primer pit and the incendiary cage (Figure 1-4).

The following operations currently occur at the ABG. The locations of many of these ABG activities are shown on Figure 1-4.

- Solid bulk propellant and explosives are open burned in 18 clay-lined steel pans at the ABG.
- The primer pit operation involves treatment of small explosive components such as hand grenade fuses and cartridge primers.
- Solvents contaminated with propellants, explosives, and pyrotechnics are burned in one unlined steel pan at the ABG.
- Waste scrap pyrotechnics, which have been desensitized in No. 2 fuel oil, are burned in a second unlined steel pan at the ABG.
- A third pan is used to burn scrap black powder desensitized with water.
- Two sets of four pans each are used at Area 6 for the treatment of a waste mixture containing red phosphorus and No. 2 fuel oil.

- The incendiary cage at the ABG is set up primarily to allow the open burning of pyrotechnic devices and components.

- The flashing and thermal treatment of suspect explosive-contaminated materials is carried out at three concrete-lined burn pads at the ABG.

- Explosive- and pyrotechnic-contaminated sludges from production operations are treated at thee sludge burning pans. RDX-contaminated sludge and phosphorus-contaminated sludge are currently burned at this unit.

### 1.2.4 Operational History of the Old Jeep Trail

An area in the valley of Little Sulphur Creek, the OJT area (Figures 1-3g and 1-3h), was used to burn out bombs and flash powder from the mid-1970s through 1983. Materials were treated at two separate regions of the Jeep Trail Area, the burn area and the burn pit. The approximate boundaries for these two areas are shown on Figure 1-7. At the burn area, bomb casings from which the bulk explosives had been removed were filled with initiating powder, tilted on-end toward a hillside east of the Jeep Trail in the direction of the adjacent hillside, and flashed to complete the demilitarization process. Some munitions are thought to have been lashed to a horizontally positioned utility pole (that may have been creosote treated) prior to flashing.

The burn pit was a trench or natural depression, approximately 100 feet long, 30 feet wide, and 10 to 12 feet deep, located just south-southeast of the burn area (Figure 1-7). Powder was flashed and explosives-contaminated materials were burned in this pit. The contaminated material may have included cardboard, paper, wood, and metal packaging that may have come into contact with explosives, solvents-contaminated rags, or any other material that may have been contaminated with explosives. Some of the wooden packaging material may have contained pentachlorophenol. Small munition items and components were also reportedly treated. The area has not been used for any operations since 1983. In 1983, the burn pit was filled with clean fill material and revegetated. The area is now overgrown with brush, trees, and grasses (Figures 1-3g and 1-3h).

The exact size, shape, and locations of the burn pit and the burn area are not known. Their approximate locations have been outlined on Figure 1-7. However, descriptions of the treatment areas in previous reports and interviews with base personnel during the first field event of this investigation indicate that the treatment areas may have covered a larger area, extending from Jeep Trail 25 westward to the LSC

stream channel and southward as far as well 03-07 (Figure 41 in Dunbar, 1982; Murphy, 1996). Although inactive as a treatment area, Jeep Trail 25 is still used as an active vehicle route.

### 1.2.5 Previous Investigations

Multiple environmental investigations and surveys have been conducted at the ABG, the OJT area, and LSC. These past investigations are summarized in Table 1-1. The amount of geological, hydrogeological, hydrological, geochemical, and water-quality data and information gathered for this watershed is quite large.

A multi-phased RCS was conducted by the USACE between 1990 and 1993 to identify the nature, degree, and extent of hazardous constituents in the soils, surface water, sediments, springs, and ground water at the ABG. In 1995-1997, in preparation for a Current Contamination Conditions Risk Assessment (CCCRA), additional soil, surface water, sediment, spring, and ground water samples were taken to supplement the 1990-1993 samples (TtNUS, 1999).

Many of the historical data (pre-1995) were collected through programs that did not require independent data validation, so most of these chemical data never underwent validation to the extent necessary for use in a risk assessment. The U.S. EPA reviewed select data packages from these historical databases in 1997 and concluded that much of the pre-1993 data could not be used for risk assessment purposes due to a lack of quality control (QC) information. All the 1995 through 1997 data were found to be acceptable for use in risk assessments because they had been independently validated.

## 1.3 SITE CHARACTERISTICS

### 1.3.1 Physiography and Topography

NSWC Crane is located in the nonglaciated area of the Crawford Uplands Physiographic Province. This province is a rugged, highly vegetated, dissected plateau bounded by the Mitchell Plain Physiographic Province to the east and the Wabash Lowland Physiographic Province to the west (Murphy, 1996). The Mitchell Plain is a low, dissected limestone plateau characterized by sinkholes and karst topographic features. The boundary between the Crawford Upland and the Mitchell Plain is marked by the highly irregular, eastward-facing Chester Escarpment. Springs, caverns, caves, and other solution-weathering features can be found along this escarpment and on the eastern edge of the NSWC Crane facility. The boundary between the Crawford Upland and the Wabash Lowland near the western boundary of NSWC Crane is gradual (Murphy and Wade, 1998a). The terrain is predominantly rolling, with moderately incised stream valleys throughout and occasional flat areas in the central and northern portions of NSWC Crane.

The elevations across NSWC Crane range from about 500 feet above mean sea level (amsl) to about 850 feet amsl. Topographic relief in the Crawford Upland generally ranges from 100 to 350 feet. Greater relief exists in the eastern part of NSWC Crane near the Chester Escarpment (Murphy and Wade, 1998a).

The LSC watershed containing ABG and OJT is characterized by rugged relief, with ground surface elevations ranging from about 600 to 800 feet amsl in the headwaters of LSC (Figure 1-8). At the OJT, ground surface elevations range from approximately 550 to 800 feet amsl. The surface elevation is approximately 500 feet amsl where LSC exits the southern border of the installation.

The ABG treatment area is essentially devoid of vegetation (Figures 1-3a and 1-3b) in order to minimize the potential for fires during open burning treatments. However, areas along LSC within the ABG have been seeded with grass to minimize erosion of soil into LSC (Figures 1-3c through 1-3f). The OJT site is located in a gravel-covered area on the western side of the gravel access road (Jeep Trail 25), where the road widens in excess of 50 feet (Figures 1-3g and 1-3h). The OJT and the remainder of the LSC valley are surrounded by wooded areas along the hillsides to the east and west, with miscellaneous natural ground vegetation under the tree canopy and along the creek banks.

### 1.3.2 Climate and Meteorology

NSWC Crane is located in a warm, temperate climatic zone. In general, the summers are warm and humid, and winters are mild with occasional short cold periods. The temperature ranges from an average maximum July temperature of 89°F to an average minimum January temperature of 26°F. Precipitation is fairly evenly distributed throughout the calendar year; the maximum precipitation occurs during the spring and early summer. The average annual precipitation at the facility is 44 inches, consisting of 42 inches of rain and 15 inches of snow. The average humidity ranges from 40 to 90 percent in summer and 60 to 90 percent in winter. Long-term climatological records for the area indicate that the monthly prevailing wind direction is from the southwest from April through December and from the northwest during January through March [National Oceanic and Atmospheric Administration (NOAA), 1988]. The annual prevailing wind direction for the region is from the southwest, and the annual average wind speed for the area is about 9.6 miles per hour. Figure 1-9 is a wind rose diagram that summarizes the wind direction and mean wind speed distribution for the Indianapolis International Airport over a 5-year period (1985 through 1989).

### 1.3.3 Geology and Stratigraphy

Bedrock underlying the Crane facility consists of sedimentary rocks from the Lower Pennsylvanian age Mansfield Formation (Raccoon Creek Group) and the Upper Mississippian age Stephensport and West Baden Groups (Figure 1-10). Due to erosion and the moderate relief in the area, the Lower Pennsylvanian and Upper Mississippian rock units crop out on the ridgetops and along the stream valleys. A map showing the uppermost bedrock units in the LSC watershed is provided in Figure 1-11.

The USACE, the Indiana Geological Survey, and Indiana University have been investigating the geology and hydrogeology of this watershed since the early 1980s. Based on boring logs drilled to various depths throughout the LSC watershed, the USACE has developed a detailed understanding of the geologic units in the watershed. Several existing USACE geologic cross-sections are reproduced in this report. The lines of section for these figures are presented in Figure 1-8. The actual cross-sections are presented in Figures 1-12 (cross-section A-A'), 1-13 (cross-section AA-AA'), 1-14 (cross-section C-C'/D-D'), 1-15 (cross-section K'-K"), and 1-16 (cross-section P-P'). Cross-section A-A' is the shortest cross-section and traverses in a northeast-southwest direction directly through the OJT area. This cross-section is most pertinent to the discussions of the OJT area. Cross-section P-P' (Figure 1-16) also traverses in a northeast-southwest direction, but covers a greater distance. It extends from the Dye Burial Grounds (SWMU 02) in the northeast, through the southeastern corner of the ABG, and southwestward to well 03C25, located on the western side of the watershed. Cross-section C-C'/D-D' (Figure 1-14) lies in a semicircle around the northern and eastern edges of the ABG. Cross-section AA-AA' (Figure 1-13) traverses from the northwestern to the southeastern portions of the watershed. Cross-section K'-K" (Figure 1-15), the longest cross-section, traverses from north of ABG to the southern end of the study area near the NSWC Crane property line. These cross-sections are referred to throughout the remainder of this subsection and the next subsection on "Hydrogeology."

The uppermost (youngest) bedrock units in the LSC watershed belong to the Lower Pennsylvanian Mansfield Formation of the Raccoon Creek Group. This formation consists of alternating beds of shales (e.g., black shale and carbonaceous shale), sandstone, mudstone, siltstone, and thin discontinuous coal units and is typically about 110 feet thick or more (Murphy and Wade, 1998a). For example, over 120 feet of Pennsylvanian strata occur in well 03C29 on the western side of the watershed (see Figure 1-13), in well 03C31 located about 800 feet south of ABG and 2,400 feet west of OJT (see Figure 1-16), and in well 03C16 located on the northwestern side of ABG (see Figure 1-14). In the area near the Dye Burial Grounds (Murphy and Wade, 1998a; TtNUS, 2002) and throughout much of the LSC watershed, thick sandstone units are the predominant component of the Mansfield Formation. The Pennsylvanian age sedimentary rocks are absent where LSC and its tributaries have eroded into the Mississippian

strata. As a result, the Mansfield sandstones and coal units crop out in the uppermost portions of the ridges (Figures 1-13 through 1-16). The Pennsylvanian sedimentary rocks were also deposited on an erosional surface that developed on the Mississippian rock units, so the basal elevation of the Pennsylvanian rocks is spatially variable (Barnhill, 1993a; Kvale and Barnhill, 1994). The base of the Pennsylvanian age strata has the highest elevation (about 670 to 680 feet amsl) near the Dye Burial Grounds in the northeastern portion of the watershed (Figure 1-16). The paleoerosion surface generally lies between 640 to 660 feet amsl in the central and southeastern portions of the watershed (Figures 1-13, 1-15, and 1-16). The base of the Pennsylvanian decreases to its lowest elevation (about 615 to 620 feet amsl) on the northwestern side of the ABG near wells 03C16 and 03C19 (Figure 1-14). This agrees with the pre-Pennsylvanian paleosurface that has been mapped to NSWC Crane (Barnhill, 1993a; Kvale and Barnhill, 1994).

The Stephensport Group (uppermost Mississippian) lies beneath the Pennsylvanian strata and includes a number of sandstone and limestone formations, including (from top to bottom) the Glen Dean Limestone, the Hardinsburg Formation, the Haney (also called Golconda) Limestone, the Indian Springs Shale and the Big Clifty Sandstone member of the Big Clifty Formation, and the Beech Creek Limestone (Figure 1-10). The Stephensport Group is generally 120 to 190 feet thick.

A thin layer of Glen Dean Limestone is found directly beneath the Mansfield Formation in isolated areas of the watershed: near well 03C31 south of the ABG (Figures 1-15 and 1-16) and east of the LSC valley near well 03C35 and the NWSC Crane property line (Figure 1-13). This limestone is considered to be a productive aquifer unit in other parts of the NSWC Crane installation, but in this watershed it was extensively eroded prior to Pennsylvanian deposition. The maximum observed thickness was 4 feet in well 03C31. Hence, it is not considered as an aquifer unit in the remainder of this report.

The Hardinsburg Formation is found immediately below the Mississippian-Pennsylvanian unconformity in the northeastern, central, and southern portions of the watershed (Figures 1-13 and 1-16). This unit is up to 50 feet thick and contains primarily shale. Near well 03C31 south and southwest of the ABG, a sandstone lens is present in the middle of the formation (Figure 1-16). The Hardinsburg Formation typically acts as an aquitard between the Mansfield sandstone units above and the underlying Haney Limestone. However, this unit is absent in areas north and northwest of the ABG due to pre-Pennsylvanian erosion (Figures 1-14).

The underlying Haney Limestone (also referred to as Golconda Limestone) is characterized by shaly limestone and limey shales. The thickness ranges from several feet to almost 20 feet. The

Golconda/Haney (G-H) Limestone is thinnest northwest of the ABG where it has been partially eroded due to pre-Pennsylvanian erosion.

The Big Clifty Formation underlies the Haney Limestone and includes two distinctly different lithologic members. The upper member is known as the Indian Springs Shale and is approximately 20 feet thick (Figures 1-13 through 1-16). The lower member of the Big Clifty Formation is referred to as the Big Clifty Sandstone and consists of 35 to 45 feet of tan to green-gray, massive to thick-bedded, fine-grained, friable sandstone. Barnhill and Ambers (1994) discuss the lithologic characteristics and sedimentary facies of this sandstone in detail. The Big Clifty Sandstone is the uppermost bedrock unit in the central and southeastern portions of the ABG and along the floodplain of LSC southward to the NSWC Crane property line (Figures 1-11 through 1-16).

The Beech Creek Limestone Formation consists of fossiliferous, hard, and dense limestone, when unweathered. The thickness of this unit ranges from 20 to 25 feet. The lithologic characteristics and sedimentary facies of this limestone are discussed in detail by Barnhill and Ambers (1994). Joints and bedding-plane fractures in the limestone are sparse to numerous in cores recovered from this formation and surface outcrops (Barnhill and Ambers, 1994). As mentioned in the previous paragraph, erosion has removed the Indian Springs Shale from above the Big Clifty Sandstone in the central and southeastern portions of the ABG area and from the floodplain south of the ABG. In the areas where the Indian Springs Shale is absent, the fractures and joints have been enlarged due to solutioning of the limestone. Fracture widths measured in creek bed exposures range from 2 to 25 cm (1 to 10 inches); these fractures were found to be filled with cobbles, gravel, and sand (Barnhill and Ambers, 1994). Some outcrops show large [up to 30 cm (12 inches)] wide solution channels along the bedding-plane fractures. Drilling logs for wells along the LSC valley show a mass of weathered sandstone and limestone blocks, gravel, silt, and clay that is 10 to 30 feet thick (Figures 1-12 through 1-14). This zone along Little Sulphur Creek downstream of the ABG has been interpreted by the USACE to represent a zone where the Beech Creek Limestone was intensely fractured and karstified (Hunt, 1988; Murphy and Ciocco, 1990; Murphy, 1994; and Murphy, 1996). The development of solution channels was so intense that the Beech Creek and overlying Big Clifty Sandstone collapsed in the geologic past, and all that remains is the valley filled with weathered rubble and alluvium (Figures 1-12 through 1-16).

The Elwren Formation (uppermost unit of the West Baden Group) lies below the Beech Creek Limestone and below the collapse zone material that lies in the LSC valley (Figures 1-12 through 1-16). It consists of massive to thinly bedded, dark gray to green shale with interbedded red-brown claystone. The formation averages approximately 20 feet in thickness. The Reelsville Formation lies just below the Elwren Shale and is approximately 10 feet thick. It consists of dark gray to gray-green shale, with thin

(less than 3 feet thick) beds of fine-grained sandstone. The Sample Formation is just below the Reelsville and it consists 40 to 45 feet of dark gray to black, thinly bedded, platy to fissile shale with some interbeds of fine-grained sandstone. Together, the Elwren, Reelsville, and Sample Shales form an aquiclude that is approximately 75 feet thick (Figures 1-14 and 1-15). These shales virtually prevent the vertical seepage of shallow ground water downward into the underlying Beaver Bend Limestone.

The Beaver Bend Limestone is the deepest geologic unit in the ABG/OJT/LSC area that is considered a significant aquifer and that has been investigated or monitored in the past. The Beaver Bend ranges from 10 to 12 feet thick and consists of medium gray-brown, medium to coarsely crystalline, very hard and dense limestone. This limestone has numerous intersecting joints.

NSWC Crane is located on the eastern edge of the Illinois Structural Basin, where the Pennsylvanian and Mississippian age bedrock dips to the west-southwest and southwest at approximately 30 to 35 feet per mile (Kvale, 1992). Locally, however, the dip of the Mississippian bedrock can range from 0 to 15 feet per mile to as much as 100 feet per mile to the southwest in the Sulphur Creek watershed (Kvale, 1992). A structure contour map for the top of the Elwren Shale (i.e., base of the Beech Creek Limestone) is presented in Figure 1-17. It shows that the Beech Creek Limestone is generally dipping to the southwest. Superimposed on the general structural dip to the southwest is an anticlinal structure trending through the OJT area that plunges to the southwest. Parallel to this, two synclinal structures trend through the ABG area and the southern end of the watershed and also plunge to the southwest. These structural features may have had some effect on the orientation and frequency of fracturing in the limestones and the initial development of solution features along the fractures. The regional structure also has a significant effect on the ground water flow system within the Beech Creek Limestone, as will be discussed in the next subsection.

The unconsolidated overburden deposits at NWSC Crane generally consist of two types: Quaternary and Pleistocene age alluvial and colluvial deposits near the floodplains of primary streams and unconsolidated residual soils and loess on sides and tops of ridges. Residual soils at NSWC Crane were derived from the underlying sedimentary rocks of the Lower Pennsylvanian Raccoon Creek Group and the Upper Mississippian Stephensport and West Baden Groups. These soils consist of clay, silt, sand, and fragmented and/or partially weathered bedrock. The residual soils developed on the ridgetops and upper sideslopes of the ridges were derived from the weathering of Pennsylvanian strata. The residual soils in the lower elevations of the LSC valley were derived from the weathering of the Mississippian sandstones, limestones, and collapse fill materials.

Using the U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS) soil classification system (McElrath, 1988), the soil at NSWC Crane has been classified into 23 different soil series. Each

of these soil series is defined by various soil characteristics (e.g., grain size, erosion, slope, drainage, parent material, or depositional source, etc.) specific to each series. Within these soil series, various sub-classes or soil map units have been defined.

Chemical characteristics of soils at NSWC Crane were evaluated during a basewide background soils investigation conducted by TtNUS in 2001 (TtNUS, 2001a). The objectives of the investigation were to identify and chemically characterize soils based on three factors: depositional environment, grain size, and depth. A total of 16 soil types were identified and evaluated in the report, based on combinations of these three factors. Four depositional environments were identified at NSWC Crane, based on the mapped geologic parent material: Pennsylvanian bedrock, Mississippian bedrock, alluvium, and loess. Three predominant grain sizes (clay, silt, and sand) and two depths (surface and subsurface) were also identified as factors possibly contributing to soil chemical characteristics. Soil samples were collected to establish representative background metals concentrations for each of the 16 soil types.

Based on the classification scheme developed in the base-wide background soil study (TtNUS, 2001a), the soils encountered at SWMU 03 fall into three different soil groups. The surface soils 0 to 2 feet below ground surface (bgs)] all belong to Group 3 (surface soils, undifferentiated). The subsurface soils (2 to 10 feet bgs) are all derived from weathered Mississippian bedrock and belong to soil groups 6 and 7. These groupings are discussed further in Section 3.0.

### 1.3.4 Hydrogeology

**Description of Aquifers and Aquitards**

Ground water in the nonglaciated southwestern portion of Indiana is generally contained in fractures and joint openings of limestone and sandstone aquifers. Aquifers are generally isolated from one another vertically by less permeable shale and siltstone units. Ground water enters the aquifers as infiltration in outcrop areas and flows by gravity down the dip of the strata or locally in directions controlled by the potentiometric gradients, which are in most cases influenced by topography and locations of stream channels (i.e., ground water discharge areas).

Based on 20 years of drilling and hydrogeological investigations in the LSC watershed (most notably in the ABG area), the hydrostratigraphic units and hydrogeologic conditions in the watershed are well characterized and documented. However, because of the fractured rock units and karstic nature of the limestone formations present in the watershed, the ground water flow system is very complex and

therefore there are some uncertainties concerning the details of the flow system in localized areas at a small scale.

Four primary aquifers in the LSC watershed have been identified in the Pennsylvanian and Upper Mississippian strata:

- Pennsylvanian sandstones
- the Haney Limestone [also referred to as the Golconda-Haney (G-H) aquifer]
- the Big Clifty Sandstone/Beech Creek Limestone (BC/BC) aquifer
- the Beaver Bend Limestone

The Pennsylvanian sandstone aquifer is the uppermost aquifer and is present only along the tops of ridges at elevations above 615 feet amsl. Typically, the base of the Pennsylvanian Mansfield Formation is even higher (about 650 to 660 feet amsl). The Pennsylvanian rocks are up to 120 feet thick (Figures 1-13 through 1-16). The Pennsylvanian sandstone aquifer actually consists of two or more irregular sandstone units that are commonly separated by shale, siltsone, and clay lenses and some coal beds. The stratigraphy, lithologic characteristics, and hydraulic characteristics of the Pennsylvanian strata of this area are discussed in detail by Barnhill and Hansley (1993), Kvale and Barnhill (1994), Fisher (1996), and Murphy and Wade (1998a). The hydrogeologic characteristics of the Pennsylvanian aquifer were also presented in the draft RFI report for SWMU 02 - Dye Burial Grounds (TtNUS, 2002). This SWMU is located in the far northeastern corner of the LSC watershed (Figure 1-8). The Pennsylvanian sandstone aquifer is not present in the ABG area, OJT area, or the LSC valley floor.

The Glen Dean Limestone is present beneath the Pennsylvanian aquifer in isolated areas of the watershed. Because of its limited presence in the watershed and its complete absence from the ABG, OJT area, and LSC valley, it is not considered a separate aquifer unit and is not discussed further in this report.

The Hardinsburg Shale is up to 50 feet thick and contains mostly shale with some low-permeability sandstone in the middle. This formation forms a nearly continuous, relatively impermeable barrier to ground water flow between the Pennsylvanian sandstones above and the Golconda-Haney Limestone below.

The G-H Limestone aquifer crops out on the sides of LSC and Johnson Hollow (Figure 1-11). This limestone aquifer is up to 20 feet thick. A small spring (location 02SWSD07, Figure 1-8) located south-

southwest of the Dye Burial Grounds discharges ground water from the G-H aquifer (Murphy and Wade, 1998a; TtNUS, 2002).

The Indian Springs Shale aquitard (the 20-foot-thick upper member of the Big Clifty Formation) underlies the G-H Limestone throughout the watershed and minimizes vertical movement of ground water downward into the Big Clifty Sandstone. In places where the Indian Springs Shale and higher strata have been removed by post-Pennsylvanian erosion, surface recharge into the Big Clifty Sandstone is relatively rapid.

The Big Clifty Sandstone and the underlying Beech Creek Limestone are both permeable rock units and are in direct hydraulic communication with one another. Together, they form the most important aquifer unit in the watershed. The porosity and permeability of the Big Clifty Sandstone are due to intergranular pore spaces and to fractures (i.e., it has both primary and secondary permeability). The Beech Creek Limestone is very dense and well cemented; all of its permeability and porosity are due to vertical fractures, bedding- plane fractures, and solution openings along the fractures. The lithology, fracture patterns, and permeability characteristics of the Big Clifty Sandstone and the Beech Creek Limestone are detailed in reports by the USACE (Hunt, 1988; Murphy and Ciocco, 1990; Murphy, 1994) and the Indiana Geological Survey (Barnhill and Ambers, 1994). The BC-BC aquifer is exposed near the ground surface in the eastern half of the ABG, down along the LSC valley, and in the lower elevation of Johnson Hollow (Figure 1-11). Beneath the ridges, the aquifer is approximately 60 feet thick and fracture flow is dominant in the limestone. Solution openings and cavities become larger and hydraulically more significant close to the stream valleys where conduit systems in the limestone have developed. Starting in the eastern half of the ABG and continuing down the LSC valley to the facility property line, the solutioning of the Beech Creek Limestone was so extensive that the overlying limestone has collapsed in the geologic past and the Big Clifty Sandstone has collapsed with it. The collapsed zones extend down the centers of the LSC valley and Johnson Hollow, are permeable, and form a hydraulic continuum with the BC-BC aquifer on both sides of the valleys (e.g., Figures 1-12 through 1-16).

The Elwren, Sample, and Reelsville Formations lie beneath the BC-BC aquifer and have a combined thickness of about 75 feet. The permeability of the shales in these formations is so low that a significant hydraulic head difference (about 46 feet) exists between the BC-BC aquifer above and the Beaver Bend Limestone aquifer below (Baedke, 1998). The chemistry of the ground water in the BC-BC and Beaver Bend aquifers is also significantly different (Baedke, 1998). Based on the geological, hydrogeological, and geochemical evidence mentioned above and on previous reports, the hydrological separation of the BC-BC aquifer from lower strata in the LSC watershed appears to be significant. Ground water flows

laterally through the BC-BC aquifer on top of the Elwren Shale and discharges as springs along the valley bottoms where this aquifer is exposed.

The Beaver Bend Limestone forms an important aquifer below the Elwren-Sample-Reelsville aquiclude. The Beaver Bend aquifer is about 12 feet thick. Five monitoring wells and one ground water production well have been drilled and screened in the Beaver Bend aquifer, all within the ABG area. Ground water samples collected from the monitoring wells in 1987 through 1992 have shown minor contamination by trichloroethylene (TCE) and the explosive compound RDX (Murphy, 1994). However, a ground water sample collected from the ABG "Break Room Water Well" (Figure 1-8) in 1999 showed the ground water in the Beaver Bend aquifer did not contain detectable concentrations of RDX or TCE or any other organic contaminants (TtNUS, 2000). Because of its depth, hydraulic isolation, and lack of significant contamination, this aquifer unit is not discussed further in this report.

**Hydraulic Properties of the Aquifers**

Most of the bedrock units (including the limestone aquifers) are well cemented and have relatively low values of intergranular porosity and permeability (Barnhill and Ambers, 1994; Fisher, 1996). The Pennsylvanian sandstone and the Big Clifty Sandstone aquifers are exceptions. They do have moderate values of intergranular porosity and permeability. Most of the overall porosity and permeability present in the aquifers are due to vertical fractures, bedding-plane fractures, solution openings in the limestones, and large openings where the BC-BC aquifer has collapsed along the bottom of the LSC valley and Johnson Hollow.

Slug tests and pumping tests have been performed in numerous monitoring wells in the ABG and Dye Burial Grounds by the USACE (Murphy, 1995) and the Indiana Geological Survey (Fisher, 1996). Low-flow pumping tests were performed in monitoring wells within the OJT area for this RFI. Monitoring data and data evaluation for the tests conducted in June 2001 for this RFI are included in Appendix B-11. Results of all these tests are summarized in Table 1-2. Based on 11 slug tests performed in the Dye Burial Grounds area, the hydraulic conductivities of the Pennsylvanian sandstones are moderate to low; they range from $1.0 \times 10^{-4}$ up to 0.56 feet/day (Table 1-2). One pumping test performed in the G-H aquifer also yielded a relatively low value of hydraulic conductivity (0.24 feet/day). Pumping tests and low-flow purge tests conducted in the Big Clifty Sandstone, Beech Creek Limestone, and the collapse breccia material have yielded hydraulic conductivity values that are slightly higher than those measured for the upper aquifers. Based on the results of 25 tests, the calculated hydraulic conductivity values for the BC-BC aquifer ranged from 0.058 up to 4.08 feet/day (Table 1-2). The lowest value was determined for well 03-10, which is screened in the collapse breccia in the OJT area. The highest value was

determined for well 03-23, which is screened in the Beech Creek Limestone and the collapse breccia in the OJT area. These test results reflect the low to moderate permeabilities that are present in the fractured rock and brecciated collapse materials, but not in the rock that contains open cavities and solution channels. Well 03-24 is screened in competent limestone and does contain solution cavities. The hydraulic conductivity determined at this location was 2.53 feet/day, which is at the upper part of the measured range for hydraulic conductivity (see Table 1-2). However, it does not reflect the high conductivity values that are present where the karst conduits are well developed.

The solution openings and cavities in the Beech Creek Limestone have formed ground water conduits that roughly trend north to south on both sides of the LSC valley. These conduit systems have been investigated extensively by the USACE (Murphy and Ciocco, 1990; Murphy, 1994; May et al., 2002) and Indiana University (Baedke, 1998; Krothe, 2002). Based on the results of dye tracer studies, ground water enters these karst conduits, which allow rapid flow of ground water southward roughly parallel to LSC but in the valley walls where the BC-BC aquifer has not collapsed. The hydraulic conductivity values of these conduits are extremely large and cannot be measured using standard field methods typically employed for an RFI. These conduits and conduit outlets (i.e., springs) along the valley walls south of the OJT area are discussed below.

**Ground Water Flow Directions**

In general, the shallow ground water flow patterns mimic topography; highest ground water elevations are typically found along ridge crests, and ground water flow is toward the major stream or tributary valleys. Recharge to the shallow ground water system generally occurs over most of the uplands and sideslopes. Ground water moves downward and then laterally, where it discharges to the deeper stream valleys as springs, seeps, and baseflow.

A total of four aquifers are present in the LSC watershed, consisting primarily of sandstone and limestone. These aquifers are separated by shale and siltstone aquitards. The upper aquifers, which include the Pennsylvanian sandstones and the G-H Limestone, are exposed in outcrops on the upper hillsides surrounding the ABG, OJT area, and LSC valley bottom. The G-H limestone is underlain by the Indian Springs Shale. Ground water in the G-H aquifer is prevented from seeping downward into the BC-BC aquifer by the intervening Indian Springs Shale. Instead, perched ground water in the G-H aquifer flows on top of the shale toward nearby outcrops. In the northeastern portion of the watershed (by the Dye Burial Grounds), ground water in the G-H aquifer is generally flowing toward the southwest toward an unnamed tributary of LSC (TtNUS, 2002). The aquifer also dips to the southwest. A small spring located southwest of the Dye Burial Grounds (northeast of the ABG) is a discharge point for the G-H aquifer,

where the aquifer crops out on the hillside. In the ABG area, ground water in the G-H aquifer is generally flowing inward toward the ABG from the northern, western, and southern sides (Hunt, 1988; Murphy, 1994; Duwelius et al., 1995). When the ground water reaches the cropline of this aquifer (see Figure 1-11), the ground water is apparently seeping near the ground surface through residual soils and weathered shale until it reaches the cropline of the Big Clifty Sandstone. There, it infiltrates into the Big Clifty Sandstone. No visible surface seeps or springs have been reported emanating from the G-H aquifer in the vicinity of the ABG.

The next lower aquifer, the Big Clifty-Beech Creek aquifer, has the most monitoring wells screened in it and more effort has gone into characterizing the hydrogeology of this aquifer than any of the other three aquifers. The BC-BC aquifer has been studied the most because:

- It lies directly under the ABG and OJT treatment areas.
- It is the aquifer where the highest concentrations of contaminants have been detected during previous investigations.
- It contains the conduits that feed the majority of springs and baseflow in LSC.

Potentiometric surface maps for the BC-BC aquifer in the LSC watershed have been presented in previous reports (Murphy and Ciocco, 1990; Murphy, 1994). In general, the highest ground water elevations (560 to 565 feet amsl) in this aquifer were found at the northern end of the LSC watershed (north of ABG and in the vicinity of the Dye Burial Grounds). Ground water was generally flowing from north to south in the watershed, and the flow direction was also inward toward LSC (i.e., from the perimeter of the watershed in toward the creek and Johnson Hollow). The elevation at which ground water discharges from Spring C is about 530 feet amsl. The lowest ground water elevations (about 510 to 515 feet amsl) were recorded at the southern end of the watershed at Spring A and well 03B10. A comprehensive set of elevations was measured on June 12 and 13, 2002. Table 1-3 lists all the known wells and stream gaging locations in the watershed, physical characteristics of each well, and the spatial coordinates and reference elevations for each location. The water elevations measured in June 2002 are also listed in this table. Water levels were measured in a total of 120 monitoring wells and at four stream gage locations at this time. A total of 64 monitoring wells are screened in the Big Clifty Sandstone, Beech Creek Limestone, or the collapse breccia material along LSC. The water levels measured in these 64 wells, along with the water levels at three stream gage locations, were used to map the potentiometric surface in the BC-BC aquifer. These water levels and potentiometric contours are presented in Figure 1-18, which shows the highest ground water elevation (577.59 feet amsl) was measured in the Dye Burial Grounds (well 02C20) at the northeast end of the watershed. The lowest elevations (511 to 512 feet amsl) were measured at the southern end of the watershed, close to LSC (wells 03B10 and 03C37 and

Spring A). The wells in the ABG area had ground water levels of 543 to 560 feet amsl. Wells in the OJT area had water levels ranging from 535 to 543 feet amsl. The ground water potentiometric map, based on the June 2002 set of measurements, shows that ground water flow is from north to south and from the perimeter of the watershed inward toward two stream karst ground water conduit systems. The two known conduits run from north to south, one on each side of the valley. The approximate locations of these karst conduits are shown on Figure 1-18. The contours indicate that LSC is a losing stream (i.e., recharging the ground water system) in the northern part of the watershed and is a gaining stream (i.e., receives round water discharge) near and south of Spring C. These ground water flow directions are similar to those presented by Murphy (1994).

In the smaller area surrounding the OJT study site, a localized flow system in the BC-BC/breccia zone aquifer is contrary to the overall flow system for the watershed described above. Measurements of ground water elevations at OJT in the past (Murphy and Ciocco, 1990; Murphy, 1996) and measurements made during this RFI show that a ground water ridge runs from the northwest to the southeast beneath LSC. The ground water elevations measured in June and September 2001 are listed in Table 1-4 and are presented in Figures 1-19 and 1-20, respectively. Potentiometric contours indicate that ground water is flowing away from this ridge under the streambed toward the northeast and the south-southwest. As stated in previous investigations, LSC is a losing stream between ABG and OJT and probably southward toward Spring C. In this section of the watershed, the streambed is usually dry and ground water is flowing either through the breccia zone materials parallel to the stream (i.e., underflow) or it is flowing back into the bedrock valley wall, as is suggested by Figures 1-19 and 1-20. These localized flow directions (i.e., away from the Creek toward the northeast and southwest) are in contrast to the overall watershed flow directions, which are toward the stream valley (Figure 1-18). The apparent contradiction in flow directions can be explained, however, by the presence of the karst conduits that run in a north-south direction on both sides of the stream valley. The majority of ground water in the OJT area is likely flowing toward the karst conduits. In June 2001, there were relatively large horizontal hydraulic gradients toward the northeast (0.0219 foot/foot between wells 03-07 and 03-24) and southwest (0.0414 foot/foot between wells 03-07 and 03-17). In September 2001, the gradients were much lower (0.0253 foot/foot toward the northeast and 0.00684 foot/foot toward the southwest).

Ground water in the BC-BC aquifer and the conduits eventually discharge back into the stream at springs A, A', B, C, smaller springs, and diffuse seepage through the streambed. All this discharge occurs at Spring C and south of Spring C, where the top of the Elwren Shale intersects the streambed and LSC becomes a gaining stream (i.e., flow of water is from the ground into the stream). LSC becomes a perennial stream at Spring C, where the flow of ground water to the stream is sufficient to maintain flow in the stream continuously. More details regarding the conduits and springs are presented below.

The Beaver Bend limestone is 10 to 12 feet thick and comprises the lowest aquifer that has been investigated in this watershed. Five monitoring wells in the ABG area are screened in the Beaver Bend Limestone. Based on data from these five wells, the Beaver Bend is fully saturated and flowing southward at a very gentle gradient (Murphy, 1994). The Beaver Bend is considered to be isolated hydraulically from the BC-BC aquifer above, based on the following:

- The thickness (approximately 70 feet) and low permeability of the intervening Elwren-Reelsville-Sample aquiclude.
- The large hydraulic head difference (approximately 46 feet) that exists between the two aquifers.
- The large difference in basic chemical composition of ground waters that have been found in the two aquifers. The ground water in the BC-BC aquifer contains mostly calcium, magnesium, bicarbonate, and some sulfate as its primary ions. However, the Beaver Bend ground water clearly has a sodium and bicarbonate composition (Baedke, 1998).

Based on these findings, the Beaver Bend aquifer was not investigated during this current RFI for the OJT area and LSC.

**Ground Water Discharge and Springs of the Big Clifty-Beech Creek Aquifer**

As stated above, the BC-BC aquifer discharges to the ground surface from both sides of the valley via numerous springs and baseflow in LSC downstream of Spring C. These springs and baseflow are forced to the ground surface because, at this point in the watershed, the stream has incised down to the underlying Elwren Shale. Springs A, A', B, and C are the largest in this watershed area. The locations of these springs are shown on Figures 1-8 and 1-18. Springs A, A', and B are located on the western side of the valley, approximately 6,000 to 6,800 feet south of the ABG. Spring C is located on the eastern side of the creek, about 2,000 feet south of the OJT area. Presumably, Springs A, A', and B are draining the portion of the BC-BC aquifer west of the creek, and Spring C is draining the aquifer positioned on the east side of the creek. These springs flow year round; however, flow rates fluctuate rapidly due to rainstorm or large snowmelt events. Flow rates of Springs A and C were measured continuously in March and April 1996 (Figure 1-21). As shown in this figure, the flow rates of the two springs rose rapidly in response to rain events and declined fairly rapidly within a few days. The peak flows in these two springs during the 2-month time period were approximately 10,000 gallons per minute (gpm), or 22.3 cubic feet per second ($ft^3/s$). It has been noted in previous reports (e.g., Hunt, 1988; Murphy and Ciocco, 1990) that the springs

become turbid during high flow events and then clear up and return to normal flow within a day or two after a storm event. The flashiness of the spring flows and the fact that the discharge becomes turbid during a storm indicate that the springs are linked to conduit systems that take surface recharge and transfer it through the conduit systems quickly. The suspended solids contained in the discharge waters likely come from the areas of recharge and gradually move through the conduit system, primarily during storm events.

**Dye Tracer Studies**

During early ground water investigations in the LSC watershed, the investigators (Hunt, 1988; Murphy and Ciocco, 1990) surmised that springs at the southern end of the watershed were linked to karst conduits originating to the north. Several dye tracer studies have been performed in order to study the pathways in these conduits and the velocity of travel. The first dye tracer investigation was performed by Murphy and Ciocco (1990). They placed one gallon of fluorescein solution into well 03C02P2 at 10:35 on the morning of January 20, 1990. Approximately 1,200 gallons of water were added to the well during the next 60 minutes (about 20 gpm). The well accepted the water without overflowing. Two gallons of Direct Yellow 96 dye and Phorwrite AR mixture were added to well 03C03P2 at 12:25, also on January 20, 1990. About 500 gallons of water were added to this well at a rate of about 7 gpm. The rate of water addition in this well was less in order to prevent overflowing. Light rain occurred on January 19, preceding the tests, and on January 20, during the tests. Thus, the stream flow and spring flows were above average during the testing. The fluorescein dye appeared in springs A and A' over a period of 5 to 28 hours after injection. The dye persisted in these two springs for at least five days following injection. Based on a mean travel time of 16 hours and assuming a sinuous travel distance of about 8,000 feet, Murphy and Ciocco (1990) estimated a ground water velocity of approximately 500 feet per hour through the conduit system. They detected a weak but inconclusive presence of dye in Springs B and C and in springs located north of ABG in another watershed. They attributed these weak detections possibly to background coloration of the water. Based on these results, it was clear that the ABG was directly linked to a karst conduit system that transfers water from the ABG south to Springs A and A' through the Beech Creek Limestone. The Direct Yellow 96 dye and Phorwrite AR were not detected in any of wells or springs monitored.

Indiana University initiated a second tracer test on the western side of LSC on May 3, 1997 (Baedke, 1998). Between 12:32 pm and 12:59 pm, 1.6 kg of Rhodamine WT dye and 18.3 kg of bromide ion were added to well 03C02P2. At 1:04 pm, 1.6 kg of eosin dye was injected into well 03C10. The springs and the stream were at relatively high flow rates because 2.5 inches of rain fell the previous day. Rhodamine WT dye was visually detected at springs A and A' at 8:00 pm, 7.5 hours after injection at ABG. The

bromide tracer appeared at the same time as the Rhodamine WT. Baedke (1998) calculated a travel velocity of 938 feet per hour between well 03C02P2 and Spring A, which is faster than the velocity calculated by Murphy and Ciocco (1990). Although the Rhodamine WT was detected at these two springs up to four days after injection, the bromide tracer dissipated quickly (within 14 hours), presumably because the bromide ion does not sorb and is therefore flushed from the conduit system more quickly. Rhodamine WT was not detected during the entire test period in any other springs that were monitored. Eosin was not detected at all, even in springs A and A'. Therefore, it does not appear that the portion of the BC-BC aquifer located near well 03C10 is directly connected to the conduit system feeding springs A and A'.

On October 11, 2000, Rhodamine WT dye was again injected into well 03C02P2, but the flow rates in the stream and the springs were relatively low during this test (Krothe, 2002). Monitoring showed that the dye took 18.5 hours to travel from the well to Springs A and A'. The peak of dye arrived 28 hours after injection. Thus, the travel velocity was slower during dry weather conditions.

Previous dye tracer tests all showed that the ABG area does not seem to be hydraulically connected to Spring C, which is a major spring located on the eastern side of the creek, downstream of the OJT area. Ground water elevations indicate a flow direction from the OJT burn pits to the east-northeast toward well 03-24 (Figures 1-19 and 1-20). The geologic log for well 03-24 (see Figure 1-12) shows solution cavities in the limestone intercepted by the well screen. It was hypothesized that these solution channels might be linked to a conduit system that leads southward to Spring C, which is separate from but analogous to the conduit system investigated previously on the western side of the creek. A dye tracer test has been performed recently on the eastern side of LSC to determine whether there is a link between the OJT area and Spring C (Jock and Krothe, 2002). Fluorescein dye was injected into well 03-24 on May 24, 2002. The dye was first detected in Spring C 17 hours after injection. The dye concentration peaked 28 to 38 hours after injection and dissipated 58 hours after injection. Thus, the OJT area is linked to the Spring C conduit system in the vicinity of well 03-24. However, this conduit system does not seem to be as well developed, and travel velocities are not as fast as the conduit system on the western side of the creek feeding Springs A and A'.

Appendix I presents the May 23, 2002 quantitative dye test to determine the relationship between the flow of ground water at the ABG and OJT relative to Springs A, A', and C. The dye test determined that well 03-24 at the OJT is directly related to Spring C only and the swallow hole in the LSC channel is connected to Springs A and A'. This dye study supports previous dye traces that indicate all ground water flowing from the ABG and OJT areas ultimately discharge to the LSC Drainage (Jack and Krothe, 2002).

### 1.3.5 Surface Hydrology and Drainage System

The surface drainage at NSWC Crane has formed a dense, dendritic pattern throughout the installation. Most of the major streams flow in a general southward or southwestward direction. Seven primary creeks in five drainage basins carry surface water off the installation, where they eventually drain into the East Fork of the White River and then to the Wabash River to the southwest. Figure 1-2 shows the main drainage basins of NSWC Crane. The OJT study area lies within the Sulphur Creek drainage basin. The Sulphur Creek basin drains roughly 30 percent of NWSC Crane.

Little Sulphur Creek is a tributary of Sulphur Creek and is approximately 4.6 miles long from its northernmost headwaters to its intersection with Sulphur Creek south of the installation. The creek consists of a north and a south fork from the headwaters to approximately the center of the ABG Treatment Area (Figures 1-4 and 1-8). From the ABG, a single channel meanders south-southeastward a distance of approximately 0.5 mile to the OJT area and then continues another 0.6 mile until it reaches the installation boundary (Figure 1-8). Several intermittent tributaries discharge into LSC from both sides of the stream, including the Johnson Hollow tributary, which intersects with LSC near the NSWC Crane boundary (Figure 1-8). The Dye Burial Grounds (SWMU 02) are located north of the OJT, and surface drainage from this site enters several ephemeral gullies, which drain into LSC between ABG and OJT.

The LSC channel is usually dry north (upstream) of Spring C. During dry periods of summer and fall the flow rate in the creek between Springs C and A is typically less than about 50 gpm. Downstream of where the discharge from Spring A enters the creek, the dry weather flow in the creek is typically greater than 100 gpm. Flow rates in the creek were visually estimated on June 19, 2001. The flow estimate for 03SG05 was about 20 gpm. Downstream of Spring A at 03S06, the flow rate in the creek can increase by two to three orders of magnitude, due in large part to the rapid increases in the flow rates of the springs along the creek.

From the installation boundary, LSC flows southward about two miles before it enters Sulphur Creek. Sulphur Creek then flows southward and empties into Indian Creek, which drains into the East Fork of the White River and then southwestward into the Wabash River.

### 1.3.6 Land Use and Demography

The economic base of communities surrounding NSWC Crane is in transition from agriculture, mining, and quarrying to manufacturing and service industries. The patterns of settlement, population statistics,

and median income are similar throughout the region (TtNUS, 2000a). Because most of the region is covered by vegetation, the area is classified as rural (TtNUS, 2000a).

There is no state or local planning within the vicinity of NSWC Crane. The only zoning and land use regulations are in the municipalities in the region. None of the municipalities are close enough to impact NSWC Crane. None of the areas adjacent to NSWC Crane are zoned, and zoning is not anticipated in the near future. No known land use or community actions are being considered or proposed at this time (TtNUS, 2000a).

### 1.3.7 Ecology

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

The site also contains old agricultural fields in various stages of biological succession. Openings on dry upland sites contain almost pure stands of grasses with some clumps of woody plants such as persimmon, sassafras, and sumac. Wetter sites have river birch, willow, sycamore, and cottonwood. Hillside communities have included hickory, white and black oak, red maple, sugar maple, tulip poplar, ash, and beech [Naval Energy and Environmental Support Activity (NEESA), 1983]. Cleared areas at the facility have various stages of grassland, oldfield, and scrub/shrub vegetational forms. Dominant tree species include black oak, white oak, pignut hickory, and yellow poplar. These stands are relatively young; the average diameter ranges from 6 to 12 inches. No scrubs or shrubs are present; leaf litter, limbs, and fallen saplings cover the understory.

The wildlife habitats and vegetation types present at NSWC Crane (many stages of forest succession, streams, ponds, Greenwood Lake, and grassy open spaces) support a diverse terrestrial and aquatic fauna. The abundance of wildlife on the site is due in large measure to the mixture of land forms and vegetation types that occur over the installation. In addition, the lack of agricultural pressures has enhanced the wildlife abundance and served to provide an installation-wide "wildlife enclosure" condition.

There is an adequate amount of forage materials, concealment opportunities, and shelter locations to support a highly diverse wildlife community at the site.

Terrestrial habitats (i.e., wooded areas and grasses) near the site may provide shelter and food sources for various species of mammals such as white-tailed deer, coyote, red fox, rabbits, raccoons, and mice and of birds such as ducks, geese, wild turkey, bobwhite quail, red-tailed hawks, and American robins. The threatened and endangered Indiana bat may be a potential receptor at either the ABG or OJT sites.

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

The birds at NSWC Crane are diverse. Previous studies at the facility have identified over 100 species present at the site during breeding seasons (Hengeveld, 1987). Because the facility is largely forested, the species found at the site consist predominantly of those species that frequent wooded habitat types. There are also species of waterfowl that use the facility, especially in the vicinity of Lake Greenwood (Figure 1-2). A large number of bird species frequent the non-forested grassland, oldfield, and scrub/shrub vegetation present over portions of NSWC Crane.

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

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

The channel of Little Sulphur Creek has a riffle-and-pool structure, and standing water is often limited only to deeper pool areas during low-flow conditions. A biological survey was conducted in the fall 1995 during low-flow conditions (TtNUS, 1999) and included identification of fish and benthic macroinvertebrates at two locations on Little Sulphur Creek. A deep pool (over 6 feet deep at the time of the 1995 biological survey) was located in the LSC channel near Spring A. A shallow pool (about 1.5 feet deep) was located in the LSC channel upstream near Spring C. Low flow conditions prevailed throughout the survey.

Fish were captured for identification using an electrofishing backpack unit. Near Spring A, the bluntnose minnow (*Pimenthales notatus*) was noted as abundant, the gizzard shad (*Dorosoma cepedianum*) and creek chub (*Semotilis atromaculatus*) were noted as common, and the largemouth bass (*Micropterus salmoides*) was noted as uncommon. Near Spring C, the gizzard shad, silverjaw minnow (*Ericymba buccata*), and bluntnose minnow (*Pimenthales notatus*) were noted as common, and the ribbon shiner (*Notropus fumeus*) and blacknose dace (*Rhinichthys atratulus*) were noted as uncommon.

Benthic macroinvertebrates were collected using a D-frame kick net and preserved using 70-percent isopropanol. At the Spring A pool, a total of 71 individuals in seven taxa were observed. The Ephemeroptera, Plecoptera, and Trichoptera (EPT) Index was calculated to be 0.429, which is indicative of a relatively unpolluted stream. At the Spring C pool, a total of 81 individuals in eight taxa were observed. The EPT Index was calculated to be 0.375, indicative of a relatively unpolluted stream. For a riffle in Little Sulphur Creek adjoining the Spring C pool, a total of 40 individuals in four taxa were observed, and the EPT Index was calculated to be 0.500, which is also indicative of a relatively unpolluted stream. The methodology for bioassessments of streams is discussed in Section 8.0.

The 1995 aquatic survey of LSC was conducted as part of the Baseline Ecological Risk Assessment (BERA) completed in 1999 (TtNUS, 1999).

An Endangered Species Management Plan for NSWC Crane was prepared in October 2000 (Comarco Systems, Inc., 2000). As part of this plan, the federal and state endangered and threatened species and species of special concern for the facility were identified. This was accomplished by the compilation of a large amount of information on species present at NSWC Crane. Information included in the Endangered Species Management Plan (Comarco Systems, Inc., 2000) was obtained from studies and surveys conducted by the Navy and other agencies and groups (such as research institutions). A small subset of these studies include the Inventory of Neotropical Migratory Birds, Mist Net and Radiotelemetry Surveys for the Indiana bat, Bobcat Trapping, Rattlesnake Survey, Purdue University Wildlife Studies, and several fish surveys and bird counts. These studies and others that were used in compiling a list of endangered

species present at NSWC Crane are described in more detail in the Endangered Species Management Plan (Comarco Systems, Inc., 2000).

There are numerous species of wildlife located throughout NSWC Crane. Of these species, some are listed as endangered and threatened species or species of special concern. The Indiana bat is listed as the only federal endangered mammal and is potentially present at SWMU 03. The bald eagle is listed as a federal threatened species. The presence of the bald eagle is also unlikely because the preferred hunting habitat for this bird of prey (i.e., vast expanses of open water) is absent at SWMU 03. The County Distribution of Indiana's Federally Threatened, Endangered, Proposed, and Candidate Species list (USFWS, 2002) was reviewed to verify that no change in status of these species had occurred since October 2000.

NSWC Crane occupies three counties in Indiana (Green, Lawrence, and Martin counties). The Indiana bat is listed as federally endangered in all three counties. the Fanshell pearly mussel, tubercled blossom, ring pink, and clubshell are listed as federally endangered species within Martin, Daviess, and Lawrence counties. Additionally, the Northern riffleshell and rough pigtoe are listed as federally endangered species in Martin County. These invertebrate species are not likely to be present at SWMU 03 because they prefer medium to large rivers with moderate currents and gravel substrates as habitat. The preferred habitat that these species prefer is absent at NSWC Crane.

A larger number of species are included as state endangered species in the Endangered Species Management Plan (Comarco Systems, Inc., 2000). The state endangered species list includes two mammals (bobcat and Indiana bat), one reptile (timber rattlesnake), and several birds (bald eagle, osprey, loggerhead shrike, yellow-crowned night-heron, Virginia rail, king rail, and Henslow's sparrow. The Rare Animals of Indiana list (Indiana DNR, 2002) was also reviewed to verify that no change in status of these species had occurred since October 2000. This list is much larger than that presented in Comarco Systems, Inc. (2000) and is not reiterated here. It was verified that the species listed above did not experience a change in status.

## 1.4 CONSTITUENTS OF INTEREST

The following sections describe the available historical data for each environmental medium that was investigated.

### 1.4.1 Soil

In 1990, 12 soil borings were made at the ABG (none at the Jeep Trail Area), with samples taken from the following depth intervals at each boring: 3 to 6 inches, 12 to 18 inches, 18 to 24 inches, 36 to 42 inches, and 6 inches above bedrock. According to a U.S. EPA technical memorandum (U.S. EPA, 1997a), only the explosives data from this sampling event were deemed acceptable for use in risk assessments. Table 1-5 presents a summary of the explosives data, showing that 2-amino-4,6-dintrotoluene (2-ADNT), 4-amino-2,6-dinitrotoluene (4-ADNT), TNT, tetryl, dinitrobenzene (DNB), 1,3,5-trinitrobenzene (TNB), RDX, and HMX were detected at the ABG. The data are presented in Appendix A of the QAPP (TtNUS, 2001b).

In 1993, an additional 33 surface soil grab samples were collected, along with another 32 soil borings, as part of the RCRA Phase II Part II soils investigation. Samples were taken from depths of 1 to 30 inches, 30 to 60 inches, 60 to 90 inches, and/or at refusal. These samples were not analyzed for explosives. All other analytical data from these samples were found to be unacceptable for use in risk assessment by the U.S. EPA (1997a).

It was noted in the original review of the historical data in 1993 that none of the soil samples previously collected at ABG by the USACE were analyzed for chlorinated dioxins and furans and that no soil samples had been collected from the OJT. In 1995, three surface soil samples from around the burn pans and pads were collected and analyzed for polychlorinated dibenzo paradioxins (PCDD)/polychlorinated dibenzofurans (PCDF), and five surface soil samples were collected from the OJT area and analyzed for explosives, inorganics, and SVOCs. All these data were determined to be acceptable for use in risk assessments by the U.S. EPA (1997a). A summary of these data is found in Table 1-5. The data were presented in Appendix A of the QAPP (TtNUS, 2001b).

Based on the validation of the historical data for this medium, another round of supplemental surface and subsurface soil samples was collected in 1997. Twenty-one surface soil and five subsurface soil samples were collected at a subset of the previous sampling locations. All these samples were analyzed for inorganics; seven were analyzed for VOCs, SVOCs, and pesticides. These data are summarized in Table 1-5.

### 1.4.2 Surface Water/Sediment

Surface water and sediment sampling in LSC was also conducted near the ABG as part of the RFI that was prepared by the USACE (Murphy and Wade, 1998a). Eleven locations were selected by the USACE

for two sampling events: three upstream (background) samples, three locations within the SWMU, and five locations situated progressively downstream of the ABG (and ultimately downstream of the OJT area). Based on the U.S. EPA technical memorandum on data validation (U.S. EPA, 1997a), only the explosives data collected for these samples were determined to be acceptable for risk assessments. Three explosives [2,4-dinitrotoluene (2,4-DNT), HMX, and RDX] were detected in the downstream surface water samples. The greatest frequency of surface water detections, as well as the greatest parameter concentrations, occurred in two samples directly downstream of the OJT Area. A summary of the data is presented in Table 1-5. The data were presented in Appendix A of the QAPP (TtNUS, 2001b).

Based on the original review conducted in the historical data, several new sampling locations along LSC were recommended for sampling, specifically to address potential impacts near the OJT area. Two downstream samples near the OJT area and three additional upstream samples were collected in 1995, and analyzed for inorganics, VOCs, SVOCs, explosives and pesticides. The data are summarized in Table 1-5. The data were presented in Appendix A of the QAPP (TtNUS, 2001b).

After the samples were collected in 1995, four additional samples were collected in 1997 to fill data gaps resulting as a consequence of the 1997 U.S. EPA Technical memorandum. All four samples were analyzed for inorganics, three for pesticides, and two for VOCs, and SVOCs. All sediment samples were also analyzed for explosives. Table 1-5 also summarizes these data. The data were presented in Appendix A of the QAPP (TtNUS, 2001b).

### 1.4.3 Springs

As part of the USACE RFI, seven springs were sampled for water-quality parameters between 1987 and 1992. One of these springs (Spring A) was sampled a total of seven times. Springs B, C, and D were sampled a total of five times each during the time period. According to the U.S. EPA (1997), only the explosives analyses from these samples were found to be acceptable for risk assessments.

Between1992 and 1995, Springs A, B, and C were sampled four additional times: twice in 1993, once in 1994, and once in 1995. Only the 1994 data were found to be acceptable for risk assessments. Parameters analyzed in this sampling event included inorganics, explosives, VOCs, SVOCs, and pesticides. Table 1-5 presents a summary of the analytical data. The data were presented in Appendix A of the QAPP (TtNUS, 2001b).

In 1995, additional sampling was conducted to fill data gaps for the CCCRA (TtNUS, 1999). Spring A was selected for sampling for inorganics, VOCs, SVOCs, and explosives. Springs B and C were selected

for sampling for metals, cyanide, semivolatile organics, and explosives. Two off-facility springs (Springs 8 and 10) were selected for sampling for inorganics, explosives, VOCs, SVOCs, pesticides and PCBs. A summary of these data is presented in Table 1-5. The data were presented in Appendix A of the QAPP (TtNUS, 2001b).

### 1.4.4 Ground Water

A total of 98 monitoring wells exist at the ABG. Sampling has been performed on a sporadic basis at 71 of these wells since 1987. The four main aquifers and/or geologic units at ABG are (from the deepest to the shallowest):

- Beaver Bend Limestone
- Big Clifty Sandstone/Beech Creek Limestone
- Golconda-Haney Limestone
- Alluvium

Following is a discussion of the sampling and analyses performed for each aquifer at the ABG.

The Beaver Bend aquifer is the deepest ground water unit that is currently monitored at the ABG. Five wells are screened in this aquifer. Sampling of these wells has occurred over an 8-year period. Based on U.S. EPA's data review (U.S. EPA, 1997a), the only valid historical sampling and analysis data for the Beaver Bend wells are those from 1993 at three wells (03C03, 03C08A, and 03C09). The 03C01 well was sampled again in 1997 as a result of these findings. Data for the acceptable analyses are summarized in Table 1-5.

Quarterly sampling has also been performed at one Beaver Bend well at the ABG as part of the ABG ground water monitoring program. This program began in the fall of 1998. The samples have been analyzed for inorganics, VOCs, and explosives. A summary of these data is also provided in Table 1-5. The data were presented in Appendix A of the QAPP (TtNUS, 2001b).

The majority of the wells at the ABG and the LSC watershed are screened in the Big Clifty/ Beech Creek aquifer. Although sampling and analysis of these wells has occurred frequently since 1987 as part of various investigations, only the data from one event prior to 1995 (23 wells sampled in 1993) were found to be acceptable for risk assessment use (U.S. EPA, 1997a).

Based on the original data review for the CCCRA, 16 wells were sampled to supplement the original data (including 15 wells in the vicinity of the OJT area). Also, based on the data validation findings, five additional wells for the Beech Creek aquifer were resampled in 1997. Data from all acceptable analyses are summarized in Table 1-5. The data were presented in Appendix A of the QAPP (TtNUS, 2001b).

As part of the quarterly monitoring at selected ABG wells, 15 Beech Creek monitoring wells have been monitored quarterly since the fall of 1998. The samples have been analyzed for inorganics, VOCs, and explosives. A summary of these data is also provided in Table 1-5. The data were presented in Appendix A of the QAPP (TtNUS, 2001b).

The G-H Limestone aquifer occurs near the northern, southern, and western edges of the ABG. This unit has been removed by erosional processes in the central portions of ABG and in the valleys of Little Sulphur Creek and Johnson Hollow. Historical (pre-1995) data exist for all the G-H wells at ABG and for the three off-SWMU wells screened in this formation, but none of the pre-1995 data were found to be acceptable for risk assessment use (U.S. EPA, 1997a). As a result of these data validation findings, three wells screened in the G-H aquifer were resampled in 1997. The results are summarized in Table 1-5. The data are presented in Appendix A of the QAPP (TtNUS, 2001b). No G-H aquifer wells at the ABG are currently included in the ABG quarterly monitoring program.

Since 1992, only a few alluvial wells located at the southern end of the watershed have been sampled. The acceptable historical database for these wells (based on the U.S. EPA technical memorandum) includes the single well sample (03B02) obtained in 1993. In 1997, two additional alluvial wells were sampled as a consequence of the U.S. EPA memorandum. Two alluvial wells are currently included in the quarterly monitoring program. The samples have been analyzed for inorganics, VOCs, and explosives. The data for wells screened in alluvium were presented in Appendix A of the QAPP (TtNUS, 2001b).

## 1.5 CONCEPTUALIZED HYDROLOGIC MODEL FOR CONTAMINANT MIGRATION IN THE WATERSHED

Surface water runoff from the ABG and the OJT area enters Little Sulphur Creek. During significant rainfall and snowmelt events, these intermittent flows may be transporting some soil and dissolved materials into the stream. However, the land surface near the waterways in the ABG is now revegetated with grasses and the OJT is heavily overgrown with trees, brush, and grass, because it has not been used for waste treatment activities for nearly two decades. Thus, current overland migration of soils and dissolved materials from the ABG and OJT treatment areas is assumed to be very small.

There are four primary aquifers in the LSC watershed. The Pennsylvanian sandstones are at higher elevations only and are not present at the ABG or OJT areas. The western part of the ABG area lies over the G-H aquifer. Contaminated ground water in the G-H flows eastward until it reaches the area where the Indian Springs Shale is absent. It then moves downward and enters the GC-GC aquifer flow system. Based on several dye tracer studies, there is a significant karst conduit system on the western side of the creek that rapidly conducts ground water from the ABG southward to Springs A and A'. Based on the potentiometric surface map for the BC-BC aquifer (Figure 1-18), ground water within the ABG area is also flowing east-southeastward within the collapse breccia material toward the OJT area. Such a flow pathway could affect ground water quality along the LSC valley near the OJT.

Five VOCs and two energetic compounds were previously detected in monitoring wells located at OJT (Murphy, 1996). The chlorinated VOCs were found at greatest concentrations in well 03-07, located near the southern end of OJT. The VOC plume extends about 220 feet to the northeast, passing through wells 03-15 and 03-24. The concentrations decrease toward the northeast, and the potentiometric surface for this area (see Figures 1-19 and 1-20) indicates that ground water is flowing toward the northeast. A recent dye tracer test using well 03-24 as the injection point has shown that well 03-24 is connected to a karst conduit system that leads southward along the eastern side of the LSC valley to Spring C (see Figure 1-18). Thus, the VOC plume is migrating through this second conduit system located on the eastern side of the creek, is being greatly diluted with other noncontaminated ground water, and then discharges from Spring C into LSC .

RDX and HMX have been detected in approximately one-half the monitoring wells at OJT in the past (Murphy, 1994). The greatest concentrations of explosives were found in well 03-21, located on the eastern side of the creek. However, these compounds were detected on the western side of the creek and south of the OJT area (i.e., wells 03-13, 03-14, and 03-17). It appears that HMX and RDX are moving southward in the collapse breccia material beneath LSC and/or moving back into the western hillside where ground water and contaminants travel southward in the western conduit system to Springs A and A' (Figure 1-18).

The watershed potentiometric map for the BC-BC aquifer (Figure 1-18) shows that the regional flow of ground water is toward the south and inward toward the creek. Springs A, A', B, C, smaller springs and seeps along the LSC banks, and seepage directly up through the creekbed all contribute ground water to the creek downstream of Spring C. This is where the creek first becomes a perennial stream. There is strong evidence that none of the contaminated ground water in the BC-BC aquifer is migrating downward into the Beaver Bend aquifer or is flowing laterally beneath the ridges into another watershed (i.e., cross-

valley flow). All surface water, sediments, and ground water leaving the ABG and OJT areas eventually enter Little Sulphur Creek. All soils, sediment, and dissolved materials that do migrate out of the ABG and OJT areas via surface water, sediment, or ground water also eventually end up in Little Sulphur Creek.

A high percentage of the LSC watershed on NSWC Crane property is wooded and relatively pristine (i.e., not contaminated). The fact that numerous tributaries, springs, and seeps drain the "clean" areas causes rapid dilution of contaminants during transit in the stream water, stream sediments, and ground water within the watershed. Based on previous monitoring of the springs and stream water, the concentrations of contamination in water at the southern end of the watershed are very low, due in part to the amount of dilution that occurs while surface water and ground water are in transit.

The primary purposes of this current investigation are to determine whether

- Current or future human health or ecologic risks are unacceptable in the OJT area and LSC.
- Soils at the OJT are a source of contaminants and still affecting ground water quality in the valley.
- The conceptual model of contaminant distribution and migration pathways presented in this introduction and previous reports is still valid, or the conceptual model needs to be refined.

## TABLE 1-1

## SUMMARY OF PREVIOUS INVESTIGATIONS
## SWMU 03--OLD JEEP TRAIL/LITTLE SULPHUR CREEK
## NSWC CRANE
## CRANE, INDIANA

| Period of Investigation | Area Investigated | Nature of Investigation | Reference |
|---|---|---|---|
| 1981-1984 | ABG and OJT | Installation of monitoring wells, hydrogeological investigations, ground water sampling | Dunbar, 1982, 1983, 1984 |
| 1986-1987 | ABG, OJT, and LSC Watershed | Installation of 66 monitoring wells, hydrogeological investigations, ground water sampling | Hunt, 1988 |
| 1990 | ABG and Springs | Dye tracer test to assess possible hydraulic connection of ABG with various spring locations | Murphy and Ciocco, 1990 |
| 1990 | ABG | RCRA Phase III Part 1 soils study | USACE, 1992 |
| 1990-1994 | Primarily ABG | RCRA Phase III ground water release characterization | Murphy, 1994 |
| 1993 | ABG | Monitored ground water elevations and flow directions in Golconda-Haney Limestone | Duwelius et al., 1995 |
| 1994 | Primarily ABG | Geology, lithologic characteristics, and hydraulic properties of the Big Clifty Sandstone and Beech Creek Limestone | Barnhill and Ambers, 1994 |
| 1994-1995 | ABG | Four pumping tests were performed | Murphy, 1995 |
| 1993-1995 | OJT Area | Hydrogeological investigations and evaluation of ground water contamination | Murphy, 1996 |
| 1994-1996 | DBG Area | Evaluation of sedimentary facies and relation to hydrogeologic properties in Mansfield Formation | Fisher, 1996 |
| 1987-1993 | DBG Area | RCRA Phase III ground water release characterization | Murphy and Wade, 1998 |
| 1992-1996 | ABG and LSC Watershed | RCRA Phase II surface water release assessment | Murphy and Wade, 1998 |
| 1993-1996 | ABG | RCRA Phase III Part 2 soils study | Albertson et al , 1998 |
| 1993-1998 | ABG and LSC Watershed | Ground water geochemical investigation and dye tracer study | Baedke, 1998 |
| 1995-1999 | ABG and LSC Watershed | Screening-level human health and environmental risk assessment was performed based on existing data | TtNUS, 1999 |
| 1998-2002 | ABG and LSC Watershed | Ground water, spring, and surface water monitoring, soils investigations, and phytoremediation studies related to natural attenuation of contaminants | May et al , 2002 |
| 1993-2001 | ABG and LSC Watershed | Geophysical investigation of ABG, dye tracer investigation, and investigation of contaminants in Spring A | Krothe, 2002 |
| 2002 | OJT and Spring C | Dye tracer study of OJT and Spring C | Jock and Krothe, 2002 |
| 2001-2002 | DBG Area | RCRA RFI | TtNUS, 2002 |
| 1998-2002 | ABG and LSC Watershed | Quarterly surface water and ground water monitoring program | quarterly reports |

## TABLE 1-2

## SUMMARY OF AQUIFER TESTING RESULTS
## SWMU 03 -- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
## NSWC CRANE
## CRANE, INDIANA

| Formation | Area | Well No | Test Type | Method of Data Analysis | Hydraulic Conductivity (feet/day) | Source of Data |
|---|---|---|---|---|---|---|
| Mansfield Formation (Pennsylvanian) | DBG | 02-03 (1) | Slug | JSL | 0 0001 | Fisher, 1996 |
| | DBG | 02-03 (2) | Slug | JSL | 0 0238 | Fisher, 1996 |
| | DBG | 02-04 | Slug | JSL | 0.3260 | Fisher, 1996 |
| | DBG | 02-08 | Slug | JSL | 0 0686 | Fisher, 1996 |
| | DBG | 02C10P3 | Slug | JSL | 0 5556 | Fisher, 1996 |
| | DBG | 02C11P3 | Slug | JSL | 0 1488 | Fisher, 1996 |
| | DBG | 02C12P3 | Slug | JSL | 0 1517 | Fisher, 1996 |
| | DBG | 02C14P3 | Slug | JSL | 0 1412 | Fisher, 1996 |
| | DBG | 02C17P2 | Slug | JSL | 0 2027 | Fisher, 1996 |
| | DBG | 02C18P2 | Slug | JSL | 0.1100 | Fisher, 1996 |
| | DBG | 02C20P3 | Slug | JSL | 0 9411 | Fisher, 1996 |
| Golconda-Haney Limestone | ABG | 03PMP08 | SW Pump Test | JSL | 0 2387 | Murphy, 1995 |
| Big Clifty/Beech Creek | ABG | 03PMP20 | SW Pump Test | JSL | 0 0870 | Murphy, 1995 |
| Beech Creek Limestone | ABG | 03PMP03 | SW Pump Test | JSL | 1 7008 | Murphy, 1995 |
| | ABG | 03PMP11 | SW Pump Test | JSL | 0 1879 | Murphy, 1995 |
| | OJT | 03-24 | LF Purge Test | Ogden | 2 53 | This report |
| | OJT | 03-25 | LF Purge Test | Ogden<br>JSL | 0 0658<br>0 0887 | This report<br>This report |
| Collapse Breccia | OJT | 03-07 | LF Purge Test | Ogden<br>JSL | 3 67<br>2 09 | This report<br>This report |
| | OJT | 03-10 | LF Purge Test | Ogden | 0 0582 | This report |
| | OJT | 03-11 | LF Purge Test | Ogden<br>JSL | 0 113<br>0 118 | This report<br>This report |
| | OJT | 03-12 | LF Purge Test | Ogden | 0 0223 | This report |
| | OJT | 03-13 | LF Purge Test | Ogden | 0 122 | This report |
| | OJT | 03-14 | LF Purge Test | Ogden<br>JSL | 0 0775<br>0 068 | This report<br>This report |
| | OJT | 03-16 | LF Purge Test | Ogden | 0 563 | This report |
| | OJT | 03-17 | LF Purge Test | Ogden<br>JSL | 1 06<br>0 689 | This report<br>This report |
| | OJT | 03-18 | LF Purge Test | Ogden<br>JSL | 0 639<br>0 502 | This report<br>This report |
| | OJT | 03-20 | LF Purge Test | Ogden<br>JSL | 1 80<br>0 706 | This report<br>This report |
| | OJT | 03-22 | LF Purge Test | Ogden<br>JSL | 0 156<br>0 123 | This report<br>This report |
| Beech Creek Limestone and Breccia | OJT | 03-15 | LF Purge Test | Ogden | 1 48 | This report |
| | OJT | 03-23 | LF Purge Test | Ogden | 4 08 | This report |

DBG = Dye Burial Grounds
ABG = Ammunition Burning Grounds
OJT= Old Jeep Trail.
JSL = Jacob Straight Line method

TABLE 1-3

PHYSICAL CHARACTERISTICS OF MONITORING WELLS AND WATER LEVEL MEASUREMENTS FOR JUNE 2002
SWMU 03 -- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Monitoring Well Number | Date Installed | Horizontal Location | | Ground Surface Elevation* (feet amsl) | Top of Riser or Measuring Reference Point Elevation* (feet amsl) | Well Screen Interval | | Well Screen Interval | | Monitored Unit | Ground Water Depth & Elevation June 2002 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | North Coord. (feet N/AD 27) | East Coord. (feet N/AD 27) | | | Depth to Top (feet btor) | Depth to Bottom (feet btor) | Elevation* of Top (feet amsl) | Elevation* of Bottom (feet amsl) | | Depth to Water (feet btor) | Ground Water Elevation*(1) (feet amsl) |
| 02-01 | 8/26/1981 | 491384 48 | 596550 97 | 743 47 | 746 17 | 23 52 | 33 12 | 722 65 | 713 05 | Upper Pennsylvanian | 25 76 | 720 41 |
| 02-02 | 9/2/1981 | 491143 00 | 596074 00 | 724 67 | 727 67 | 42 70 | 52 30 | 684 97 | 675 37 | Lower Pennsylvanian | 45 31 | 682 36 |
| 02-03 | 9/3/1981 | 491058 00 | 595916 00 | 719 38 | 722 38 | 54 20 | 63 30 | 668 18 | 659 08 | Hardinsburg | 43 09 | 679 29 |
| 02-04 | 9/4/1981 | 490919 00 | 595915 00 | 716 02 | 719 02 | 38 90 | 48 10 | 680 12 | 670 92 | Lower Pennsylvanian | 37 77 | 681 25 |
| 02-05 | 9/5/1981 | 491491 00 | 596645 00 | 738 28 | 741 28 | 53 20 | 62 70 | 688 08 | 678 58 | Lower Pennsylvanian | 56 43 | 684 85 |
| 02-06 | 9/23/1981 | 491298 24 | 596384 94 | 742 56 | 744 65 | 59 48 | 68 78 | 685 17 | 675 87 | Lower Pennsylvanian | 59 87 | 684 78 |
| 02-07 | 9/24/1981 | 491192 73 | 596232 83 | 735 55 | 738 42 | 53 36 | 61 56 | 685 06 | 676 86 | Lower Pennsylvanian | 54 37 | 684 05 |
| 02-08 | 9/24/1981 | 491092 55 | 596224 65 | 730 06 | 732 20 | 48 88 | 56 14 | 683 32 | 676 06 | Lower Pennsylvanian | 48 52 | 683 68 |
| 02C09 | 1/23/1987 | 491331 00 | 597056 00 | 737 86 | 740 36 | 169 50 | 179 50 | 570 86 | 560 86 | Beech Creek | 170 26 | 570 10 |
| 02C09P2 | 1/26/1987 | 491331 00 | 597056 00 | 738 16 | 740 66 | 94 50 | 99 50 | 646 16 | 641 16 | Golconda | N/A | N/A |
| 02C10 | 2/13/1988 | 491789 00 | 596142 00 | 713 97 | 716 47 | 144 50 | 154 50 | 571 97 | 561 97 | Beech Creek | 146 56 | 569 91 |
| 02C10P2 | 2/16/1988 | 491789 00 | 596147 00 | 713 89 | 716 39 | 64 00 | 74 00 | 652 39 | 642 39 | Golconda | 40 46 | 675 93 |
| 02C10P3 | 2/22/1988 | 491784 00 | 596142 00 | 713 86 | 716 36 | 34 20 | 39 20 | 682 16 | 677 16 | Lower Pennsylvanian | 28 77 | 687 59 |
| 02C11 | 2/29/1988 | 490987 00 | 595829 00 | 712 81 | 715 31 | 150 50 | 160 50 | 564 81 | 554 81 | Beech Creek | 149 13 | 566 18 |
| 02C11P2 | 3/2/1988 | 490987 00 | 595823 00 | 712 86 | 715 36 | 72 30 | 82 30 | 643 06 | 633 06 | Golconda | 73 55 | 641 81 |
| 02C11P3 | 3/5/1988 | 490987 00 | 595817 00 | 713 16 | 715 66 | 38 80 | 43 80 | 676 86 | 671 86 | Lower Pennsylvanian | 34 65 | 681 01 |
| 02C12 | 3/14/1988 | 491496 00 | 596670 00 | 739 07 | 741 57 | 174 10 | 184 10 | 567 47 | 557 47 | Beech Creek | 171 22 | 570 35 |
| 02C12P2 | 3/21/1988 | 491496 00 | 596681 00 | 739 32 | 741 82 | 95 70 | 105 70 | 646 12 | 636 12 | Golconda | 89 22 | 652 60 |
| 02C12P3 | 3/18/1988 | 491496 00 | 596676 00 | 739 33 | 741 83 | 31 50 | 36 50 | 710 33 | 705 33 | Upper Pennsylvanian | 23 31 | 718 52 |
| 02C13 | 3/28/1988 | 491692 00 | 596436 00 | 722 61 | 725 11 | 71 80 | 81 80 | 653 31 | 643 31 | Golconda | 61 82 | 663 29 |
| 02C13P2 | 3/29/1988 | 491695 00 | 596439 00 | 722 28 | 724 78 | 36 50 | 46 50 | 688 28 | 678 28 | Lower Pennsylvanian | 39 82 | 684 96 |
| 02C13P3 | 3/30/1988 | 491698 00 | 596434 00 | 723 01 | 725 51 | 17 50 | 22 50 | 708 01 | 703 01 | Upper Pennsylvanian | 10 23 | 715 28 |
| 02C14 | 4/13/1988 | 490671 00 | 595964 00 | 713 90 | 716 40 | 156 40 | 166 40 | 560 00 | 550 00 | Beech Creek | 149 10 | 567 30 |
| 02C14P2 | 4/15/1988 | 490675 00 | 595964 00 | 713 93 | 716 43 | 76 90 | 86 90 | 639 53 | 629 53 | Golconda | 63 60 | 652 83 |
| 02C14P3 | 4/19/1988 | 490665 00 | 595964 00 | 713 76 | 716 26 | 39 60 | 49 60 | 676 66 | 666 66 | Lower Pennsylvanian | 36 58 | 679 68 |
| 02C15 | 5/10/1988 | 491186 00 | 595880 00 | 713 38 | 715 88 | 68 80 | 78 80 | 647 08 | 637 08 | Golconda | 69 88 | 646 00 |
| 02C15P2 | 5/11/1988 | 491181 00 | 595880 00 | 713 27 | 715 77 | 31 70 | 41 70 | 684 07 | 674 07 | Lower Pennsylvanian | 33 02 | 682 75 |
| 02C16 | 5/16/1988 | 490893 00 | 596177 00 | 722 86 | 725 36 | 81 10 | 91 10 | 644 26 | 634 26 | Golconda | 84 90 | (640 46) |
| 02C16P2 | 5/17/1988 | 490899 00 | 596177 00 | 722 68 | 725 18 | 46 00 | 56 00 | 679 18 | 669 18 | Lower Pennsylvanian | 42 67 | 682 51 |
| 02C17 | 5/23/1988 | 491022 00 | 596473 00 | 730 46 | 732 96 | 88 60 | 98 50 | 644 36 | 634 46 | Golconda | 84 53 | 648 43 |
| 02C17P2 | 5/26/1988 | 491027 00 | 596473 00 | 730 34 | 732 84 | 52 20 | 62 20 | 680 64 | 670 64 | Lower Pennsylvanian | 48 53 | 684 31 |
| 02C17P3 | 5/27/1988 | 491022 00 | 596473 00 | 730 34 | 733 38 | 23 10 | 28 10 | 710 28 | 705 28 | Upper Pennsylvanian | Dry | Dry |
| 02C18 | 6/6/1988 | 491103 00 | 596611 00 | 734 81 | 737 31 | 90 80 | 100 80 | 646 51 | 636 51 | Golconda | 88 73 | 648 58 |
| 02C18P2 | 6/7/1988 | 491107 00 | 596614 00 | 734 74 | 737 24 | 54 90 | 64 90 | 682 34 | 672 34 | Lower Pennsylvanian | 52 53 | 684 71 |
| 02C18P3 | 6/7/1988 | 491107 00 | 596614 00 | 734 74 | 737 45 | 15 50 | 20 50 | 721 95 | 716 95 | Upper Pennsylvanian | 20 98 | 716 47 |
| 02C19 | 6/14/1988 | 491338 00 | 596225 00 | 730 85 | 733 35 | 82 70 | 92 70 | 650 65 | 640 65 | Golconda | 87 10 | 646 25 |
| 02C19P2 | 6/15/1988 | 491332 00 | 596225 00 | 730 78 | 733 28 | 48 10 | 58 10 | 685 18 | 675 18 | Lower Pennsylvanian | 48 62 | 684 66 |
| 02C19P3 | 6/16/1988 | 491338 00 | 596225 00 | 730 78 | 733 63 | 13 20 | 18 20 | 720 43 | 715 43 | Upper Pennsylvanian | Dry | Dry |
| 02C20 | 6/29/1988 | 492114 00 | 596769 00 | 712 56 | 715 06 | 134 71 | 144 70 | 580 35 | 570 36 | Beech Creek | 137 47 | 577 59 |
| 02C20P2 | 6/22/1988 | 492120 00 | 596763 00 | 712 42 | 714 92 | 58 50 | 68 50 | 656 42 | 646 42 | Golconda | 57 69 | 657 23 |

TABLE 1-3

PHYSICAL CHARACTERISTICS OF MONITORING WELLS AND WATER LEVEL MEASUREMENTS FOR JUNE 2002
SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Monitoring Well Number | Date Installed | Horizontal Location | | Ground Surface Elevation* (feet amsl) | Top of Riser or Measuring Reference Point Elevation* (feet amsl) | Well Screen Interval | | Well Screen Interval | | Monitored Unit | Ground Water Depth & Elevation June 2002 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | North Coord. (feet N/AD 27) | East Coord. (feet N/AD 27) | | | Depth to Top (feet btor) | Depth to Bottom (feet btor) | Elevation* of Top (feet amsl) | Elevation* of Bottom (feet amsl) | | Depth to Water (feet btor) | Ground Water Elevation*(1) (feet amsl) |
| 02C20P3 | 6/23/1988 | 492120 00 | 596769 00 | 712 27 | 714 78 | 30 50 | 40 50 | 684 28 | 674 28 | Lower Pennsylvanian | 17 30 | 697 48 |
| 02C21 | 9/12/1990 | 491004 00 | 597187 00 | 726 48 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 02C22 | 10/15/1990 | 490129 00 | 597610 00 | 740 13 | 742 99 | 179 20 | 189 20 | 563 79 | 553 79 | Beech Creek | Dry | Dry |
| 02C22P2 | 10/17/1990 | 490124 00 | 597613 00 | 740 13 | 742 63 | 102 50 | 107 50 | 640 13 | 635 13 | Golconda | Dry | Dry |
| 02C22P3 | 10/18/1990 | 490119 00 | 597617 00 | 740 00 | 742 50 | 61 10 | 71 10 | 681 40 | 671 40 | Lower Pennsylvanian | 58 33 | 684 17 |
| 03C01 | 12/12/1986 | 490064 00 | 593140 00 | 624 58 | 627 28 | 176 70 | 186 70 | 450 58 | 440 58 | Beaver Bend | 114 86 | 512 42 |
| 03C01P2 | 9/22/1986 | 490068 00 | 593146 00 | 624 35 | 626 85 | 94 50 | 104 50 | 532 35 | 522 35 | Beech Creek | 69 90 | 556 95 |
| 03C01P3 | 04/--/86 | 490061 00 | 593147 00 | 624 00 | 626 50 | 22 10 | 27 10 | 604 40 | 599 40 | Golconda | 14 15 | 612 35 |
| 03C02 | 10/24/1986 | 489931 00 | 594793 00 | 580 99 | 583 49 | 122 00 | 132 00 | 461 49 | 451 49 | Beaver Bend | 71 28 | 512 21 |
| 03C02P2 | 10/29/1986 | 489931 82 | 594798 08 | 580 65 | 583 15 | 40 50 | 50 50 | 542 65 | 532 65 | Beech Creek | 37 54 | 545 61 |
| 03C03 | 9/13/1986 | 490202 94 | 594055 53 | 597 58 | 600 08 | 141 50 | 151 50 | 458 58 | 448 58 | Beaver Bend | 87 50 | 512 58 |
| 03C03P2 | 10/23/1986 | 490208 00 | 594056 00 | 597 70 | 600 20 | 58 30 | 68 30 | 541 90 | 531 90 | Beech Creek | 41 55 | 558 65 |
| 03C04 | 11/25/1986 | 490260 55 | 594783 22 | 621 92 | 624 42 | 76 00 | 86 00 | 548 42 | 538 42 | Beech Creek | 76 95 | 547 47 |
| 03C05 | 10/29/1986 | 489782 00 | 595114 00 | 578 86 | 581 36 | 34 50 | 44 50 | 546 86 | 536 86 | Beech Creek | 34 75 | 546 61 |
| 03C06 | 10/16/1986 | 489581 00 | 594596 00 | 622 90 | 625 40 | 89 50 | 99 50 | 535 90 | 525 90 | Beech Creek | 76 76 | 548 64 |
| 03C07 | 10/21/1986 | 490422 52 | 594370 95 | 633 97 | 636 47 | 91 20 | 101 20 | 545 27 | 535 27 | Beech Creek | 78 61 | 557 86 |
| 03C08AP2 | 11/26/1986 | 489701 00 | 594014 00 | 626 84 | 629 34 | 92 50 | 102 50 | 536 84 | 526 84 | Beech Creek | 74 48 | 554 86 |
| 03C08A | 4/3/1987 | 489680 00 | 594051 00 | 628 00 | 630 50 | 173 50 | 183 50 | 457 00 | 447 00 | Beaver Bend | 118 47 | 512 03 |
| 03C08AP3 | 4/5/1987 | 489685 00 | 594047 00 | 627 93 | 630 43 | 17 00 | 22 00 | 613 43 | 608 43 | Golconda | 16 48 | 613 95 |
| 03C09 | 12/5/1986 | 490615 00 | 593777 00 | 600 89 | 603 39 | 147 50 | 157 50 | 455 89 | 445 89 | Beaver Bend | 91 05 | 512 34 |
| 03C09P2 | 12/7/1986 | 490619 57 | 593775 83 | 601 06 | 603 56 | 64 50 | 74 50 | 539 06 | 529 06 | Beech Creek | 45 17 | 558 39 |
| 03C10 | 1/22/1987 | 490242 71 | 593656 93 | 605 53 | 608 03 | 68 50 | 78 50 | 539 53 | 529 53 | Beech Creek | 49 85 | 558 18 |
| 03C11 | 1/28/1987 | 490024 65 | 594440 55 | 589 86 | 592 36 | 50 00 | 60 00 | 542 36 | 532 36 | Beech Creek | 43 75 | 548 61 |
| 03C12 | 2/3/1987 | 489957 37 | 594574 22 | 584 70 | 587 20 | 41 50 | 51 50 | 545 70 | 535 70 | Beech Creek | 41 85 | 545 35 |
| 03C13 | 2/9/1987 | 490901 00 | 593860 00 | 615 25 | 617 75 | 72 70 | 82 70 | 545 05 | 535 05 | Beech Creek | 59 46 | 558 29 |
| 03C14 | 2/20/1987 | 489932 00 | 593575 00 | 640 29 | 642 79 | 107 00 | 117 00 | 535 79 | 525 79 | Beech Creek | 84 92 | 557 87 |
| 03C15 | 2/26/1987 | 489849 54 | 593146 29 | 618 51 | 621 34 | 91 33 | 101 33 | 530 01 | 520 01 | Beech Creek | 64 37 | 556 97 |
| 03C15P3 | 4/--/87 | 489855 00 | 593143 00 | 618 61 | 621 11 | 18 10 | 23 10 | 603 01 | 598 01 | Golconda | 6 20 | 614 91 |
| 03C16 | 3/12/1987 | 490478 00 | 593362 00 | 680 75 | 683 25 | 148 50 | 158 50 | 534 75 | 524 75 | Beech Creek | 125 17 | 558 08 |
| 03C17 | 3/19/1987 | 492763 63 | 594371 09 | 693 65 | 696 15 | 141 00 | 151 00 | 555 15 | 545 15 | Beech Creek | 137 97 | 558 18 |
| 03C18 | 4/--/87 | 489992 00 | 592967 00 | 622 59 | 625 09 | 18 00 | 23 00 | 607 09 | 602 09 | Golconda | 4 49 | 620 60 |
| 03C19 | 5/8/1987 | 491442 00 | 593351 00 | 648 00 | 650 50 | 113 30 | 123 30 | 537 20 | 527 20 | Beech Creek | 92 13 | 558 37 |
| 03C19P3 | 5/13/1987 | 491431 00 | 593354 00 | 647 20 | 649 70 | 39 50 | 44 50 | 610 20 | 605 20 | Golconda | 32 74 | 616 96 |
| 03C20 | 5/24/1987 | 489880 21 | 593773 34 | 644 12 | 646 62 | 110 50 | 120 50 | 536 12 | 526 12 | Beech Creek | 89 29 | 557 33 |
| 03C21 | 5/28/1987 | 489925 00 | 593356 00 | 639 72 | 642 22 | 110 90 | 120 90 | 531 32 | 521 32 | Beech Creek | 84 96 | 557 26 |
| 03C21P2 | 5/29/1987 | 489925 00 | 593361 00 | 639 72 | 642 22 | 36 10 | 41 10 | 606 12 | 601 12 | Golconda | 34 08 | 608 14 |
| 03C22 | 6/4/1987 | 490090 00 | 593319 00 | 615 08 | 617 58 | 12 50 | 17 50 | 605 08 | 600 08 | Golconda | 9 66 | 607 92 |
| 03C23 | 6/9/1987 | 490259 00 | 593462 00 | 616 11 | 618 61 | 11 00 | 16 00 | 607 61 | 602 61 | Golconda | 5 70 | 612 91 |
| 03C24 | 6/16/1987 | 485159 00 | 592615 00 | 550 64 | 553 24 | 24 60 | 29 60 | 528 64 | 523 64 | Beech Creek | 21 50 | 531 74 |
| 03C25 | 6/18/1987 | 487148 51 | 592610 07 | 594 53 | 597 03 | 62 20 | 72 20 | 534 83 | 524 83 | Beech Creek | 46 68 | 550 35 |

TABLE 1-3

PHYSICAL CHARACTERISTICS OF MONITORING WELLS AND WATER LEVEL MEASUREMENTS FOR JUNE 2002
SWMU 03 -- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Monitoring Well Number | Date Installed | Horizontal Location | | Ground Surface Elevation* (feet amsl) | Top of Riser or Measuring Reference Point Elevation* (feet amsl) | Well Screen Interval | | Well Screen Interval | | Monitored Unit | Ground Water Depth & Elevation June 2002 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | North Coord (feet N/AD 27) | East Coord. (feet N/AD 27) | | | Depth to Top (feet btor) | Depth to Bottom (feet btor) | Elevation* of Top (feet amsl) | Elevation* of Bottom (feet amsl) | | Depth to Water (feet btor) | Ground Water Elevation*(1) (feet amsl) |
| 03C26 | 8/3/1987 | 490695 18 | 594134 16 | 638 07 | 640 57 | 96 50 | 106 50 | 544 07 | 534 07 | Beech Creek | 82 44 | 558 13 |
| 03C27 | 8/14/1987 | 489658 33 | 594767 37 | 601 34 | 603 84 | 63 00 | 73 00 | 540 84 | 530 84 | Beech Creek | 60 78 | 543 06 |
| 03C28 | 8/22/1987 | 489884 00 | 595269 00 | 610 76 | 612 96 | 67 20 | 77 20 | 545 76 | 535 76 | Beech Creek | 67 41 | 545 55 |
| 03C29 | 9/1/1987 | 488529 00 | 591095 00 | 794 67 | 797 37 | 270 20 | 280 20 | 527 17 | 517 17 | Beech Creek | 242 40 | 554 97 |
| 03C30 | 9/17/1987 | 488967 44 | 592402 75 | 776 41 | 778 91 | 253 00 | 263 00 | 525 91 | 515 91 | Beech Creek | 223 23 | 555 68 |
| 03C31 | 11/1/1987 | 488492 00 | 593743 00 | 789 70 | 792 10 | 257 40 | 267 40 | 534 70 | 524 70 | Beech Creek | 238 06 | 554 04 |
| 03C32 | 11/14/1987 | 491056 00 | 594471 00 | 709 06 | 711 56 | 166 50 | 176 50 | 545 06 | 535 06 | Beech Creek | 153 65 | 557 91 |
| 03C33 | 11/31/87 | 486651 00 | 594224 00 | 782 53 | 785 03 | 241 00 | 251 00 | 544 03 | 534 03 | Beech Creek | 234 48 | 550 55 |
| 03C34 | 8/11/1989 | 487870 00 | 599301 00 | 724 57 | 727 07 | 180 00 | 190 00 | 547 07 | 537 07 | Beech Creek | 178 56 | 548 51 |
| 03C35 | 8/19/1989 | 485347 00 | 598082 00 | 695 50 | 697 00 | 166 00 | 176 00 | 531 00 | 521 00 | Beech Creek | 174 85 | 522 15 |
| 03C36 | 9/6/1989 | 485203 00 | 599202 00 | 715 74 | 718 24 | 171 50 | 181 50 | 546 74 | 536 74 | Beech Creek | Dry | Dry |
| 03C37 | 9/21/1989 | 483933 00 | 596471 00 | 617 78 | 620 28 | 107 00 | 117 00 | 513 28 | 503 28 | Beech Creek | 108 47 | 511 81 |
| 03C38 | 9/29/1989 | 485309 00 | 595951 00 | 570 47 | 572 97 | 45 50 | 55 50 | 527 47 | 517 47 | Beech Creek | 55 15 | 517 82 |
| 03B01 | 6/19/1987 | 482590 00 | 595584 00 | 501 97 | 504 47 | 10 00 | 15 00 | 494 47 | 489 47 | Alluvium | 6 96 | 497 51 |
| 03B02 | 6/27/1987 | 482573 03 | 595505 44 | 501 46 | 503 96 | 12 10 | 17 10 | 491 86 | 486 86 | Alluvium | 6 10 | 497 86 |
| 03B03 | 6/29/1987 | 482578 00 | 595406 00 | 502 46 | 504 96 | 11 00 | 16 00 | 493 96 | 488 96 | Alluvium | 5 74 | 499 22 |
| 03B04 | 6/30/1987 | 482630 95 | 595292 56 | 503 97 | 506 47 | 12 00 | 17 00 | 494 47 | 489 47 | Alluvium | 6 92 | 499 55 |
| 03B05 | 7/1/1987 | 482623 00 | 595192 00 | 504 55 | 507 05 | 11 50 | 16 50 | 495 55 | 490 55 | Alluvium | 7 05 | 500 00 |
| 03B06 | 7/2/1987 | 482666 00 | 594960 00 | 506 76 | 509 26 | 10 50 | 15 50 | 498 76 | 493 76 | Alluvium | 7 75 | 501 51 |
| 03B07 | 8/4/1987 | 482672 00 | 594768 00 | 508 22 | 510 72 | 6 50 | 11 50 | 504 22 | 499 22 | Alluvium | 6 60 | 504 12 |
| 03B08 | 8/5/1987 | 482667 00 | 594594 00 | 510 90 | 513 40 | 8 50 | 13 50 | 504 90 | 499 90 | Alluvium | 8 45 | 504 95 |
| 03B09 | 8/7/1987 | 482657 00 | 594417 00 | 513 54 | 516 04 | 8 00 | 13 00 | 508 04 | 503 04 | Alluvium | 9 82 | 506 22 |
| 03B10 | 10/22/1987 | 482607 00 | 594209 00 | 559 46 | 561 96 | 51 00 | 61 00 | 510 96 | 500 96 | Beech Creek | 50 60 | 511 36 |
| 03-01 | 9/4/1981 | 490748 00 | 593688 00 | 601 67 | 604 67 | 44 60 | 53 80 | 560 07 | 550 87 | Big Clifty and Beech Creek | 45 78 | 558 89 |
| 03-02 | 9/7/1981 | 489940 00 | 593060 00 | 619 67 | 622 67 | 6 50 | 13 00 | 616 17 | 609 67 | Mansfield | N/A | N/A |
| 03-03 | 9/8/1981 | 489838 00 | 594843 00 | 581 29 | 584 29 | 88 90 | 98 00 | 495 39 | 486 29 | Sample Shale | N/A | N/A |
| 03-04 | 9/24/1981 | 489791 00 | 594610 00 | 591 17 | 594 17 | 58 10 | 67 50 | 536 07 | 526 67 | Beech Creek | N/A | N/A |
| 03-05 | 9/29/1981 | N/A | N/A | 592 75 | 595 75 | 48 40 | 57 70 | 547 35 | 538 05 | Beech Creek | N/A | N/A |
| 03-06 | 10/6/1981 | 489796 00 | 594636 00 | 586 71 | 589 71 | 40 30 | 49 60 | 549 41 | 540 11 | Beech Creek | N/A | N/A |
| 03-07 | 10/8/1981 | 487837 91 | 596315 43 | 553 46 | 556 48 | 15 42 | 24 72 | 541 06 | 531 76 | Alluvium and Beech Creek (breccia zone) | 11 93 | 544 55 |
| 03-08 | 10/9/1981 | N/A | N/A | 583 76 | 586 76 | 35 40 | 44 80 | 551 36 | 541 96 | Beech Creek | N/A | N/A |
| 03-09 | 10/28/1981 | 489909 00 | 593047 00 | 621 72 | 624 72 | 68 90 | 78 10 | 555 82 | 546 62 | Big Clifty | 67 80 | 556 92 |
| 03-10 | 11/3/1982 | 487821 20 | 596515 84 | 554 94 | 557 99 | 15 25 | 24 55 | 542 74 | 533 44 | Beech Creek (breccia zone) | 16 60 | 541 39 |
| 03-11 | 11/4/1982 | 487708 67 | 596434 59 | 550 05 | 553 41 | 9 06 | 18 46 | 544 35 | 534 95 | Beech Creek (breccia zone) | 9 77 | 543 64 |
| 03-12 | 11/4/1982 | 487765 38 | 596231 91 | 554 99 | 558 24 | 15 45 | 24 85 | 542 79 | 533 39 | Beech Creek (breccia zone) | 16 55 | 541 69 |
| 03-13 | 11/5/1982 | 487633 96 | 596376 32 | 549 24 | 552 26 | 15 02 | 24 42 | 537 24 | 527 84 | Beech Creek (breccia zone) | 12 95 | 539 31 |
| 03-14 | 11/6/1982 | 487672 86 | 596420 54 | 549 37 | 552 41 | 8 24 | 17 74 | 544 17 | 534 67 | Beech Creek (breccia zone) | 11 57 | 540 84 |
| 03-15 | 11/22/1982 | 487874 92 | 596346 66 | 556 09 | 559 31 | 18 92 | 28 32 | 540 39 | 530 99 | Breccia zone and Beech Creek+K158 | 17 98 | 541 33 |

TABLE 1-3

PHYSICAL CHARACTERISTICS OF MONITORING WELLS AND WATER LEVEL MEASUREMENTS FOR JUNE 2002
SWMU 03 -- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Monitoring Well Number | Date Installed | Horizontal Location | | Ground Surface Elevation* (feet amsl) | Top of Riser or Measuring Reference Point Elevation* (feet amsl) | Well Screen Interval | | Well Screen Interval | | Monitored Unit | Ground Water Depth & Elevation June 2002 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | North Coord (feet N/AD 27) | East Coord. (feet N/AD 27) | | | Depth to Top (feet btor) | Depth to Bottom (feet btor) | Elevation* of Top (feet amsl) | Elevation* of Bottom (feet amsl) | | Depth to Water (feet btor) | Ground Water Elevation*(1) (feet amsl) |
| 03-16 | 11/23/1982 | 488566 76 | 595786 62 | 568 61 | 571 70 | 26 29 | 35 69 | 545 41 | 536 01 | Beech Creek (breccia zone) | 29 14 | 542 56 |
| 03-17 | 11/24/1982 | 487650 31 | 596264 68 | 550 44 | 553 47 | 15 33 | 24 73 | 538 14 | 528 74 | Beech Creek (breccia zone) | 16 18 | 537 29 |
| 03-18 | 1/14/1983 | 487508 18 | 596288 23 | 549 80 | 553 12 | 17 92 | 27 22 | 535 20 | 525 90 | Beech Creek (breccia zone) | 17 71 | 535 41 |
| 03-19 | 1/15/1983 | N/A | N/A | 556 37 | 559 37 | 23 10 | 32 50 | 536 27 | 526 87 | Beech Creek (breccia zone) | N/A | N/A |
| 03-20 | 1/17/1983 | 487674 48 | 596119 27 | 551 83 | 554 76 | 17 33 | 26 63 | 537 43 | 528 13 | Beech Creek (breccia zone) | 18 28 | 536 48 |
| 03-21 | 1/27/1983 | 488039 00 | 596246 09 | 557 12 | 560 11 | 15 79 | 25 09 | 544 32 | 535 02 | Beech Creek | 18 92 | 541 19 |
| 03-22 | 1/27/1983 | 487791 08 | 596369 15 | 555 72 | 558 68 | 17 46 | 26 86 | 541 22 | 531 82 | Beech Creek (breccia zone) | 16 58 | 542 10 |
| 03-23 | 1/28/1983 | 487958 48 | 596055 94 | 559 34 | 562 49 | 18 05 | 26 45 | 544 44 | 536 04 | Breccia zone and Beech Creek | 18 10 | 544 39 |
| 03-24 | 2/6/1983 | 488012 65 | 596461 97 | 586 04 | 589 28 | 45 24 | 54 64 | 544 04 | 534 64 | Beech Creek | 49 34 | 539 94 |
| 03-25 | 2/7/1983 | 487901 68 | 596498 01 | 570 64 | 573 97 | 27 53 | 36 83 | 546 44 | 537 14 | Beech Creek | 32 80 | 541 17 |
| 03-26 | 10/1/1983 | N/A | N/A | 592 89 | 595 89 | 38 90 | 48 00 | 556 99 | 547 89 | Big Clifty | N/A | N/A |
| 03-27 | 10/3/1983 | 489964 00 | 593967 00 | 596 08 | 599 08 | 21 50 | 30 60 | 577 58 | 568 48 | Big Clifty | N/A | N/A |
| 03-28 | 10/6/1983 | 489705 00 | 594006 00 | 624 49 | 627 49 | 15 50 | 24 60 | 611 99 | 602 89 | Hardinsburg/Gol | 11 16 | 616 33 |
| 03-29 | 10/8/1983 | 489992 00 | 593981 00 | 595 61 | 598 61 | 39 60 | 48 60 | 559 01 | 550 01 | Big Clifty | N/A | N/A |
| 03-30 | 10/4/1985 | 490818 00 | 593630 00 | N/A | 608 60 | N/A | N/A | N/A | N/A | Big Clifty | 50 15 | 558 45 |
| 03-31 | 10/10/1985 | 489788 00 | 594804 00 | N/A | 582 84 | N/A | N/A | N/A | N/A | Big Clifty | 37 73 | 545 11 |
| 03-32 | 10/11/1985 | 489857 00 | 594822 00 | N/A | 583 54 | N/A | N/A | N/A | N/A | Big Clifty | N/A | N/A |
| 03-33 | 10/13/1985 | 489923 00 | 594836 00 | N/A | 583 39 | N/A | N/A | N/A | N/A | Big Clifty | 36 67 | 546 72 |
| 03-34 | 10/21/1985 | 489844 00 | 594662 00 | N/A | 585 06 | N/A | N/A | N/A | N/A | Big Clifty | N/A | N/A |
| 03-35 | 10/23/1985 | 489830 00 | 594561 00 | N/A | 586 60 | N/A | N/A | N/A | N/A | Beech Creek | N/A | N/A |
| 03-36 | 10/25/1985 | 489691 00 | 594603 00 | N/A | 617 54 | N/A | N/A | N/A | N/A | Beech Creek | N/A | N/A |
| 03-37 | 10/27/1985 | 489890 00 | 594618 00 | N/A | 586 52 | N/A | N/A | N/A | N/A | Beech Creek | N/A | N/A |
| 03-38 | 11/2/1985 | 490676 00 | 593744 00 | N/A | 604 79 | N/A | N/A | N/A | N/A | Big Clifty | 46 25 | 558 54 |
| 03-39 | 11/2/1985 | 490700 00 | 593792 00 | N/A | 603 25 | N/A | N/A | N/A | N/A | Big Clifty | 44 36 | 558 89 |
| 03SG01 | 6/9/2001 | 490124 27 | 594313 10 | N/A | 587 20 | N/A | N/A | N/A | N/A | N/A | 2 80 | 584 40 |
| 03SG02 | 6/9/2001 | 488570 67 | 595726 88 | 555 50 | 561 84 | N/A | N/A | N/A | N/A | N/A | Dry | Dry |
| 03SG03 | 6/9/2001 | 487330 50 | 596436 67 | 541 07 | 547 42 | N/A | N/A | N/A | N/A | N/A | Dry | Dry |
| 03SG04 | 6/9/2001 | 485646 58 | 596328 42 | 525 94 | 533 32 | N/A | N/A | N/A | N/A | N/A | Dry | Dry |
| 03SG05 | 6/9/2001 | 484740 20 | 596109 74 | N/A | 525 05 | N/A | N/A | N/A | N/A | N/A | 6 93 | 518 12 |
| 03SG06 | 6/9/2001 | 483694 26 | 595518 08 | N/A | 513 57 | N/A | N/A | N/A | N/A | N/A | 6 30 | 507 27 |
| 03SG07 | 6/9/2001 | 482632 16 | 595545 26 | N/A | 499 95 | N/A | N/A | N/A | N/A | N/A | 1 04 | 498 91 |

amsl = Above mean sea level
N/A = Not available or not applicable
btor = Below top of riser
1 = Ground water elevation estimated due to well riser damage
* All elevations are based on National Geodetic Vertical Datum of 1929 (NGVD 29)

TABLE 1-4

GROUND WATER ELEVATIONS MEASURED IN 1994 AND 2001 IN MONITORING WELLS LOCATED IN THE OLD JEEP TRAIL AREA
SWMU 03 -- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

| Monitoring Well Number | Ground Water Depth & Elevation September 1994 | | Ground Water Depth & Elevation June 2001 | | Ground Water Depth & Elevation September 2001 | |
|---|---|---|---|---|---|---|
| | Depth to Water (feet btor) | Ground Water Elevation (feet amsl) | Depth to Water (feet btor) | Ground Water Elevation (feet amsl) | Depth to Water (feet bor) | Ground Water Elevation (feet amsl) |
| 03-07 | 13.36 | 542 72 | 11.62 | 544 46 | 15 02 | 541.06 |
| 03-10 | 17.00 | 540 59 | 16.63 | 540 96 | 17.00 | 540.59 |
| 03-11 | 11.80 | 541.21 | 9.81 | 543.20 | 13 04 | 539.97 |
| 03-12 | 17 45 | 540.39 | 16 85 | 540 99 | 17.53 | 540.31 |
| 03-13 | 13.46 | 538.40 | 13.01 | 538.85 | 13.53 | 538 33 |
| 03-14 | 12 42 | 539.59 | 11.58 | 540.43 | 13.58 | 538 43 |
| 03-15 | 18 46 | 540.45 | 17 98 | 540.93 | 18.46 | 540 45 |
| 03-16 | 29.67 | 541 63 | 29.29 | 542.01 | 29.47 | 541.83 |
| 03-17 | 16 45 | 536.62 | 16.22 | 536.85 | 16.98 | 536 09 |
| 03-18 | 17.98 | 534 74 | 17.73 | 534.99 | 18.15 | 534 57 |
| 03-19 | NF | NF | NF | NF | NF | NF |
| 03-20 | 19.20 | 535 56 | 18.00 | 536 76 | 19.00 | 535.76 |
| 03-21 | 19.08 | 540.63 | 18.90 | 540.81 | 19 14 | 540.57 |
| 03-22 | 17 61 | 540 67 | 16.58 | 541.70 | 17.41 | 540.87 |
| 03-23 | 18.30 | 543 79 | 17.50 | 544.59 | 19.47 | 542 62 |
| 03-24 | 49.32 | 539.56 | 49.35 | 539.53 | 49 36 | 539.52 |
| 03-25 | 33.06 | 540 51 | 33 00 | 540.57 | 33.04 | 540.53 |

NF = Not found, presumed to be destroyed
amsl = Above mean sea level.
btor = Below top of riser.
Survey coordinates for all wells except 03-19 were taken from the TTNUS survey performed in 2001.
Vertical elevations are based on National Geodetic Vertical Datum of 1929 (NGVD 29).

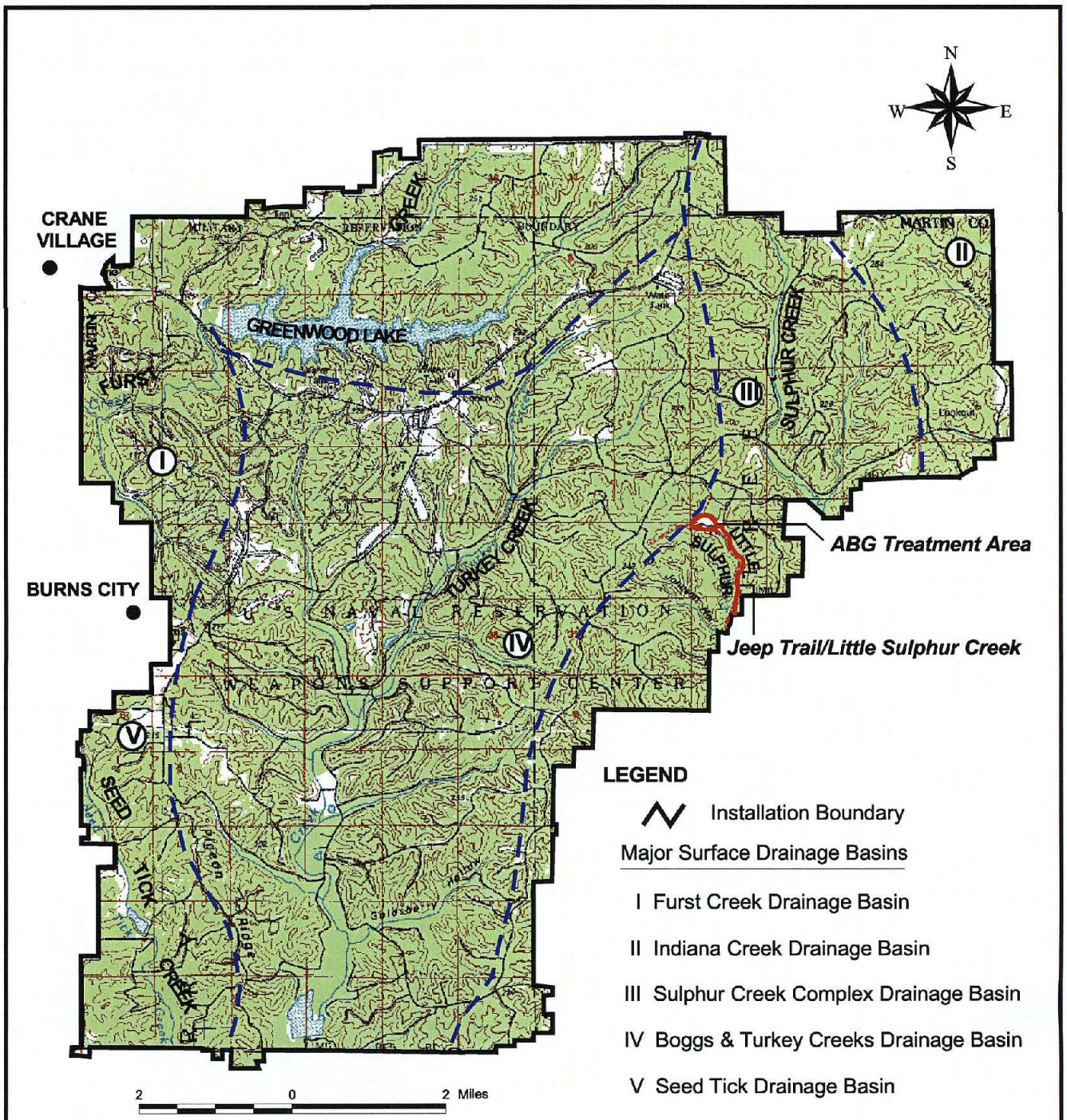
**TABLE 1-5**

**SUMMARY OF HISTORICAL CHEMICAL DATA**
**SWMU 03 -- OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

| Media | Area | Year of Sampling | Primary Organic Contaminants | Maximum Concentration Detected | Units | Source of Data |
|---|---|---|---|---|---|---|
| Soil | OJT | 1995 | 2,4-dinitrotoluene | 76 | mg/kg | TtNUS, 2001b |
| | | | 2,6-dinitrotoluene | 4.0 | mg/kg | |
| | | | HMX | 2.31 | mg/kg | |
| | | | RDX | 2.07 | mg/kg | |
| | ABG | 1990-1993 | 2,4,6-trinitrotoluene | 2,030 | mg/kg | |
| | | | 2,4-dinitrotoluene | 11.6 | mg/kg | |
| | | | 2,6-dinitrotoluene | 0.575 | mg/kg | |
| | | | 2-amino-4,6-dinitrotoluene | 5 65 | mg/kg | |
| | | | 4-amino-2,6-dinitrotoluene | 8.2 | mg/kg | |
| | | | 1,3,5-trinitrobenzene | 37.5 | mg/kg | |
| | | | HMX | 232 | mg/kg | |
| | | | RDX | 1,820 | mg/kg | |
| | | | tetryl | 0.7 | mg/kg | |
| Ground Water | OJT | 1994 | 1,1,1-trichloroethane | 1.0 | ug/L | TtNUS, 2001b |
| | | | 1,1,2,2-tetrachloroethane | 2,100 | ug/L | |
| | | | trichloroethene | 4,000 | ug/L | |
| | | | cis-1,2-dichloroethene | 1,000 | ug/L | |
| | | | trans-1,2-dichloroethene | 1.2 | ug/L | |
| | | | HMX | 134 | ug/L | |
| | | | RDX | 365 | ug/L | |
| | ABG | 1987-1998 | 1,2-dichloroethane | 29 | ug/L | |
| | | | trichloroethene | 3,700 | ug/L | |
| | | | cis-1,2-dichloroethene | 120 | ug/L | |
| | | | trans-1,2-dichloroethene | 8.8 | ug/L | |
| | | | vinyl chloride | 8 0 | ug/L | |
| | | | 2,4,6-trinitrotoluene | 0.54 | ug/L | |
| | | | 2,6-dinitrotoluene | 0 94 | ug/L | |
| | | | 2-amino-4,6-dinitrotoluene | 12 | ug/L | |
| | | | 4-amino-2,6-dinitrotoluene | 19 | ug/L | |
| | | | 1,3,5-trinitrobenzene | 6 7 | ug/L | |
| | | | HMX | 38 | ug/L | |
| | | | RDX | 190 | ug/L | |
| Spring A | | 1987-1995 | trichloroethene | 0.6 | ug/L | TtNUS, 2001b |
| | | | 2,4,6-trinitrotoluene | 1 8 | ug/L | |
| | | | 2-amino-4,6-dinitrotoluene | 2.1 | ug/L | |
| | | | 4-amino-2,6-dinitrotoluene | 4.9 | ug/L | |
| | | | HMX | 31 | ug/L | |
| | | | RDX | 120 | ug/L | |
| Creek Water | | 1992 | 2,4-dinitrotoluene | 9 | ug/L | Murphy and Wade, 1998 |
| | | | HMX | 45 | ug/L | |
| | | | RDX | 37 | ug/L | |
| Creek Sediment | | 1992 | 2,4,6-trinitrotoluene | 1.13 | mg/kg | TtNUS, 2001b |
| | | | 2,4-dinitrotoluene | 0.55 | mg/kg | |
| | | | HMX | 10.2 | mg/kg | |
| | | | RDX | 1.78 | mg/kg | |
| | | | 1,3,5-trinitrobenzene | 0.2 | mg/kg | |

| | | | |
|---|---|---|---|
| DRAWN BY J. LAMEY | DATE 3/9/00 | LOCATION OF NSWC CRANE<br>SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK<br>NSWC CRANE<br>CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY T. JOHNSTON | DATE 9/27/02 | | APPROVED BY — DATE — |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 1-1 / REV 0 |

P:\GIS\NSWC_CRANE\0087.APR GENERAL LOCATION MAP 10/8/03 JAL




SOURCE: "Initial Assessment of Study of Naval Weapons Support Center Crane, Indiana." Naval Energy and Environmental Support Activity, May 1983.

| | | | |
|---|---|---|---|
| DRAWN BY J. LAMEY DATE 6/1/00 | | LOCATION OF AMMUNITION BURNING GROUNDS, OLD JEEP TRAIL, LITTLE SULPHUR CREEK, AND MAJOR DRAINAGE BASINS SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK NSWC CRANE CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. SCHUBERT DATE 8/22/02 | | | APPROVED BY — DATE — |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 1-2 REV 0 |

P:\GIS\NSWC_CRANE\7651.APR AOC LOCATIONS AND DRAINAGE BASINS 10/8/03 JAL

**FIGURE 1- 3**

**SITE PHOTOGRAPHS (6-16-02)**
**SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

Figure 1-3a – Overview of Ammunition Burning Ground (ABG) showing rolling terrain, main burn pan grid, and dewatering units in the background.

Figure 1-3b - Overview of ABG showing rolling terrain, storage areas, and break building in the background.

**FIGURE 1- 3**

**SITE PHOTOGRAPHS (6-16-02)**
**SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

Figure 1-3c – Little Sulphur Creek tributary enters the ABG from the west (bottom of photo). This tributary flows through the site at a moderate rate in an easterly direction. Note steep slope to the right of photograph is terraced and well-vegetated to retard surface water run-off and erosion.

Figure 1-3d – The same easterly-flowing tributary stream (from Figure 1-3c) is shown prior to flowing under Highway 462. More than a dozen minnows were observed in this section of the tributary.

**FIGURE 1- 3**

**SITE PHOTOGRAPHS (6-16-02)**
**SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

Figure 1-3e (facing northwest) – The tributary of Little Sulphur Creek located in the northern portion of the ABG is shown flowing in a southeasterly direction at a slow to moderate rate. This photograph was taken just north (upstream) of its confluence with the tributary shown in Figures 1-3c and 1-3d.

Figure 1-3f (facing northwest) - The upper reaches of Little Sulphur Creek as it flows through the southern portion of the ABG at a slow to moderate rate in a southeasterly direction. This photograph was taken just south (downstream) of its confluence with the tributaries shown in Figures 1-3c, 1-3d, and 1-3e.

FIGURE 1- 3

SITE PHOTOGRAPHS (6-16-02)
SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

Figure 1-3g (facing southeast) – View of the northern portion of the Old Jeep Trail's former burn area showing open storage areas on both sides of the Jeep Trail 25.

Figure 1-3h (facing northwest) – View of the southern portion of the OJT's former burn pit showing the storage trailer and travel trailer on the left side (west side) of the Jeep Trail, and open storage on the right side (east side) of the Jeep Trail 25.

**FIGURE 1- 3**

**SITE PHOTOGRAPHS (6-16-02)**
**SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

Figure 1-3i –Monitoring well 03-07 (photo center) is shown and is almost overgrown by vegetation. This location on the Jeep Trail is the most likely place that was used as a truck turn-around at the former burn pit.

Figure 1-3j (facing upstream and north) – View of Little Sulphur Creek, showing a dry streambed just west of the OJT's former burn area and north of sediment sampling location 03SD10. Surface depositional material is gravel size and larger, fines not observed – most likely washed away. Bedrock surface is exposed at this location (see brown area right and below of photo's center).

**FIGURE 1- 3**

**SITE PHOTOGRAPHS (6-16-02)**
**SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

Figure 1-3k (facing upstream and northwest) – View of Little Sulphur Creek showing a dry streambed just west of the trailers located at the OJT's former burn pit and near sediment sampling location 03SD11. Metal debris was observed at this location.

Figure 1-3ℓ – Close-up of typical metal debris found in the dry streambed of Little Sulphur Creek, between sediment sampling locations 03SD11 and 03SD12. Note that some of the pieces are fused as a result of burning.

FIGURE 1- 3

SITE PHOTOGRAPHS (6-16-02)
SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

Figure 1-3m - Close-up of Spring C, which contributes to the flow in Little Sulphur Creek.

Figure 1-3n –Weir for measuring flow rate discharging from Spring A', which also contributes to the flow in Little Sulphur Creek.

**FIGURE 1- 3**

**SITE PHOTOGRAPHS (6-16-02)**
**SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

Figure 1-3o - Weir for measuring flow rate discharging from Spring A (just south of Spring A'), which likewise contributes to the flow in Little Sulphur Creek.

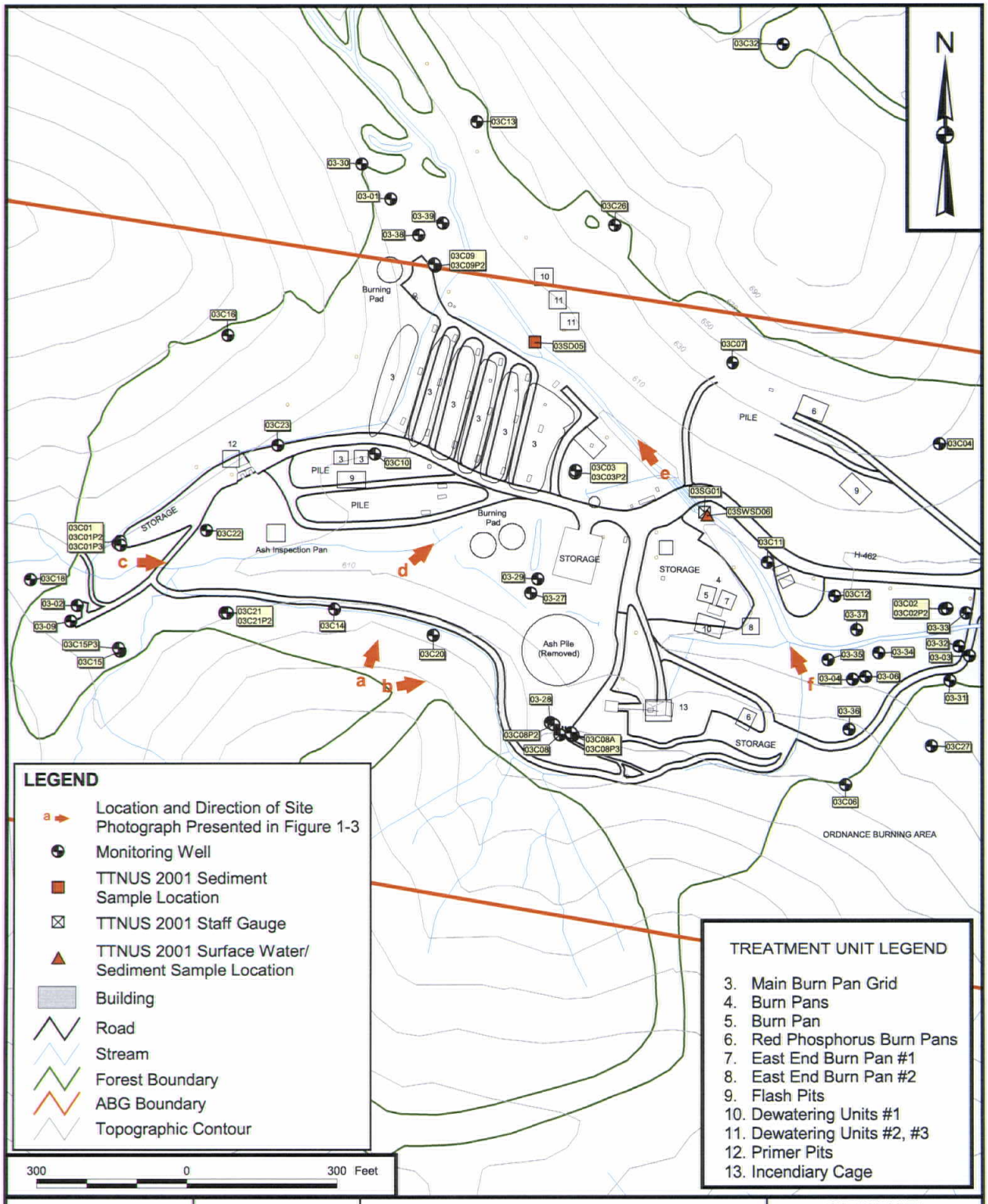
Figure 1-3p – Close-up of Spring A, where it discharges from the Beech Creek Limestone in the hillside.

**FIGURE 1- 3**

**SITE PHOTOGRAPHS (6-16-02)**
**SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

Figure 1-3q (facing upstream and north) – Moderate flow in Little Sulphur Creek streambed just downstream of Springs A and A', and just upstream of staff gauge 03SG06.

Figure 1-3r (facing upstream and north) – Moderate stream flow in Little Sulphur Creek just prior to leaving the southern boundary of NSWC Crane (just south of staff gauge 03SG07). Numerous minnows were observed in the creek at this photo location.

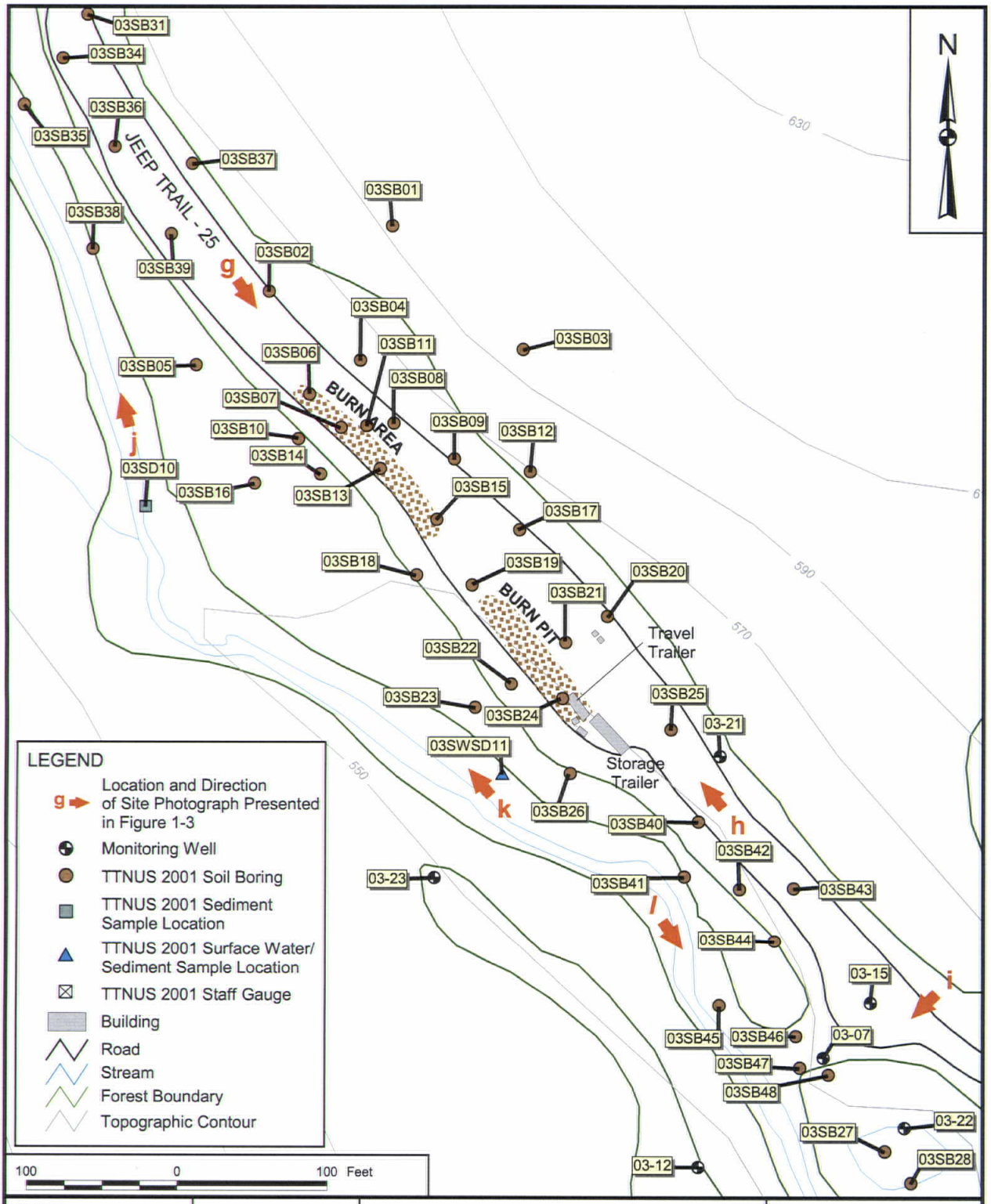



| DRAWN BY | DATE |
|---|---|
| A. JANOCHA | 7/11/02 |
| CHECKED BY | DATE |
| J. SCHUBERT | 8/22/02 |
| COST/SCHEDULE-AREA | |
| SCALE | |
| AS NOTED | |

LOCATIONS OF PHOTOGRAPHS TAKEN AT
THE AMMUNITION BURNING GROUNDS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

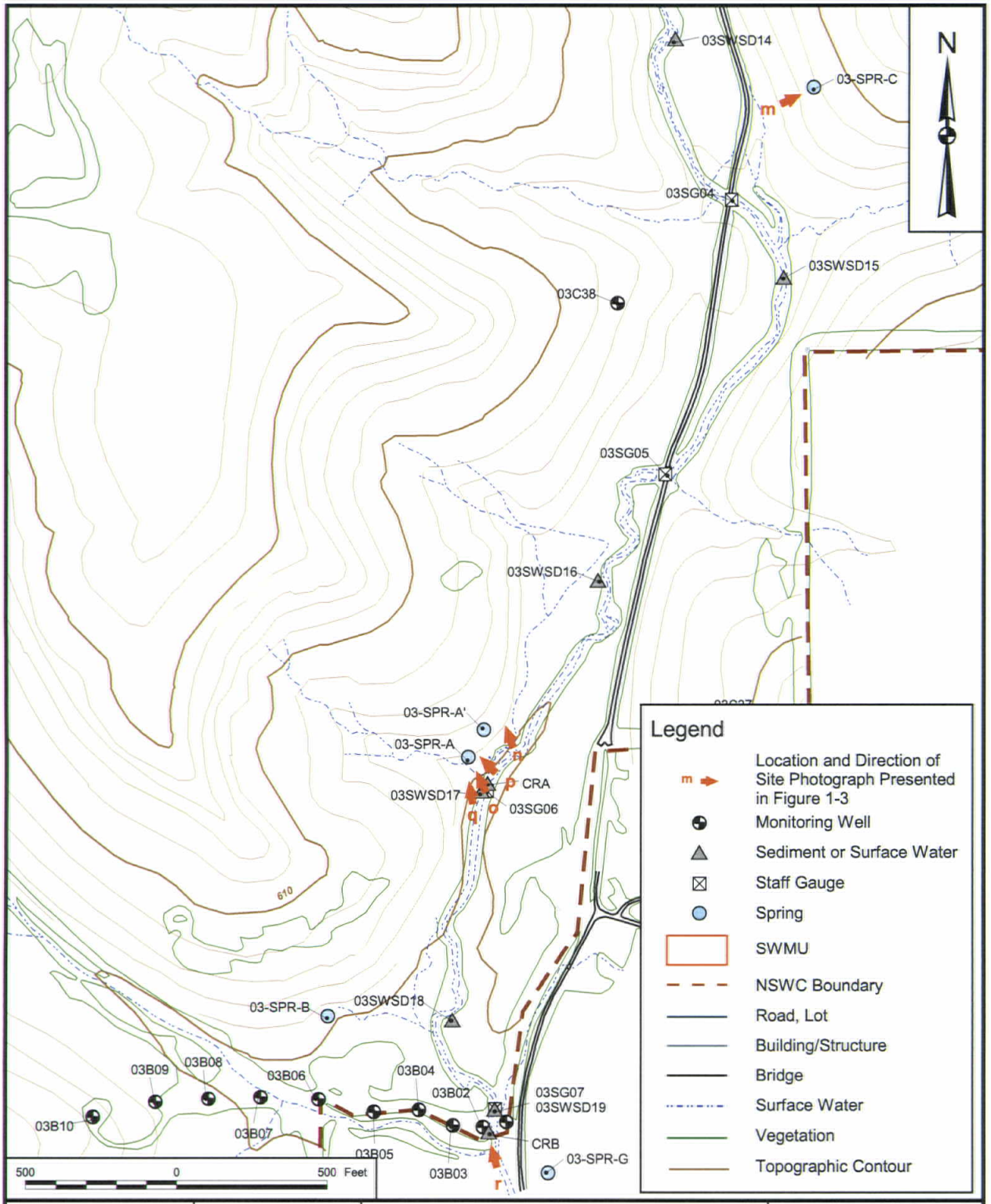
| CONTRACT NUMBER | |
|---|---|
| 3960 | |
| APPROVED BY | DATE |
| APPROVED BY | DATE |
| DRAWING NO. FIGURE 1-4 | REV 0 |

P:\GIS\NSWC_CRANE\APR\7651.APR LOCATIONS OF PHOTOGRAPHS TAKEN AT THE AMMUNITION BURNING GROUNDS LAYOUT 10/8/03 JAL




| | | | |
|---|---|---|---|
| DRAWN BY A. JANOCHA | DATE 7/11/02 | LOCATIONS OF PHOTOGRAPHS TAKEN AT THE OLD JEEP TRAIL AREA SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK NSWC CRANE CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. SCHUBERT | DATE 7/17/02 | | APPROVED BY — DATE — |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 1-5 REV 0 |

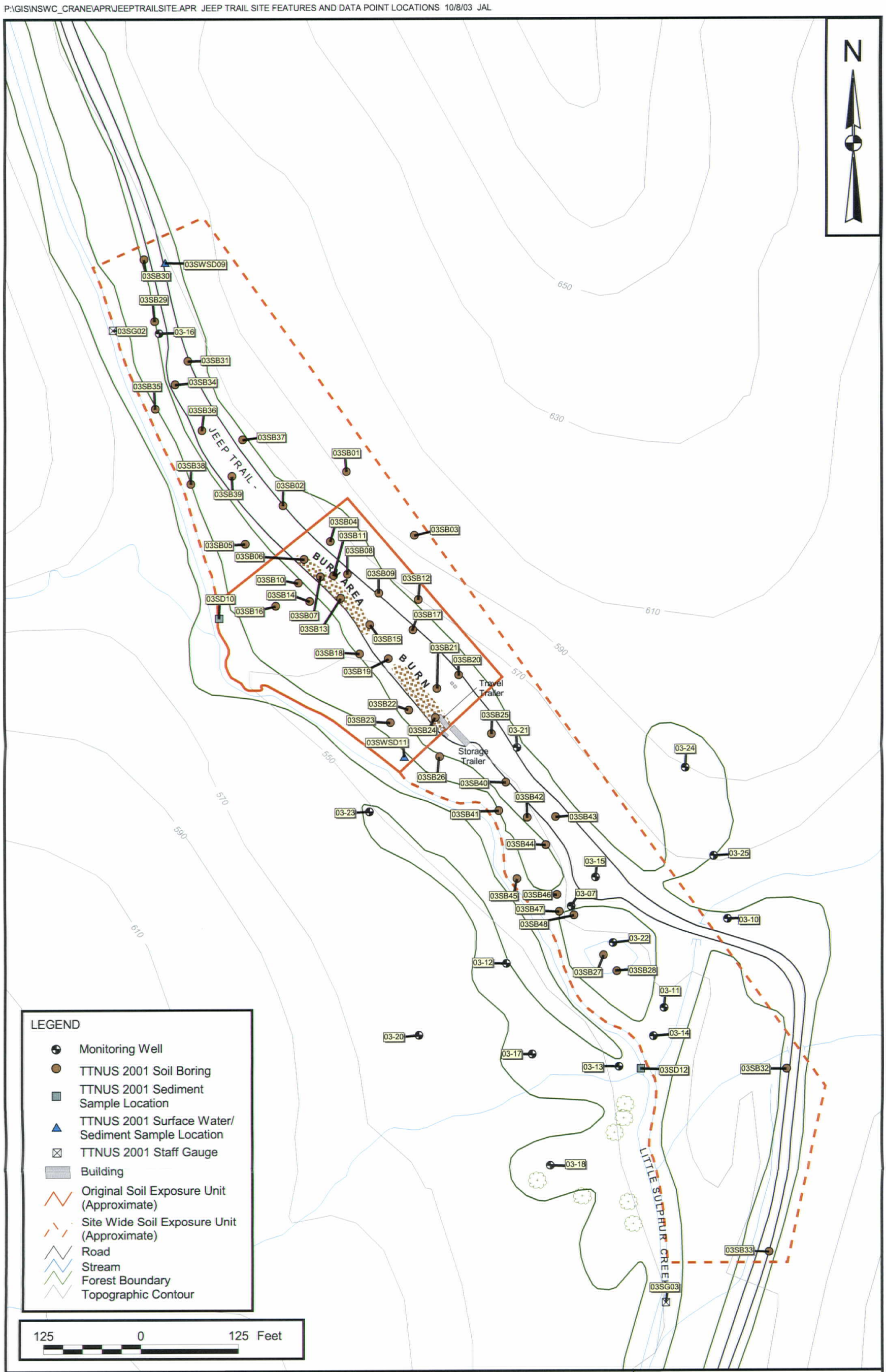
P:\GIS\NSWC_CRANE\APR\JEEPTRAILSITE.APR LOCATIONS OF PHOTOGRAPHS TAKEN AT THE OLD JEEP TRAIL AREA LAYOUT 10/8/03 JAL



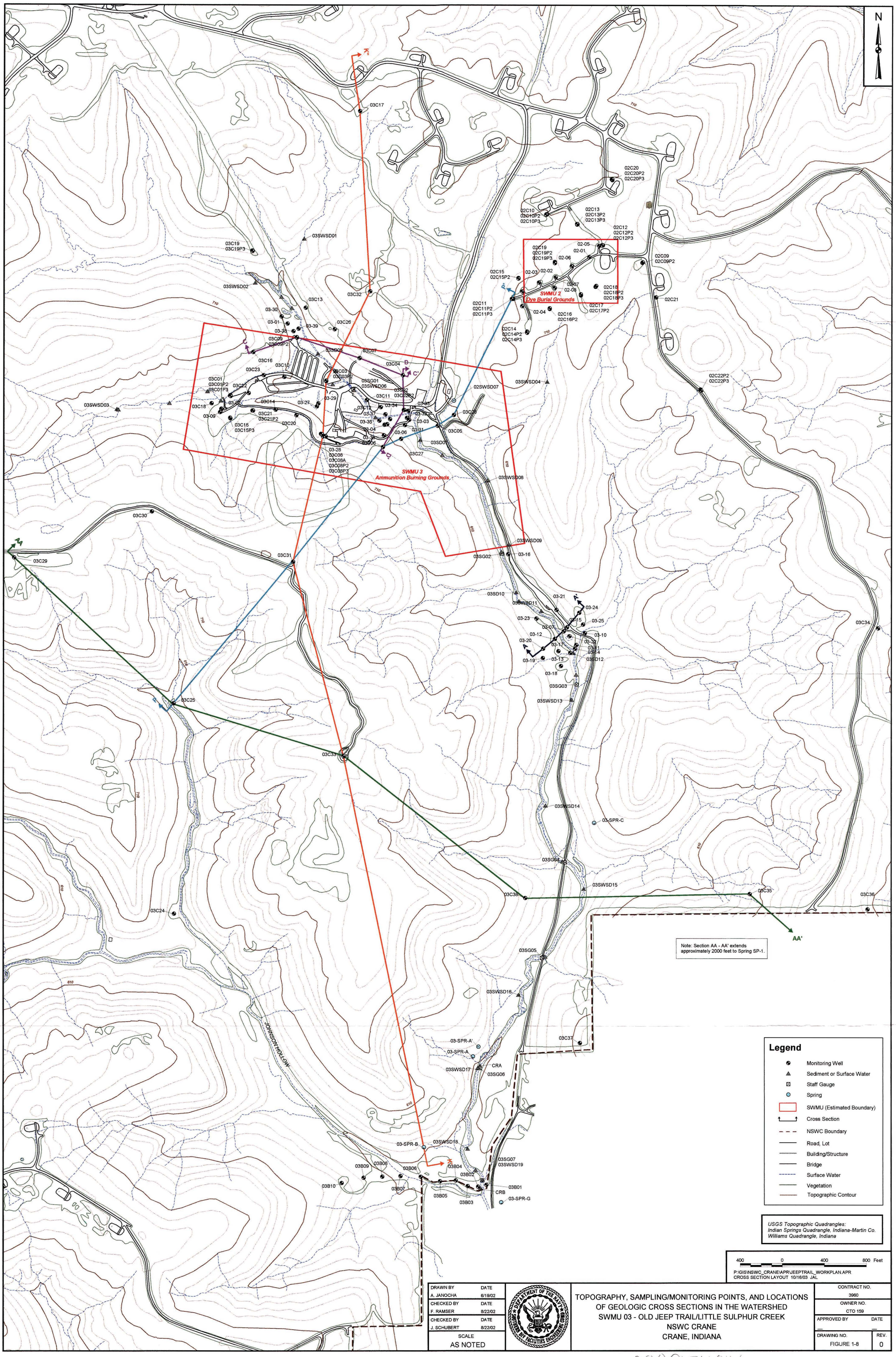

| | | | |
|---|---|---|---|
| DRAWN BY A. JANOCHA | DATE 7/11/02 | LOCATIONS OF PHOTOGRAPHS TAKEN DOWNSTREAM ALONG LITTLE SULPHUR CREEK<br>SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK<br>NSWC CRANE<br>CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. SCHUBERT | DATE 7/17/02 | | APPROVED BY — DATE — |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 1-6 / REV 0 |

P:\GIS\NSWC_CRANE\APR\JEEPTRAIL_WORKPLAN.APR LOCATIONS OF PHOTOGRAPHS TAKEN DOWNSTREAM ALONG LITTLE SULPHUR CREEK LAYOUT 10/8/03 JAL

P:\GIS\NSWC_CRANE\APR\JEEPTRAILSITE.APR JEEP TRAIL SITE FEATURES AND DATA POINT LOCATIONS 10/8/03 JAL




| | | | |
|---|---|---|---|
| DRAWN BY J. LAMEY | DATE 5/20/02 | OLD JEEP TRAIL AREA SHOWING APPROXIMATE TREATMENT AREA BOUNDARIES AND SAMPLING LOCATIONS SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK NSWC CRANE CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. SCHUBERT | DATE 7/18/02 | | APPROVED BY — DATE — |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 1-7 REV 0 |

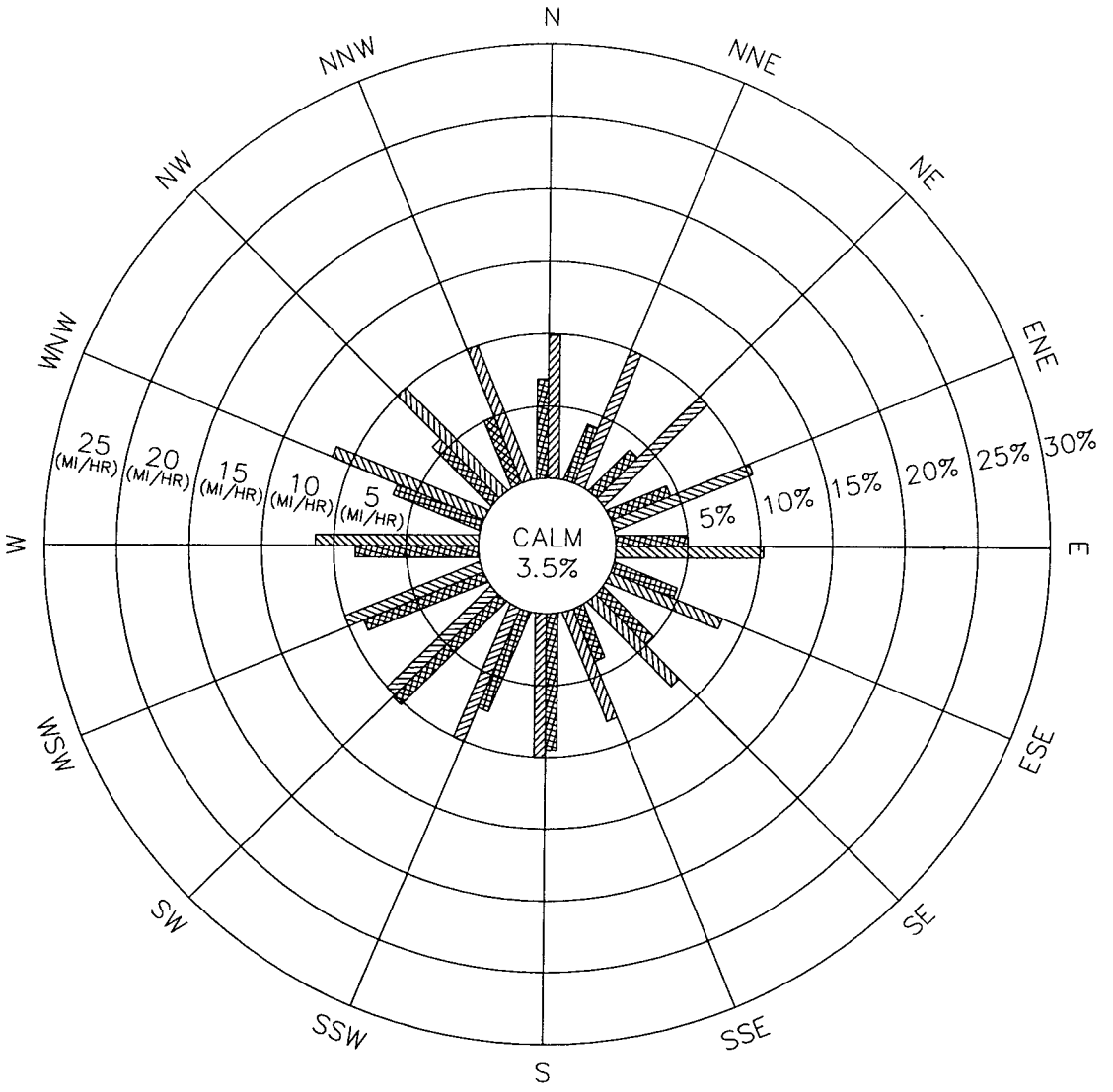



| DRAWN BY | DATE |
|---|---|
| A. JANOCHA | 6/19/02 |
| CHECKED BY | DATE |
| F. RAMSER | 8/22/02 |
| CHECKED BY | DATE |
| J. SCHUBERT | 8/22/02 |
| SCALE | |
| AS NOTED | |

TOPOGRAPHY, SAMPLING/MONITORING POINTS, AND LOCATIONS OF GEOLOGIC CROSS SECTIONS IN THE WATERSHED
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

| CONTRACT NO. | |
|---|---|
| 3960 | |
| OWNER NO. | |
| CTO 159 | |
| APPROVED BY | DATE |
| — | — |
| DRAWING NO. | REV. |
| FIGURE 1-8 | 0 |

000915U01Y




**LEGEND:**

WIND DIRECTION FREQUENCY (PERCENT)
(DIRECTION FROM WHICH THE WIND IS BLOWING)

MEAN WIND SPEED (MI/HR)

DATA SOURCE: INDIANAPOLIS, INDIANA AIRPORT
PERIOD OF RECORD: 1985–1989
43,824 OBSERVATIONS

| | | | |
|---|---|---|---|
| DRAWN BY HJB DATE 7/17/02 | DEPARTMENT OF THE NAVY ★ SOUTHERN DIV FACILITIES ENGINEERING COMD ★ | FIVE-YEAR WINDROSE SUMMARY FOR INDIANAPOLIS, INDIANA SWMU 03-OLD JEEP TRAIL/ LITTLE SULPHUR CREEK NSWC CRANE CRANE, INDIANA | CONTRACT NO. 3960 |
| CHECKED BY DATE | | | APPROVED BY DATE |
| COST/SCHED-AREA | | | APPROVED BY DATE |
| SCALE NOT TO SCALE | | | DRAWING NO. FIGURE 1-9 REV. 0 |

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

ACAD 3960KM01.DWG 10/07/03 DM PIT

| PERIOD | EPOCH | THICKNESS (FEET) | LITHOLOGY | FORMATION | GROUP |
|---|---|---|---|---|---|
| PENN-SYL-VANIAN | POTTS-VILLE | 150–300 | | MANSFIELD FM. | "RACCOON CREEK" |
| MISSISSIPPI | CHESTER | 20–30 | | GLEN DEAN LS | STEPHENS-PORT |
| | | 30–40 | | HARDINSBURG SS. | |
| | | 40–50 | | GOLCONDA LS. | |
| | | 25–40 | | BIG CLIFTY FM. | |
| | | 15–25 | | BEECH CREEK LS. | |
| | | 20–40 | | ELWREN FM. | WEST BADEN |
| | | 0–5 | | REELSVILLE LS. | |
| | | 20–40 | | SAMPLE FM. | |
| | | 10–20 | | BEAVER BEND LS. | |
| | | 12–30 | | BETHEL FM. | |
| | MERAMEC | 15–20 | | PAOLI LS. | BLUE RIVER |
| | | 100–120 | | STE. GENEVIEVE LS. | |
| | | 100–120 | | ST. LOUIS LS. | |
| | | 90–100 | | SALEM LS. | SANDERS |
| | | 50–80 | | HARRODSBURG LS. | |
| | OSAGE | 600–800 | | MULDRAUGH FM. | BORDEN |

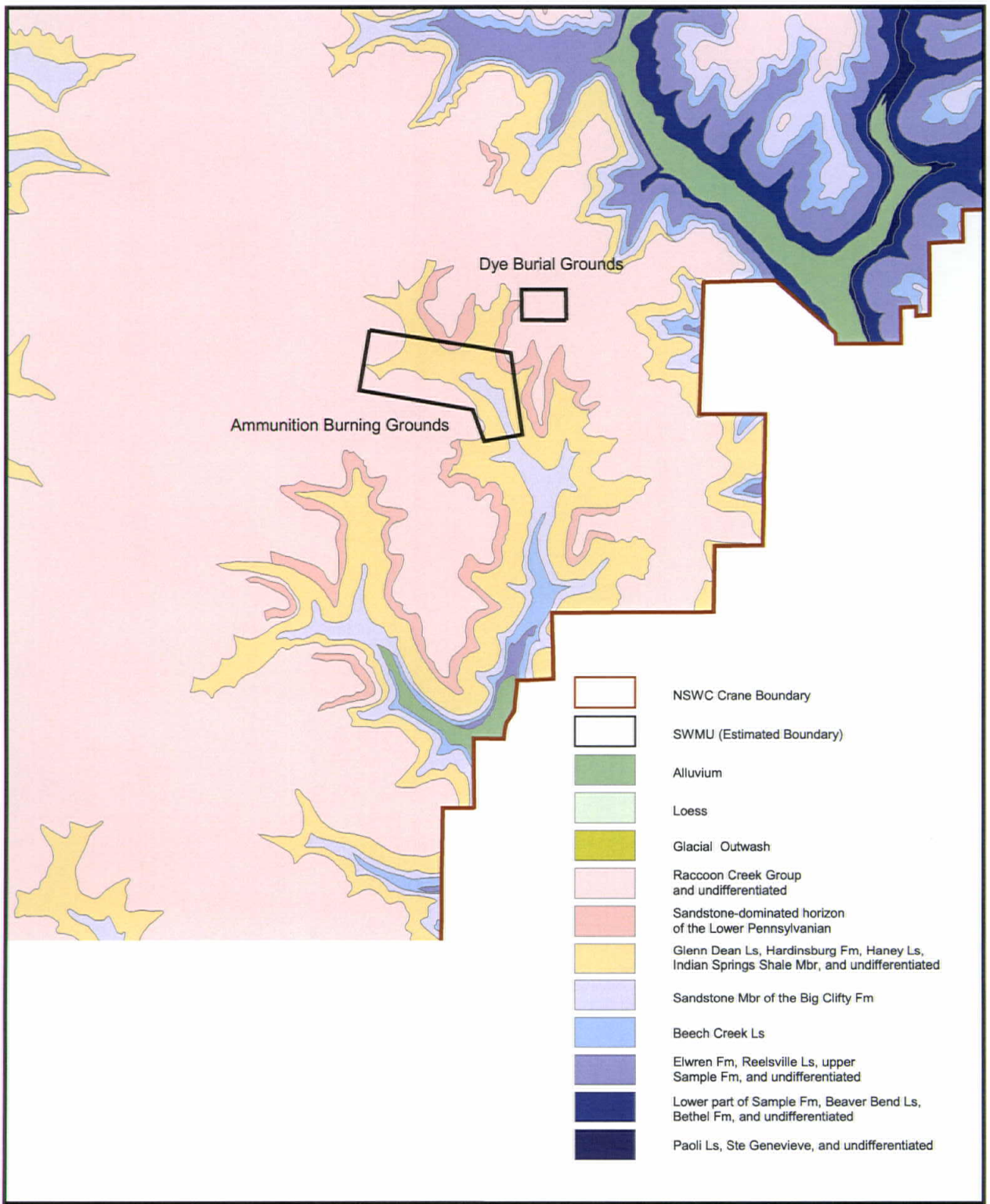
Source Palmer, 1989

| DRAWN BY | DATE |
|---|---|
| A JANOCHA | 7/21/02 |
| CHECKED BY | DATE |
| J SCHUBERT | 8/21/02 |
| COST/SCHEDULE-AREA | |
| SCALE | AS NOTED |

GENERALIZED STRATIGRAPHIC COLUMN
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

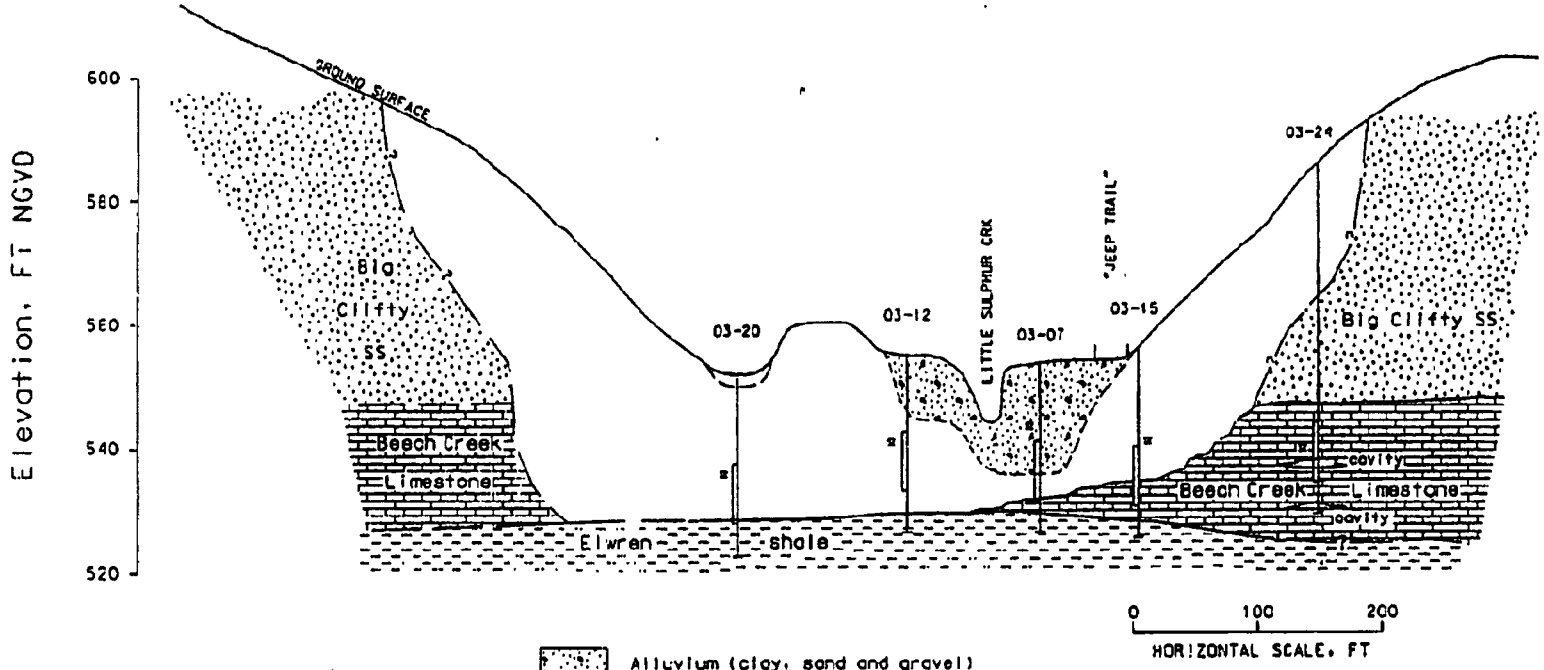
| CONTRACT NUMBER | |
|---|---|
| 3960 | |
| APPROVED BY | DATE |
| — | — |
| APPROVED BY | DATE |
| — | — |
| DRAWING NO | REV |
| FIGURE 1-10 | 0 |

P:\GIS\NSWC_CRANE\APR\JEEPTRAIL_WORKPLAN APR GENERALIZED STRATIGRAPHIC COLUMN LAYOUT 10/8/03 JAL




| | | | |
|---|---|---|---|
| DRAWN BY A. JANOCHA | DATE 11/20/02 | SURFICIAL BEDROCK MAP<br>SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK<br>NSWC CRANE<br>CRANE, INDIANA | CONTRACT NUMBER 7141 |
| CHECKED BY J. GOERDT | DATE 11/20/02 | | APPROVED BY T. JOHNSTON — DATE 11/20/02 |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 1-11 — REV 0 |

P:\GIS\NSWC_CRANE\APR\JEEPTRAIL_WORKPLAN.APR SURFICIAL BEDROCK MAP LAYOUT 11/20/02 AJ




Well screen

Water level Sept 94

Alluvium (clay, sand and gravel)

Sandstone

Limestone

Shale

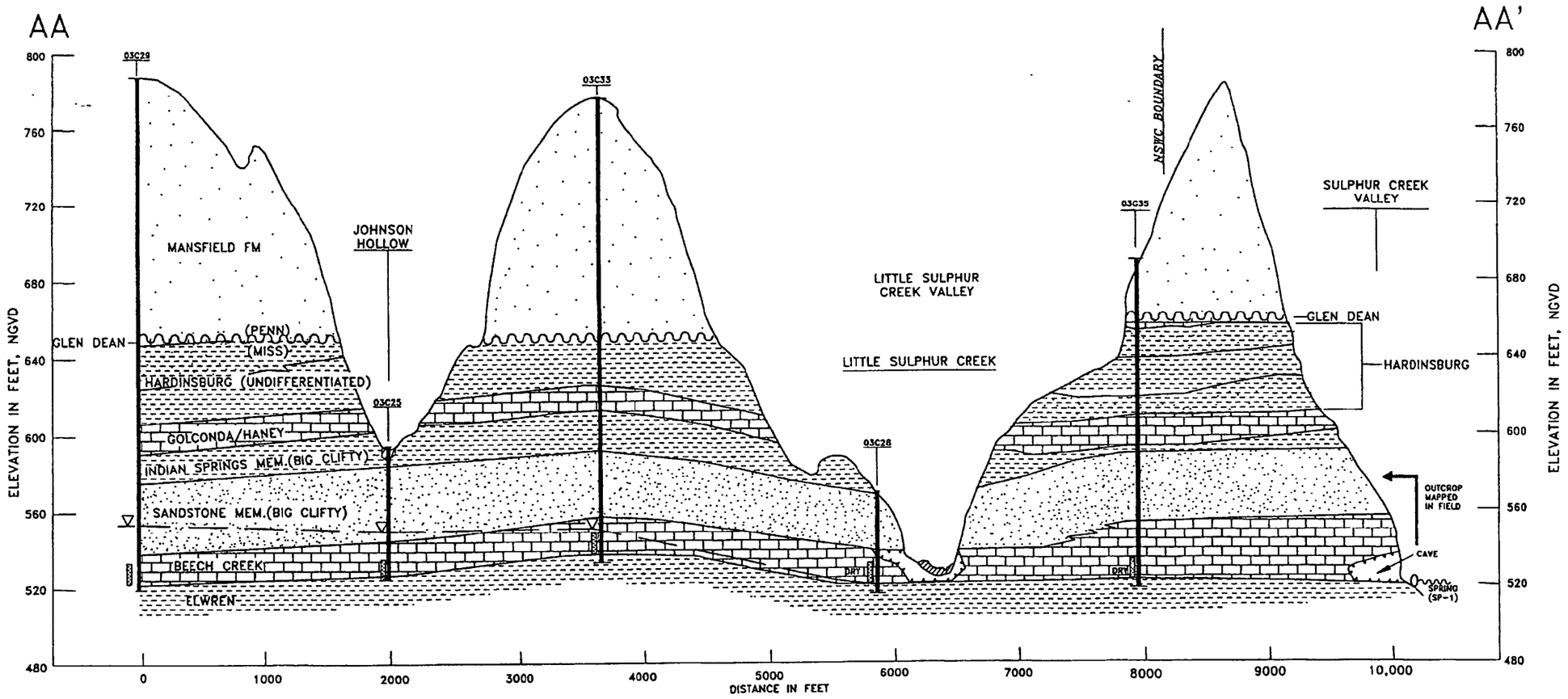
Weathered Sandstone and Limestone Collapse Breccia

MODIFIED FROM MURPHY, 1996

| | | | |
|---|---|---|---|
| DRAWN BY A JANOCHA DATE 7/17/02 | GEOLOGIC CROSS SECTION A-A' | CONTRACT NUMBER 3960 | |
| CHECKED BY J SCHUBERT DATE 7/17/02 | SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK | APPROVED BY — DATE — | |
| COST/SCHEDULE-AREA | NSWC CRANE | APPROVED BY — DATE — | |
| SCALE AS NOTED | CRANE, INDIANA | DRAWING NO FIGURE 1-12 | REV 0 |

P:\GIS\NSWC_CRANE\APR\JEEPTRAIL_WORKPLAN APR GEOLOGIC CROSS SECTION A-A' LAYOUT 10/8/03 JAL

P /GIS/NSWC_CRANE/APR/JEEPTRAIL_WORKPLAN APR GEOLOGIC CROSS SECTION AA-AA' LAYOUT 10/8/03 JAL




## LEGEND

- SOIL OVERBURDEN
- UNDIFFERENTIATED (PENNSYLVANIAN)
- SHALE AND SANDSTONE
- SANDSTONE
- SHALE
- LIMESTONE.
- WATER SURFACE (3/29/91)
- SCREEN INTERVAL
- POSTULATED COLLAPSE OR SOLUTION ZONE

Modified from Murphy, 1994.

CONTRACT NO 3960

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO FIGURE 1-13

REV 0

GEOLOGIC CROSS SECTION AA-AA'
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

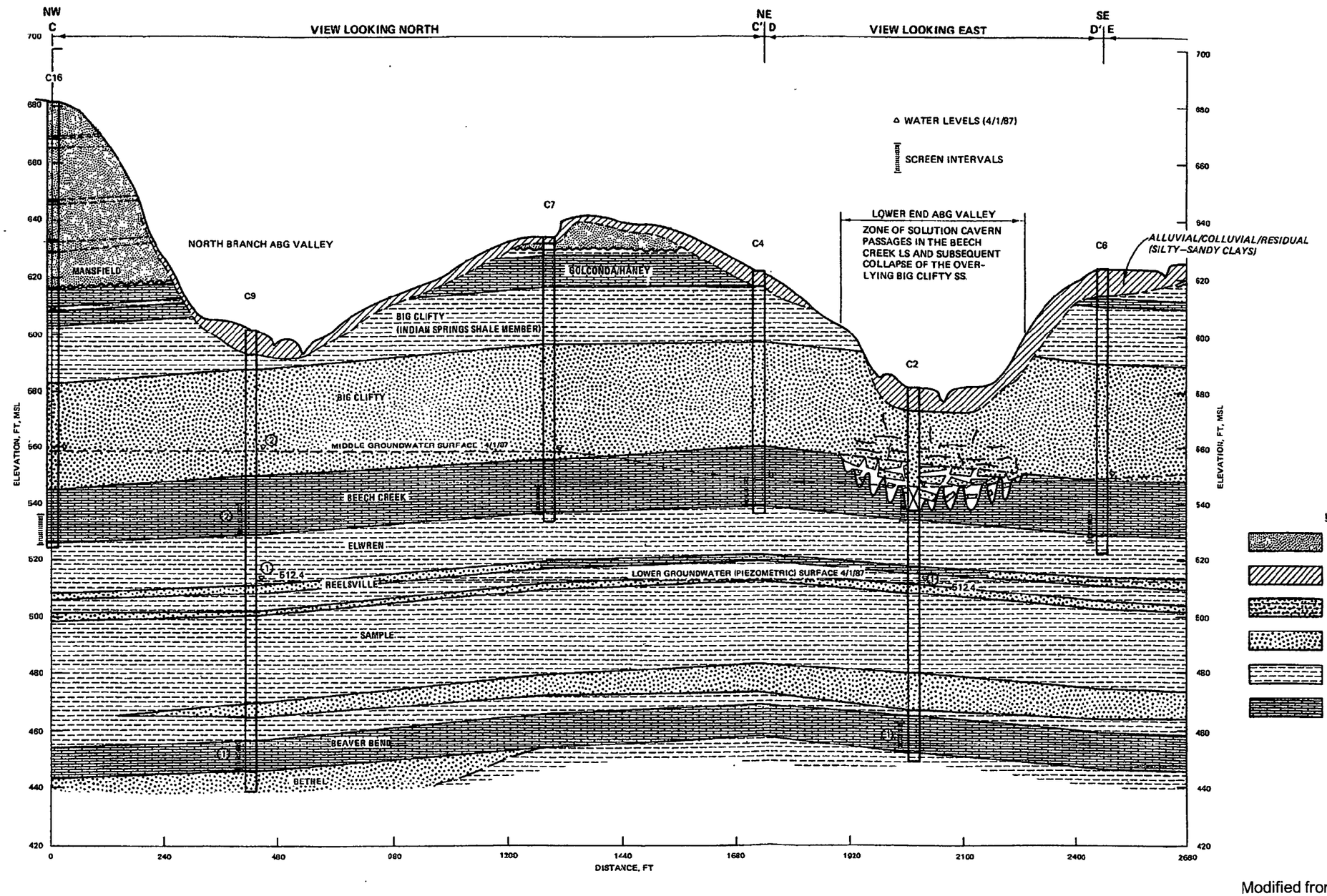
DRAWN BY A JANOCHA DATE 7/17/02

CHECKED BY J SCHUBERT DATE 7/17/02

COST/SCHED-AREA

SCALE AS NOTED

P /GIS/NSWC_CRANE/APR/JEEPTRAIL_WORKPLAN APR GEOLOGIC CROSS SECTION C-C' AND D-D' LAYOUT 10/8/03 JAL




Modified from Hunt, 1988.

CONTRACT NO 3960

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO FIGURE 1-14

REV 0

GEOLOGIC CROSS SECTION C-C' AND D-D'
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

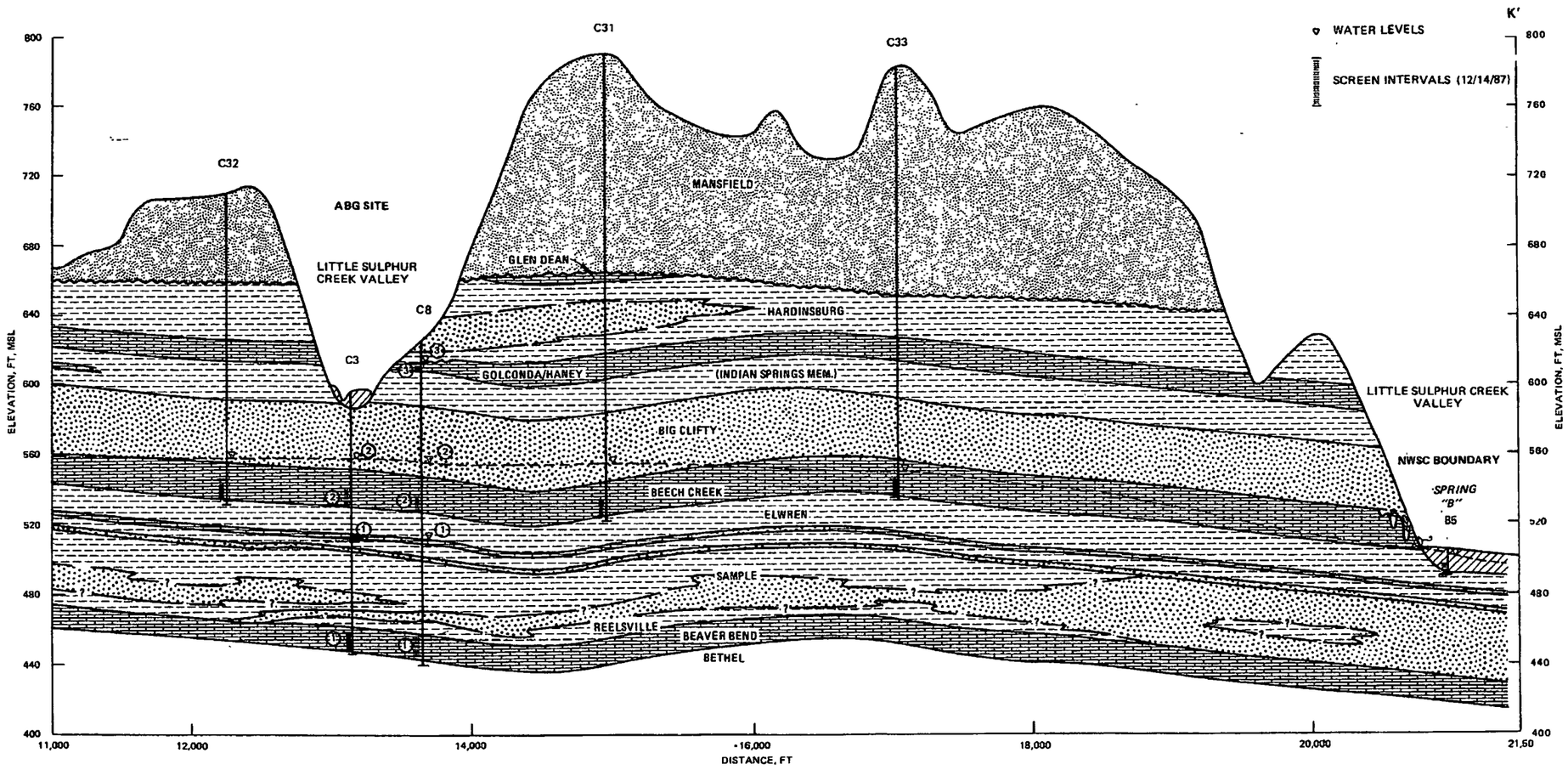
DRAWN BY A JANOCHA DATE 7/17/02

CHECKED BY J SCHUBERT DATE 7/17/02

COST/SCHED-AREA

SCALE AS NOTED

P /GIS/NSWC_CRANE/APR/JEEPTRAIL_WORKPLAN APR GEOLOGIC CROSS SECTION K'-K" LAYOUT 10/8/03 JAL




LEGEND

- UNDIFFERENTIATED
- CLAY SYMBOL
- SHALE AND SANDSTONE
- SANDSTONE
- SHALE
- LIMESTONE

Modified from Hunt, 1988.

CONTRACT NO 3960

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO FIGURE 1-15

REV 0

GEOLOGIC CROSS SECTION K'-K"
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

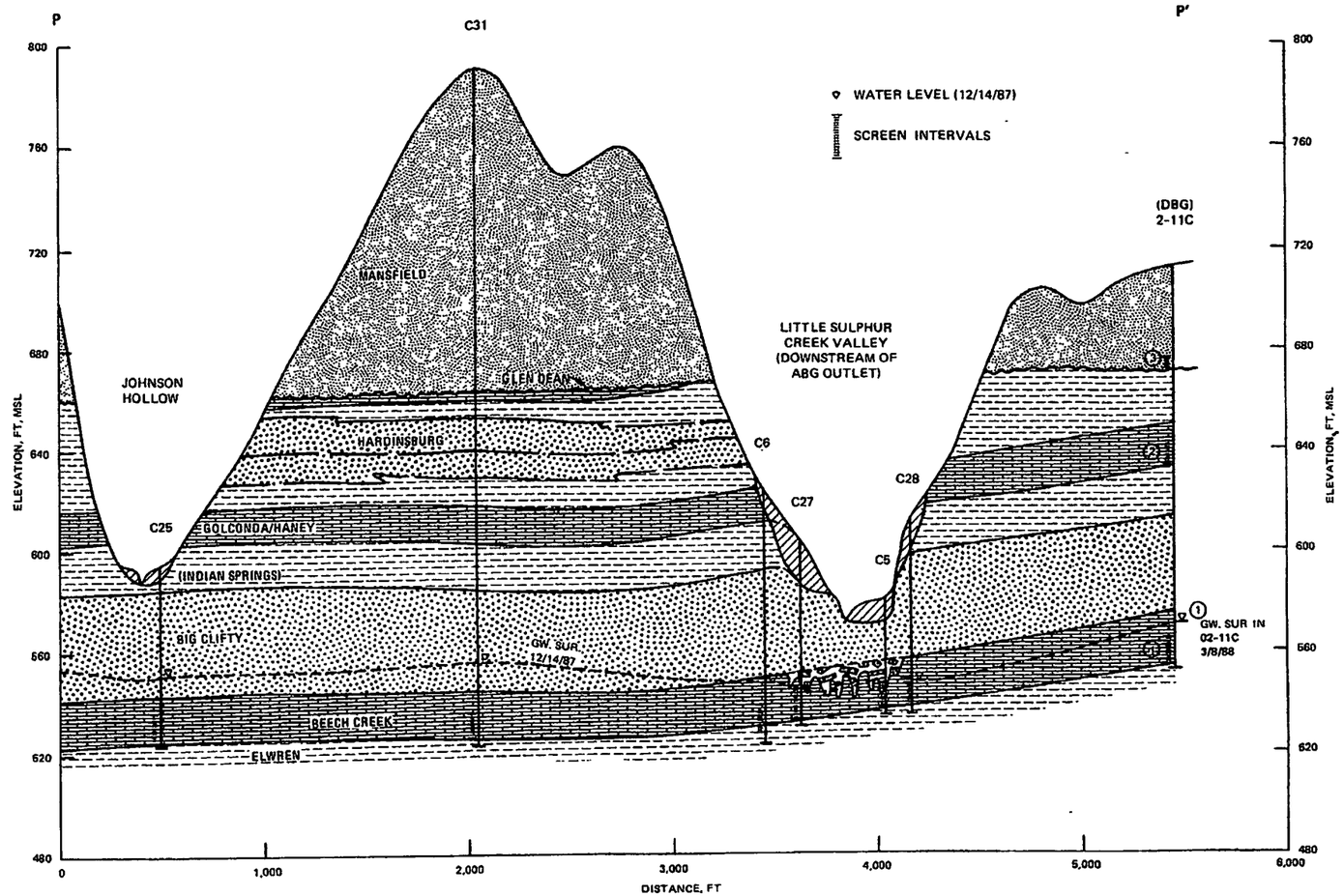
DEPARTMENT OF THE NAVY * CIVIL ENGINEERING CORPS * SOUTHERN DIVISION

DRAWN BY A JANOCHA DATE 7/17/02

CHECKED BY J SCHUBERT DATE 7/17/02

COST/SCHED-AREA

SCALE AS NOTED




LEGEND

- UNDIFFERENTIATED
- CLAY SYMBOL
- SHALE AND SANDSTONE
- SANDSTONE
- SHALE
- LIMESTONE

Modified from Hunt, 1988.

CONTRACT NO 3960

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO FIGURE 1-16

REV 0

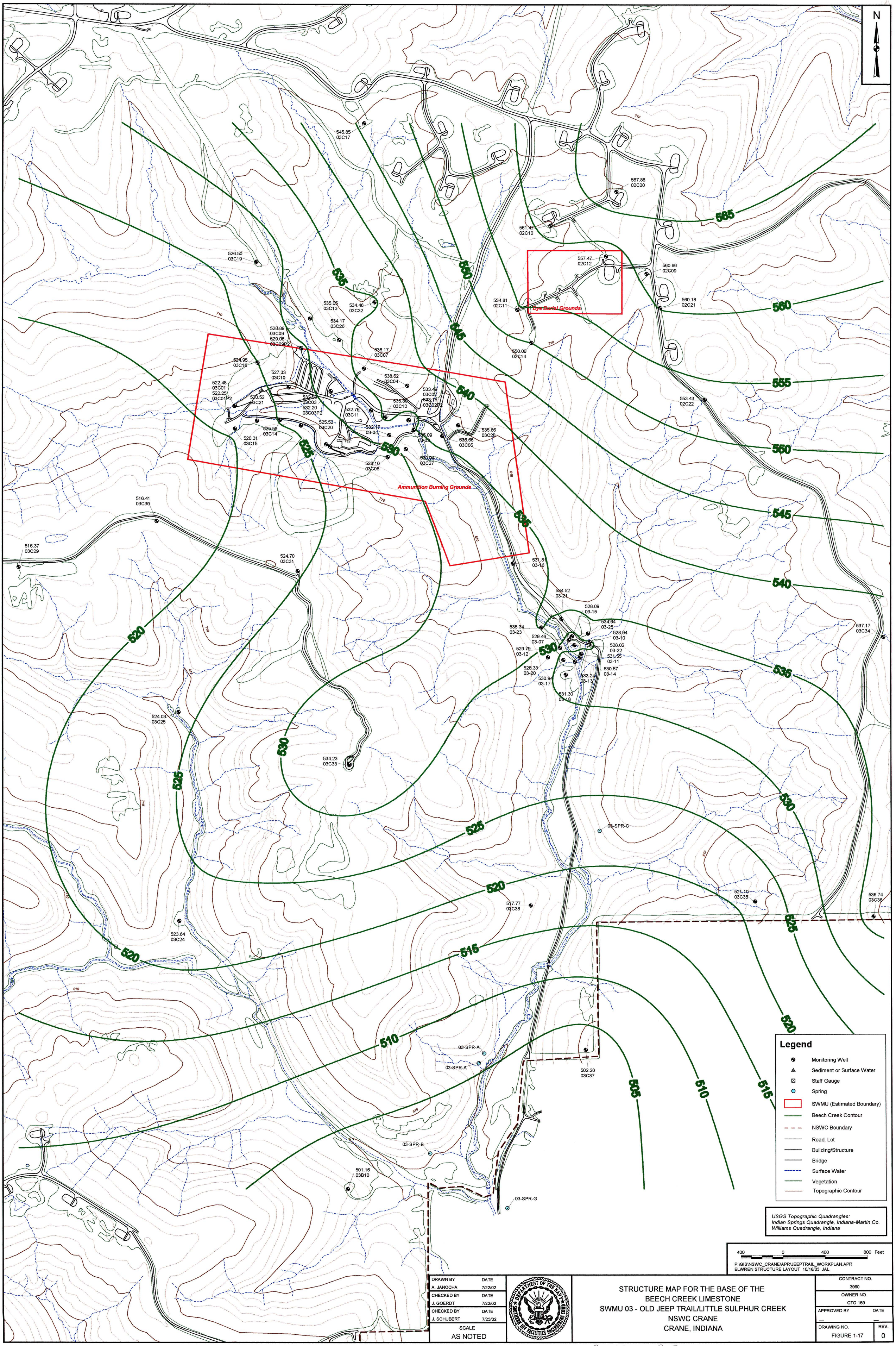
GEOLOGIC CROSS SECTION P-P'
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

DRAWN BY A. JANOCHA DATE 7/17/02

CHECKED BY J SCHUBERT DATE 7/17/02

COST/SCHED-AREA

SCALE AS NOTED


N
Dye Burial Grounds
Ammunition Burning Grounds
565
560
555
550
545
540
535
530
525
520
515
510
505
545.85
03C17
567.86
02C20
561.47
02C10
557.47
02C12
560.86
02C09
554.81
02C11
560.18
02C21
550.00
02C14
553.43
02C22
526.50
03C19
535.05
03C13
534.46
03C32
534.17
03C26
528.89
03C09
529.06
03C09P2
536.17
03C07
524.95
03C16
527.33
03C10
522.48
03C01
522.25
03C01P2
520.52
03C21
538.52
03C04
533.49
03C02
533.15
03C02P2
532.09
03C03
532.20
03C03P2
535.80
03C12
532.76
03C11
525.52
03C20
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03C14
520.31
03C15
532.17
03-04
535.09
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536.66
03C05
535.66
03C28
528.10
03C06
530.93
03C27
516.41
03C30
516.37
03C29
524.70
03C31
531.87
03-16
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03-21
528.09
03-15
534.64
03-25
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03-22
529.79
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531.55
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03-20
530.57
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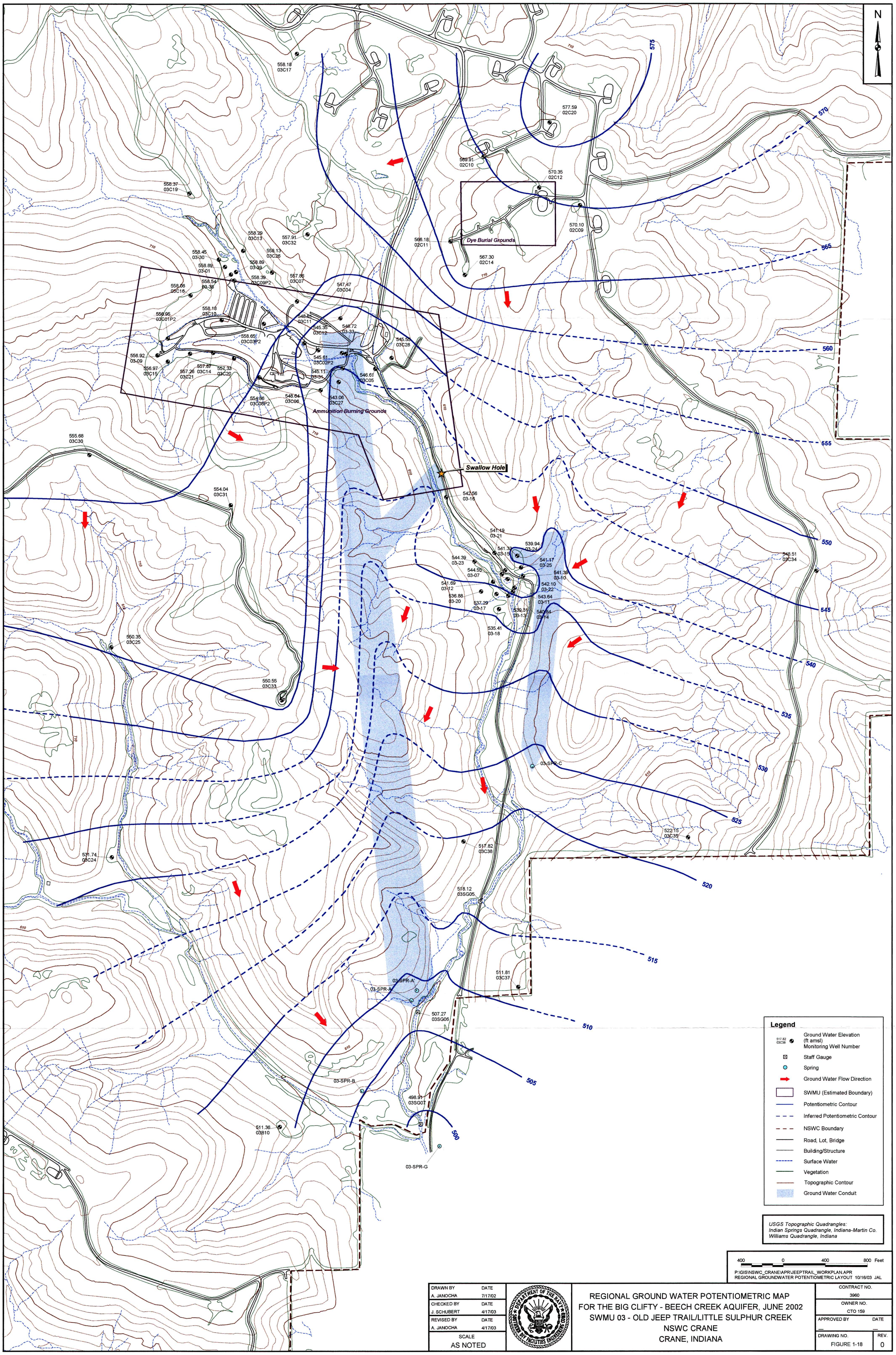
03-17
533.24
03-13
531.30
03-18
537.17
03C34
524.03
03C25
534.23
03C33
03-SPR-C
521.10
03C35
536.74
03C36
523.64
03C24
517.77
03C38
03-SPR-A'
03-SPR-A
502.28
03C37
03-SPR-B
501.16
03B10
03-SPR-G
Legend
Monitoring Well
Sediment or Surface Water
Staff Gauge
Spring
SWMU (Estimated Boundary)
Beech Creek Contour
NSWC Boundary
Road, Lot
Building/Structure
Bridge
Surface Water
Vegetation
Topographic Contour
USGS Topographic Quadrangles:
Indian Springs Quadrangle, Indiana-Martin Co.
Williams Quadrangle, Indiana
400 0 400 800 Feet
P:\GIS\NSWC_CRANE\APR\JEEPTRAIL_WORKPLAN.APR
ELWREN STRUCTURE LAYOUT 10/16/03 JAL
DRAWN BY A. JANOCHA DATE 7/22/02
CHECKED BY J. GOERDT DATE 7/22/02
CHECKED BY J. SCHUBERT DATE 7/23/02
SCALE AS NOTED
DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD
STRUCTURE MAP FOR THE BASE OF THE
BEECH CREEK LIMESTONE
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA
CONTRACT NO. 3960
OWNER NO. CTO 159
APPROVED BY
DATE
DRAWING NO. FIGURE 1-17
REV. 0




**Legend**

- 517.82 / 03C38 — Ground Water Elevation (ft amsl) Monitoring Well Number
- Staff Gauge
- Spring
- Ground Water Flow Direction
- SWMU (Estimated Boundary)
- Potentiometric Contour
- Inferred Potentiometric Contour
- NSWC Boundary
- Road, Lot, Bridge
- Building/Structure
- Surface Water
- Vegetation
- Topographic Contour
- Ground Water Conduit

*USGS Topographic Quadrangles:*
*Indian Springs Quadrangle, Indiana-Martin Co.*
*Williams Quadrangle, Indiana*

400 0 400 800 Feet

P:\GIS\NSWC_CRANE\APR\JEEPTRAIL_WORKPLAN.APR
REGIONAL GROUNDWATER POTENTIOMETRIC LAYOUT 10/16/03 JAL

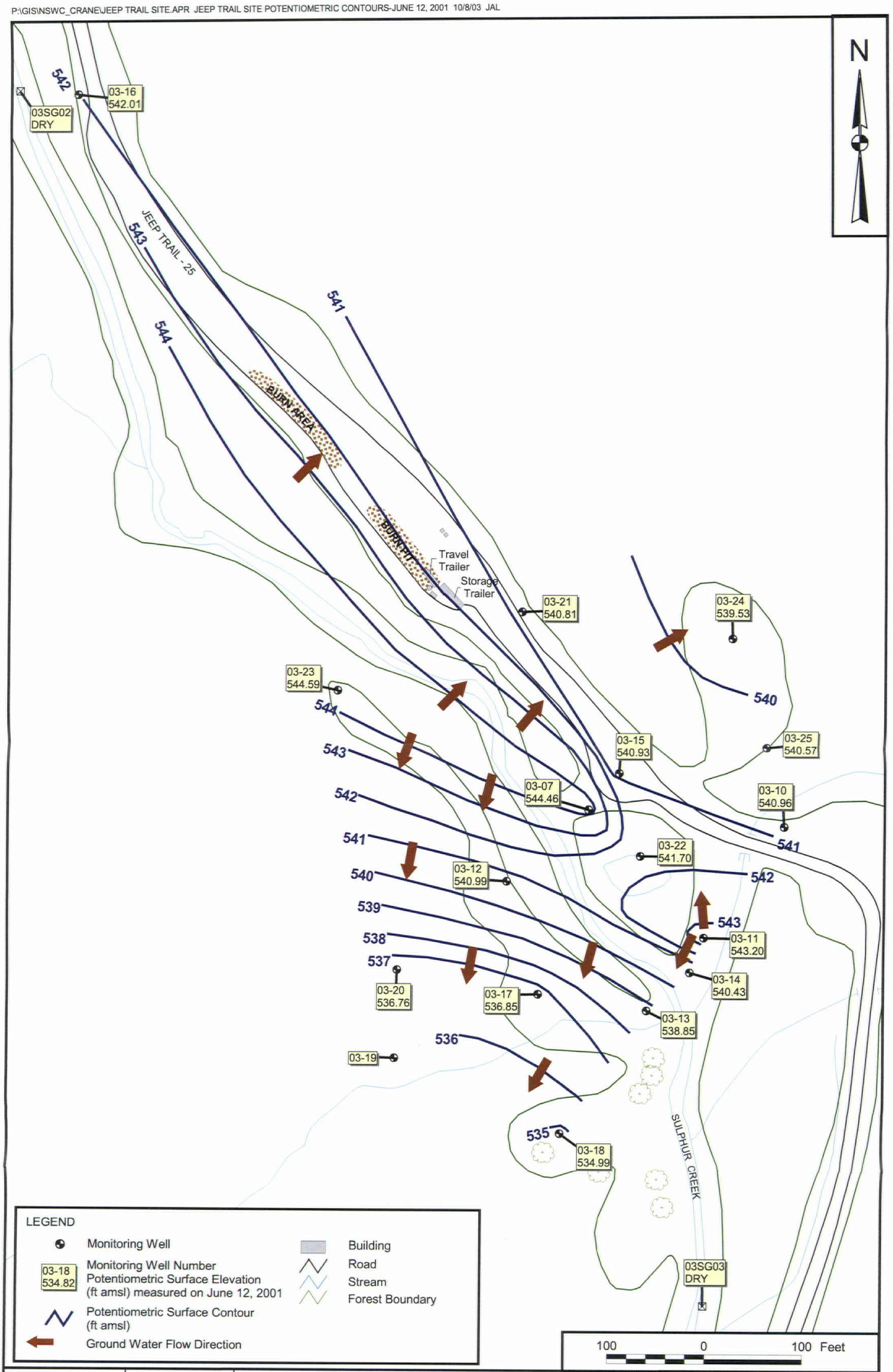
| | | |
|---|---|---|
| DRAWN BY | DATE | |
| A. JANOCHA | 7/17/02 | |
| CHECKED BY | DATE | |
| J. SCHUBERT | 4/17/03 | |
| REVISED BY | DATE | |
| A. JANOCHA | 4/17/03 | |
| SCALE | | |
| AS NOTED | | |

DEPARTMENT OF THE NAVY ★ SOUTHERN DIV FACILITIES ENGINEERING COMD

REGIONAL GROUND WATER POTENTIOMETRIC MAP
FOR THE BIG CLIFTY - BEECH CREEK AQUIFER, JUNE 2002
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

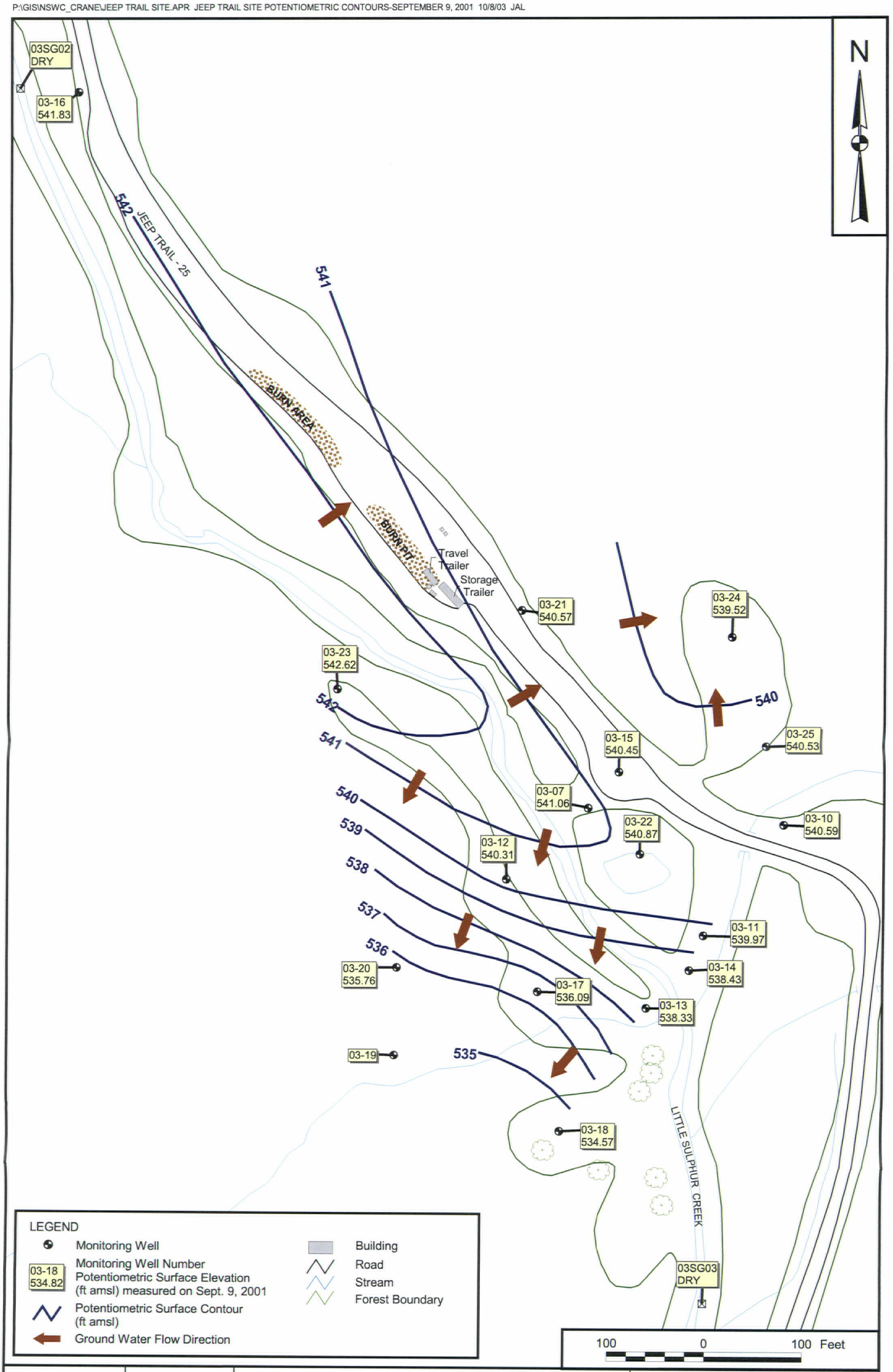
| | |
|---|---|
| CONTRACT NO. | 3960 |
| OWNER NO. | CTO 159 |
| APPROVED BY | DATE |
| — | — |
| DRAWING NO. | REV. |
| FIGURE 1-18 | 0 |

P:\GIS\NSWC_CRANE\JEEP TRAIL SITE.APR JEEP TRAIL SITE POTENTIOMETRIC CONTOURS-JUNE 12, 2001 10/8/03 JAL




| | | | |
|---|---|---|---|
| DRAWN BY J. LAMEY | DATE 10/19/01 | LOCAL SHALLOW GROUND WATER POTENTIOMETRIC SURFACE MAP<br>FOR OLD JEEP TRAIL AREA ON JUNE 12, 2001<br>SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK<br>NSWC CRANE<br>CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. SCHUBERT | DATE 8/22/02 | | APPROVED BY — DATE — |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 1-19 REV 0 |

P:\GIS\NSWC_CRANE\JEEP TRAIL SITE.APR JEEP TRAIL SITE POTENTIOMETRIC CONTOURS-SEPTEMBER 9, 2001 10/8/03 JAL

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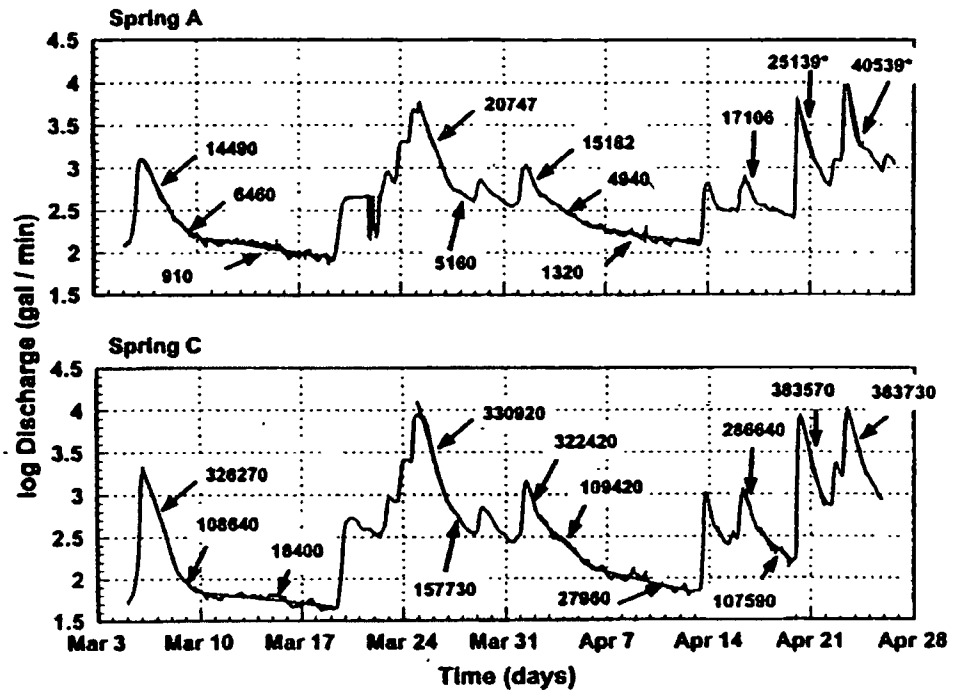
|---|---|---|---|
| DRAWN BY J. LAMEY | DATE 10/19/01 | LOCAL SHALLOW GROUND WATER POTENTIOMETRIC SURFACE MAP<br>FOR OLD JEEP TRAIL AREA ON SEPTEMBER 9, 2001<br>SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK<br>NSWC CRANE<br>CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. SCHUBERT | DATE 8/22/02 | | APPROVED BY — DATE — |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 1-20 / REV 0 |




Two-month hydrographs for Springs A and C (thin lines) during March – April 1996. Heavy lines show the conduit-, mixed-, and diffuse-flow systems. Numbers correspond to the ratio of T/S*y* calculated from the corresponding segment of the hydrograph. An * next to the values of T/S*y* indicates that discharges exceeded the calibrated range of the weir and pressure transducers for the rain event

SOURCE: JOCK AND KROTHE, 2002

| | | | |
|---|---|---|---|
| DRAWN BY A JANOCHA — DATE 7/21/02 | | FLOW HYDROGRAPHS FOR SPRINGS A AND C, MARCH-APRIL 1996 | CONTRACT NUMBER 3960 |
| CHECKED BY J SCHUBERT — DATE 7/21/02 | | SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK | APPROVED BY — DATE — |
| COST/SCHEDULE-AREA | | NSWC CRANE | APPROVED BY — DATE — |
| SCALE AS NOTED | | CRANE, INDIANA | DRAWING NO FIGURE 1-21 — REV 0 |

P:\GIS\NSWC_CRANE\APRJEEPTRAIL_WORKPLAN APR FLOW HYDROGRAPHS FOR SPRINGS A AND C, MARCH-APRIL 1996 LAYOUT 10/8/03 JAL

# 2.0 FIELD INVESTIGATIONS

This section discusses sampling activities, procedures, and documentation utilized during field operations performed in 2001 and 2002 for the Old Jeep Trail/Little Sulphur Creek (part of SWMU 03) at NSWC Crane Division, Crane, Indiana.

## 2.1 OVERVIEW

The field activities were conducted from June through September 2001 (Round 1) and June 2002 (Round 2) in accordance with the procedures and methodologies described in the QAPP (TtNUS, 2001b). Referenced standard operating procedures (SOPs) were included in Appendix H of the QAPP (TtNUS, April 2001b). These SOPs were followed during the course of the field activities. Copies of the field logbooks and all field notes are provided in Appendices A through D of this document, as follows:

- A Correspondence, Boring Logs, and Monitoring Well Construction Sheets
- A-1 Correspondence Regarding the Collection of Additional Soil Samples
- A-2 Boring Logs of Soil Borings Drilled in June 2001
- A-3 Boring Logs and Well Construction Sheets of Existing Wells
- B Sample Log Sheets and Other Field Forms
- B-1 Soil Sample Log Sheets
- B-2 Monitoring Well Inspection Sheets
- B-3 Monitoring Well Development Records
- B-4 Ground Water Sample Log Sheets, Low-Flow Purge Data Sheets, and Field Analytical Log Sheets
- B-5 Surface Water Sample Log Sheets with Field Analytical Log Sheets
- B-6 Sediment Sample Log Sheets
- B-7 Chain-of-Custody Records
- B-8 Equipment Calibration Logs
- B-9 Monitoring Well Water-Level Measurement Sheets
- B-10 Surface Water Flow Measurement Sheets
- B-11 Hydraulic Conductivity Calculations
- C Field Log Books
- C-1 Master Site Log Book, No. 1330

- C-2 Field Notebooks, No. 2493 (Sampling),. 2494 (Geology), unexploded ordnance (UXO), and 1340 (High-Flow Surface Water Sampling, September 2001, and Round 2 Water Levels (June 2002)
- D Survey Data

## 2.2 MOBILIZATION / DEMOBILIZATION

Following approval of the work plan, TtNUS began mobilization activities. All field team members reviewed the QAPP, particularly the field sampling plan (FSP) and the health and safety plan (HASP), prior to the start of project activities. In addition, the field operations leader (FOL) held a field team orientation meeting upon arrival at NSWC Crane on June 4, 2001 to ensure that personnel were familiar with the scope of the field activities. The site safety officer held a second meeting at NSWC Crane, also on June 4, 2001, to review the HASP, safety procedures specific to NSWC Crane, and emergency numbers for the site. The equipment required for the field activities was shipped to the site from the TtNUS Pittsburgh warehouse and from vendors that rent environmental equipment.

Before fieldwork began, the FOL coordinated utility clearance of all proposed boring locations through NSWC Crane Public Works. All soil boring activities and the majority of field sampling activities and site characterization work were performed from June 5 through July 11, 2001 After these activities were completed, the FOL decontaminated and demobilized of all equipment and cleaned the field office.

Additional work was performed at OJT/LSC on September 9, 2001. Between September 8 and 6:20 pm on September 9, 2001, a total of 1.25 inches of rain were recorded at the rain gauge at Building 3245. Stream water samples were collected on September 9, 2001 at 14 sampling locations during this storm event, and a second round of ground water elevations was also measured on this date. Work performed on September 9, 2001 is considered to be part of the Round 1 activities.

In June 2002, a second round of site characterization work was performed. Ground water elevations were measured in 120 monitoring wells located throughout the LSC watershed. In addition, photographs of the site were taken and a Checklist for Ecological Assessment was completed to support the ecological risk assessment described in Section 8.0.

## 2.3 SUBSURFACE INVESTIGATION METHODOLOGIES AND PROCEDURES

### 2.3.1 Avoidance of Unexploded Ordnance at Drilling Locations

The former burn pit and burn area were believed to be depressions with possible buried anomalies no deeper than 8 to 10 feet bgs. Prior to and during drilling [including direct push technology (DPT) and hand auguring], all boring locations in and around the burn pit and burn area were screened for UXO. UXO avoidance consisted of the following steps:

- Scan the ground surface at the proposed drilling location with a magnetic locator (this step is also performed at surface soil sampling locations).
- Drill vertically and sample 2 feet of soil.
- Remove all drilling and soil sampling equipment from the borehole.
- Move all drilling and soil sampling equipment at least 20 feet away from borehole to avoid any interference with the monitoring equipment.
- Scan (down hole) for magnetic anomalies in the newly drilled section of the borehole.
- Repeat steps 2, 3, 4, and 5 until a depth of 10 feet is reached.

A technician qualified for explosive ordnance disposal (EOD) conducted all UXO avoidance activities. Details regarding UXO avoidance are contained in Attachment VI (UXO SOP Number HS-2-0) of the *HASP* (TtNUS, 2001) The types of geophysical equipment used to perform UXO avoidance are listed in Section 13 of Attachment VI of the HASP.

During the drilling activities, several boring locations were moved due to surface interference (i.e., the storage trailer, travel trailer, etc.) with geophysical equipment and detected subsurface anomalies. For example, the former burn pit and burn area locations were littered with widespread underground anomalies. As a precaution, a backhoe was used to clear borings 03SB19, 03SB22, and 03SB24, located within the former burn pit area. Backhoe clearing proceeded with Navy approval and Navy-EOD oversight on June 21, 2001. At each of the three boring locations within the former burn pit area, the backhoe was used to scratch away the compacted gravel (about an inch at a time) down to a depth of approximately 6 inches. The soil was inspected visually for UXO after each pass of the backhoe bucket.

This process continued until confirmation could be made that the detected anomalies were non-UXO (mostly metal pallet strapping). Following this confirmation, sampling resumed using the standard avoidance procedure described in the beginning of this section.

### 2.3.2 Drilling

The QAPP initially specified that 83 soil samples would be collected from 33 soil borings (TtNUS, 2001b, Table 4-2). However, during the field sampling activities, several site conditions were encountered that altered the locations where borings were placed, increased the total number of borings that were drilled, and increased the total number of soil samples that were collected. Metallic objects, including empty shell casing fragments, were identified in the burn area and the burn pit by geophysical tools and visual observations. The risk of encountering UXO caused some of the boring locations to be moved. The need to collect soil samples from additional locations arose as a result of information obtained from interviews with NSWC Crane personnel; these interviews occurred during Round 1 site characterization work (see Appendix A-1). The amended soil sampling plan called for 116 soil samples to be collected from 48 soil borings (Table 4-2A in Appendix A-1).

A total of 48 soil borings (03SB01 through 03SB48, see Figure 1-7) were drilled in June 2001 during Round 1 of the RFI. Of these 48 soil borings, 28 were advanced using DPT) to depths of 10 to 15 feet bgs. Twenty other soil borings were advanced 1 to 10 feet bgs using hand augers. Table 2-1 lists each soil boring, the date each was drilled, the method of advancement used, and the depth interval(s) from which soil samples were collected. Borings were drilled in accordance with SOP CTO126-04, contained in Appendix H of the QAPP (TtNUS, 2001b), for soil sampling and lithologic descriptive purposes.

When finished, the soil sampling activities resulted in 48 borings as planned, but only 110 soil samples were collected. The deepest soil samples in six borings (03SB09, 03SB18, 03SB23, 03SB25, 03SB26, and 03SB28) could not be collected because the hand auger or DPT core barrel encountered refusal before the intended sampling depth was reached.

### 2.3.3 Boring and Sample Logging

All soil samples collected from the soil borings were monitored immediately after the sample tool was opened and the acetate liner was cut open (for DPT borings only). A photoionization detector (PID) was passed along the length of the exposed soil core to monitor for the presence of VOCs. All PID readings were recorded on the boring logs. Soil samples collected for chemical analysis were handled in accordance with the procedures outlined in Section 2.5.1.

A lithologic description of each soil sample (Appendix B-1) and a complete log of each soil boring (Appendix A-2) were maintained by the TtNUS geologist in accordance with SOP CTO126-07, contained in Appendix H of the QAPP. Boring logs were not completed for 14 of the hand auger borings (03SB01, 03SB03, 03SB12, 03SB29, 03SB30, 03SB31, 03SB32, 03SB33, 03SB35, 03SB37, 03SB38, 03SB41, 03SB43, 03SB45) because they were all drilled to 2.0 feet deep or less, and the description of materials encountered were recorded on the soil sample collection log sheets (see Appendix B-1) instead of boring log sheets. For soil borings greater than 2.0 feet deep, information on the location, type of drilling equipment, boring number, and a complete description of materials that were encountered during drilling were entered onto each boring log sheet. In addition, depths of changes in lithology, sample moisture observations, depth to water, presence of organic vapor (i.e., PID readings), visual observance of soil discoloration, and total depth of each boring were included on each boring log, as well as any other pertinent observations. Soil boring logs are included in Appendix A-2

### 2.3.4 Boring Abandonment

When a boring was completed to the desired depth and the appropriate samples were collected, the boring was backfilled. All soil materials in DPT cores were scanned with a PID and the readings were all 0 ppm. Thus, excess soil materials were considered to be clean for backfilling purposes. Each boring was backfilled with a mixture of excess soil core materials and bentonite pellets, which were hydrated in accordance with the manufacturer's specifications.

## 2.4 MONITORING WELL INSPECTION AND REDEVELOPMENT

Sixteen existing monitoring wells in the OJT area (Figure 1-7) were identified in the QAPP to be sampled. These wells were inspected for their physical condition and integrity during well redevelopment and prior to sampling, in accordance with SOP CTO126-09 (contained in Appendix H of the QAPP). Monitoring well inspection sheets are included in Appendix B-2 of this report.

Each of the 16 existing wells were redeveloped in early June 2001 prior to sampling. The wells were developed by surging and pumping using a surge block and a small submersible pump (Whale pump). Approximate recharge rates were noted. Temperature, specific conductance, pH, turbidity, and ground water levels were measured at approximately 10-minute intervals during development and recorded on a monitoring well development record form. All well development was performed in accordance with SOP CTO126-10, contained in Appendix H of the QAPP. Well development records can be found in Appendix B-3.

Development water was containerized and discharged into the NSWC Crane permitted sanitary sewer system, in accordance with the QAPP.

## 2.5 SAMPLING OPERATIONS

This section presents the sampling methodology for all surface soil, subsurface soil, ground water, surface water, and sediment sampling activities performed at OJT/LSC in June and July, 2001. A summary of the samples collected and analytical program is included in Table 2-2. This section also describes the QC samples that were collected in the field and shipped to the laboratory in conjunction with the normal environmental samples. Sample handling, packaging, shipping, and custody procedures are described at the end of this section.

### 2.5.1 Soil Sampling

A total of 110 soil samples were collected from the 48 soil borings (Table 2-1). The soil borings ranged in depth from 1.1 to 15 feet bgs. Surface soil samples were collected from the 0- to 2-foot interval at all 48 boring locations. Sixty-two subsurface soil samples were collected from depth intervals greater than 2 feet in 34 of the 48 soil borings. Soil boring locations are shown on Figure 1-7. The depth intervals that were sampled in each boring are listed in Table 2-1. All soil samples were collected in accordance with SOP CTO126-08. Soil sample log sheets can be found in Appendix B-1.

#### 2.5.1.1 Surface Soil Sampling

A total of 48 surface soil samples were collected, one from each soil boring. The samples were collected using either a DPT core barrel with acetate liner or a decontaminated hand auger. At boring locations where a hand auger was used, the ground surface was cleared of vegetation and debris first and a VOC sample was collected using an Encore sampling device prior to the use of the hand auger. When a soil core was collected using a DPT rig, the VOC sample was collected directly from the soil core using an Encore sampler. All surface soil samples were monitored with a PID, placed into the appropriate sample containers, labeled, sealed in a plastic bag, and placed in a cooler containing ice immediately after collection. The parameters that were analyzed for each sample are listed in Table 2-2.

#### 2.5.1.2 Subsurface Soil Sampling

A total of 62 subsurface soil samples were collected from 34 soil borings using either 4-foot clear plastic sleeves placed inside the direct-push core sampler or a hand auger. The depth intervals sampled in each

boring are identified in Table 2-1. All samples collected from the borings were screened with a PID, placed in the appropriate sample containers, labeled, and placed in a cooler containing ice immediately after collection. Samples for VOC analysis were collected directly from the soil core materials using an Encore sampler. If detectable levels of VOCs wee measured, the EnCore samples were collected from the core interval with the greatest VOC concentration.

### 2.5.2 Ground Water Sampling

Prior to sampling of monitoring wells, the wells were redeveloped, a synoptic set of water levels was measured on June 12, 2001, and the wells were purged using the low-flow purge technique (SOP CTO126-16 found in Appendix H of the QAPP). Ground water samples were collected between June 7 and July 11, 2001 from the 16 existing monitoring wells in accordance with SOP CTO126-05, which is contained in Appendix H of the QAPP. Ground water sample log forms can be found in Appendix B-4.

#### 2.5.2.1 Well Purging

Purging was accomplished using low-flow techniques, in accordance with SOP CTO126-16, with either a surface peristaltic pump or downhole bladder pump. The peristaltic and bladder pumps were decontaminated between each monitoring well. New Teflon tubing for was placed on the pumps for each well. In addition, a new Teflon bladder was used each time a well was purged and sampled using a bladder pump. Water temperature, pH, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), turbidity, and water levels were measured at approximately 10-minute time intervals during the purging process.

When the well cap was opened, a PID reading within the riser pipe was taken prior to purging. Following collection and recording of the PID reading, the water level and the total depth of the monitoring well were measured to within 0.01-foot accuracy from the marked location on the top of the well riser pipe, using the electronic water-level indicator. Water levels were monitored every 5 to 10 minutes as purging occurred.

Initially, the pumping rate was set at approximately 100 milliliters (mL) per minute, or lower when possible. If little or no drawdown occurred, the pumping rate was increased to a maximum of about 160 mL per minute. The pumping rates were adjusted to prevent drawdown from exceeding 0.3 foot, if possible, during purging. During purging, water-quality parameters (pH, turbidity, specific conductance, temperature, ORP, and DO) were measured and recorded every 5 to 10 minutes on a low-flow purge data sheet (see Appendix B-4) using a multi-parameter meter. Well purging continued until all parameters stabilized and the minimum purge volume (static well volume plus the extraction tubing volume) had been

removed. A well was considered stabilized when the field parameter measurements stayed within the following tolerance limits during three consecutive measurements:

- Temperature ± 3%
- pH ± 0.1 standard units
- Turbidity < 10 nephelometric turbidity units (NTUs)
- Specific conductance ± 3%
- DO ± 10%

The pumping rate was reduced below 100 mL per minute if turbidity exceeded 10 NTUs after all the other field parameters had stabilized If the field parameters did not stabilize within 4 hours, the water-quality parameter values were recorded on the well purge log sheets and the sample collection log sheets and sampling was initiated.

Purge water was collected in appropriate containers and discharged into the NSWC-permitted sanitary sewer system, in accordance with the QAPP

#### 2.5.2.2 Monitoring Well Sampling

All monitoring wells were sampled using low-flow purging and sampling techniques. The monitoring wells were sampled using the same decontaminated pump (peristaltic or bladder) and new tubing that were used during well purging Immediately following the purging process and before sampling, the temperature, pH, specific conductance, DO, ORP, and turbidity of the well water were measured and recorded on the ground water sample log form. Results of these field measurements are presented in Figure 6-1.

All sample containers were filled by placing the pump discharge tube at the top of a partially tipped container (without actually touching the container) and allowing the discharge water to gently flow down the inside of the container with minimal turbulence. Immediately after collection, these samples were labeled, tagged, sealed in a plastic bag, and placed in a cooler containing ice prior to shipment to the fixed-base laboratory. In addition, a sample aliquot was also collected for field analysis of nitrite and nitrate. These aliquots were also sealed and placed in a cooler containing ice immediately after collection. Upon arriving at the field office, all nitrite and nitrate samples were either analyzed immediately or were refrigerated at 4°C and analyzed within 24 hours. Ground water samples were analyzed for the parameter groups listed in Table 2-2.

### 2.5.3 Surface Water Sampling

In the QAPP (TtNUS, 2001b, Figures 4-2 and 4-3), 15 surface water sampling locations were identified for sampling. During June 2001, very little rain fell at NSWC Crane and most portions of the LSC streambed were dry and surface water could not be sampled at all the locations identified in the QAPP (only 9 of 15 stream locations could be sampled in June 2001). Surface water sampling locations are shown on Figure 1-8.

Between September 8 and 9, 2001, 1.25 inches of rain fell at NSWC Crane. A set of high-flow surface water samples was collected on September 9, 2001 to represent chemical conditions in the stream during high flow. These samples were collected at 14 of the 15 stream sampling locations identified in the QAPP A surface water sample was not collected at location 03SW04 because this upgradient location, which is positioned at the head of an unnamed tributary above the ABG (see TtNUS, 2001b, Figure 4-2), did not have flow in the channel at the time of either sampling event (i.e., low flow or high flow).

Surface water samples were collected as grab samples from LSC and its tributaries in accordance with SOP CTO126-19 (Appendix H of the QAPP, TtNUS, 2001b). A surface water sample was collected before the sediment sample at each sampling location in order to minimize the possibility of introducing sediment into the water column The surface water sample bottles were filled directly in the flowing water, using the direct-fill method. The aliquot for dissolved metals analyses was collected in an unpreserved high-density polyethylene (HDPE) container; the sample was then filtered through a disposable 0.45-um filter cartridge. A peristaltic pump and new Teflon tubing for each sample were used to perform the filtration within 4 hours or less after sample collection. The filtrate was collected directly into the sample container containing acid preservative.

Immediately after collection, all sample containers were sealed, properly labeled, tagged, sealed in plastic bags, and placed in a cooler containing ice. For each sample, the sampling location description and all pertinent field data were recorded on a surface water sample log sheet, including DO, ORP, pH, specific conductance, water temperature, and turbidity measurements. The surface water sample log sheets are included in Appendix B-5.

Surface water samples were analyzed for the parameter groups listed in Table 2-2.

### 2.5.4 Sediment Sampling

Thirty-eight sediment samples were collected at 19 sampling sites located along LSC and its unnamed tributaries. A surface sediment sample (0 to 6 inches deep) and a near-surface sample (6 to 12 inches deep) were collected from each of the 19 stream sampling stations. These locations were shown on Figures 4-2 and 4-3 in the QAPP (TtNUS, 2001b) and on Figure 1-8 of this report. Each pair of sediment samples was collected in a depositional area of the stream channel, where fine sediment has accumulated. The samples were collected using disposable trowels and a decontaminated shovel. The sediment samples were collected in accordance with SOP CTO126-20, contained in Appendix H of the QAPP. Sediment samples were collected from two different depths to determine whether contaminated sediment is limited to the uppermost 6 inches. Based on field conditions, sediment samples (e.g., 03SD10) may have been collected in areas that were slightly different from the planned locations. These conditions include sampling location accessibility, availability of sediments, and predominant sediment grain size. Unless otherwise noted, the actual sampling locations are viewed to be as representative of drainage channel sediments as the originally planned locations.

After collection, all sample containers were sealed, properly labeled, tagged, bagged, and placed in a cooler containing ice. A sample collection log sheet was completed for each sample. These logs included information on the date, time, sampling personnel, flow conditions at the sampling location, and a description of the sample. The sediment sample log sheets are found in Appendix B-6.

A 2- by 2-inch wooden stake was driven into the stream bank opposite the sample location, and a piece of brightly colored flagging was attached. The sampling site identification number was marked on each stake with a black waterproof marker. This was done so that sampling locations could be revisited at a later date for surveying and, if necessary, resampling.

Sediment samples were analyzed for the parameter groups listed in Table 2-2.

### 2.5.5 Quality Control Samples

QC samples were collected or generated during environmental sampling activities to monitor both field and laboratory procedures. QC samples included field duplicates, equipment rinsate blanks, batch blanks, source water blanks, matrix spikes, and temperature blanks. These types of QC samples are briefly described below:

- Field Duplicates - Field duplicates were two samples collected either independently at a single sampling location at approximately the same time, in the case of ground water and surface water, or as a single sample split into two portions, in the case of soil and sediment. Field duplicates were collected at the rate of 1 in 10 per medium and were used to assess the overall precision of the sampling and analysis program. Duplicates were analyzed for the same parameters in the laboratory and were each labeled with a unique sample number so the identify of the duplicate sample would be unknown to the laboratory (i.e., blind duplicates). During the field investigation of OJT/LSC, field duplicates were collected for five surface soil samples, nine subsurface soil samples, two ground water samples, three surface water samples, and four sediment samples.

- Equipment Rinsate Blanks and Batch Blanks - Equipment rinsate blanks were obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through or over sample collection equipment, after it was decontamined and before it was used. One equipment rinsate blank per 10 samples per aqueous matrix and 20 samples per solid matrix were collected for each type of sampling equipment used (i.e., macro-core sampling barrel). Equipment rinsate blanks were analyzed for the same chemical constituents as the associated environmental samples. During the field investigation, a total of four rinsate samples were collected and analyzed. Two rinsate samples were collected on different dates from a DPT cutting shoe, one collected from a hand auger bucket and one from a stainless-steel mixing bowl.

When pre-cleaned, dedicated, or disposable sampling equipment was used (i.e., tubing, disposable 4-foot plastic sleeves, disposable plastic trowels, etc.), one equipment rinsate blank was collected as a batch blank for each type of sampling equipment. During this field investigation, a total of four batch blank samples were collected and analyzed. One batch blank was collected for the silicon and Teflon tubing used for ground water sampling, one was collected from a disposable Teflon-lined bladder (used in bladder pumps), one was collected from a disposable plastic trowel, and one was collected from a DPT plastic liner.

- Source Water Blanks - Source water blanks were obtained by sampling and analyzing the water used for decontamination of sampling equipment. Two source water blanks were collected to verify the quality of water used to decontaminate sampling equipment: SB06230101 was the sample of deionized water and SB06230102 was a sample of tap water from Building 3245 (the field office used for select chemical measurements).

- Matrix Spikes - Matrix spikes (MS) are investigative samples analyzed to provide information about the effect of the sample matrix on the analytical process. All matrix spikes for organic constituents

were analyzed in duplicate (matrix spike duplicate; MSD); matrix spikes duplicates for inorganic constituents are not performed. MS/MSD samples were collected at a frequency of one per every 20 samples for each of the two media sampled (soil, water). During this RFI investigation, MS/MSD samples were collected for six soil, two sediment, two surface water, and two ground water samples.

- Trip Blanks – Trip blanks were prepared by the fixed-base laboratory by completely filling 40-mL vials with analyte-free water. One blank was placed in each cooler that contained soil or water samples identified for analysis of VOCs. The trip blank remains with those samples placed in the cooler during sample collection, packaging, shipping, and in the laboratory. If VOCs are detected in a trip blank, then this may be evidence that there was cross-contamination between samples or there was an introduction of VOCs to the samples between the time they were collected and the time they were analyzed. During this RFI, a total of nine trip blanks were sent to the laboratory and analyzed for VOCs.

- Temperature Blanks - Temperature blanks were used to determine whether samples were adequately cooled during shipment. Temperature blanks consisted of analyte-free water poured in a sample container. One temperature blank was submitted to the laboratory in each cooler and the temperature was checked upon receipt at the laboratory. The fixed-base laboratory reported that all coolers were received with ice and that the temperature blanks were all within the acceptable range of 4 ± 2°C.

### 2.5.6 Sample Handling, Packaging, and Shipping

The sample containers, preservatives, required analyses, and allowable holding times for each sample aliquot were specified in the QAPP. The supplier of the containers added the appropriate chemical preservatives. Sample identification nomenclature was addressed in SOP CTO126-02 (Appendix H of the QAPP).

Once sample material was placed in a sample container, the date and time of sample collection, the initials of the sample collector, and other pertinent information were completed on the sample label and tag. Glass sample containers were wrapped in plastic bubble wrap to minimize the possibility of breakage and secured in a sealed Ziploc-type plastic bag. The secured sample containers were then placed in a sturdy cooler lined with a large plastic garbage bag. The cooler was packed with a noncombustible, cushioning material (bubble wrap) to minimize container breakage. Samples were cooled with bagged ice placed around the shoulders of the sample containers. A temperature blank was placed in the cooler before shipment. The inside plastic bag liner was sealed with a knot, and the chain-

of-custody form was placed in a Ziploc-type plastic bag and taped to the inside of the cooler lid. The cooler was sealed at both ends using strapping tape, and a signed and dated custody seal was applied to the cooler (both front and back at opposite ends), beneath the last wrap of strapping tape, to provide a tamper-evident seal. A Federal Express airbill was applied to the shipping cooler. TtNUS maintained custody of the samples until they were relinquished to the carrier. The Federal Express tracking number (airbill number) was recorded on the chain-of-custody form, and the sender's copy of the airbill was maintained for shipment tracking. All samples were shipped to the laboratories using overnight priority shipping and were received within sample holding times. The procedures for sample preservation, packing, and shipment can be found in Section 4.7 of the QAPP and SOP CTO126-01, which is located in Appendix H of the QAPP (TtNUS, 2001b).

### 2.5.7 Field Sample Documentation

Sample documentation consisted of the completion of field logbooks (Section 2.13), sample logsheets, sample labels, and the chain-of-custody forms. The sample log sheets contain information such as container source and description; sample type; and time, date, field parameters, and method of sample collection. The sample label contains information on the sample identification number, medium type, and analyses required. The chain-of-custody forms (Appendix B-7) track each sample from collection to receipt and analyses at the laboratory. The field samples were documented in accordance with SOP CTO126-01 (Sample Labeling), CTO126-02 (Sample Identification Nomenclature), and CTO126-03 (Sample Custody and Documentation of Field Activities), which are contained in Appendix H of the QAPP (TtNUS, 2001b).

## 2.6 FIELD MEASUREMENTS

Field measurements were taken and recorded during field sampling operations. Ambient air quality was measured using a PID. Ambient air-quality measurements included monitoring of organic vapors in the breathing zone during intrusive field investigation activities and monitoring of organic vapors emanating from site sources such as soil samples, borings, and well casings. SOP CTO126-06 (found in Appendix H of the QAPP) provides additional details concerning the calibration, maintenance, and use of a PID.

The YSI Model 650, a multi-parameter water-quality meter, was used for both ground water and surface water field measurements. Water-quality parameters included water temperature, pH, specific conductance, ORP, and DO. A LaMotte 2020 turbidity meter was used to measure turbidity in water samples. SOP CTO126-14 (found in Appendix H of the QAPP) provides details concerning the calibration, operation, and maintenance of the water-quality meters.

Water-level measurements were obtained using an electronic water-level indicator. SOP CTO126-18 (found in Appendix H of the QAPP) provides details concerning the maintenance and use of the water-level indicator.

Nitrate and nitrite were measured in the field office using Hach field test kits and a Hach DR-850 colorimeter. The calibration and use of the colorimeter are described by the manufacturer's user's manual.

### 2.6.1 Equipment Calibration

Instruments used in the field were calibrated using procedures and frequencies according to manufacturer's specifications. Field equipment calibration was documented on equipment calibration log sheets, which are provided in Appendix B-8.

### 2.6.2 Field Instrument Preventive Maintenance Procedures/Schedule

The field instruments for this project included the PID, water-level indicator, two water-quality meters, and field test kits for nitrate and nitrite. The specific preventive maintenance procedures that were followed for field equipment were those recommended by the manufacturer.

An appropriate maintenance check was performed daily on each piece of equipment prior to use. If damaged or defective parts were identified during the maintenance check and it was determined that the damage could have an impact on the instrument's performance, the instrument was removed from service until the defective parts were repaired or replaced. Critical spare parts were kept on site to reduce downtime. Spare parts included batteries, a DO-probe membrane kit (membranes and a bottle of solution), and inline dust and moisture filters for the PID. Back-up instruments and equipment were available on site or were shipped within 1 day via overnight courier to avoid delays in the field schedule.

## 2.7 WATER-LEVEL AND STREAM FLOW MEASUREMENTS

### 2.7.1 Water-Level Measurements

One round of synoptic water-level measurements was obtained on June 12, 2001 in the 16 monitoring wells located closest to the OJT/LSC (Table 1-4). These data were used to provide information regarding ground water flow patterns and flow gradients in the immediate area during dry, low stream flow conditions. The synoptic round of water-level measurements was taken within a 3-hour period. The

results of these water-level measurements and a potentiometric surface map are presented in Figure 1-19.

A second round of synoptic water-levels in the 16 monitoring wells located closest to the OJT site was measured on September 9, 2001 (Table 1-4) toward the end of a relatively large storm event (1.25 inches of rain fell during a 24-hour period). This second set of measurements represents wet weather (high flow) ground water conditions. The ground water elevations and potentiometric surface map for this date are presented in Figure 1-20.

A third, much more comprehensive set of water levels (ground water and surface water) was measured on June 12 and 13, 2002, during a period of no rainfall that was preceded by a period of moderate rainfall. Water levels were measured in 120 monitoring wells and four stream gaging stations, which were distributed through a large portion of the LSC watershed. The monitoring wells are screened in four different aquifers, as discussed in Section 1.3.4. This large set of synoptic water levels was used to characterize and evaluate the regional nature of the flow system in the BC-BC aquifer. Ground water elevations and potentiometric contours for the measurements in the BC-BC aquifer are presented in Figure 1-18.

Water-level measurements were taken with an electronic water-level indicator, using the top of the riser pipe as the reference point for determining depths to water. A notch or mark was placed on the top of the riser pipe to ensure that measurements were taken from the same reference point between measuring events. All measurements were made in accordance with SOP CTO126-18, contained in Appendix H of the QAPP. Water-level measurements were recorded on water-level measurement sheets, which are included in Appendix B-9 of this report.

### 2.7.2 Staff Gage Installation and Estimation of Stream Flow

Seven staff gages were installed along LSC, starting at a point along the ABG Treatment Area (03SG01) and extending downstream to the facility boundary (03SG07). The locations of these stream flow gaging stations are shown on Figure 1-8. The staff gages were placed at approximately equidistant locations in order to collect spacial distribution of flow rate in the stream channel. Existing permanent structures, such as culverts and bridge abutments, were used as much as possible as staff gage locations so that flow was constricted to a simple geometry. A mark and staff gage identification number were placed on these permanent structures, denoting the point where measurements were taken. If a permanent structure was not available, a metal pipe was pounded into the sediment with a sledge hammer and the top of the pipe was used as the reference point.

The stream water surface elevation was measured at each gaging station by measuring the vertical distance between the water surface and the reference point and subtracting that distance from the reference point elevation (assuming there was flowing water at the gaging station). All surface water elevations were measured at the same time as the ground-water-level measurements in monitoring wells. Staff gages and monitoring well water levels were measured three times during the course of the OJT/LSC RFI field work in 2001 and 2002 (June 12, 2001; September 09, 2001; and June 12 and 13, 2002). These data are included in Appendix B-9.

The approximate flow rates of surface water at four staff gage locations (03SG01 and 03SG05 through 03SG07) were estimated for June 19, 2001 by measuring the cross-sectional depth profile of the stream bed and the surface water flow velocity, in accordance with SOP CTO126-21 (found in Appendix H of the QAPP). The creek was dry at three of the staff gages (03SG02 through 03SG04) on this date. The calculated flow rates (see Appendix B-10) were used to qualitatively evaluate gains and losses of stream flow through the watershed.

### 2.7.3 Hydraulic Testing of Monitoring Wells

During the low-flow purging of monitoring wells prior to collection of ground water samples, water levels were measured in the well at the beginning of purging and about every 5 to 10 minutes during purging (Appendix B-11, Attachment 1). The data were later analyzed by two different procedures to obtain hydraulic conductivity values for the geologic materials in contact with the well screens. The first method used for data analysis was the Ogden method, as described by Kasenow and Pane (1995). This method uses the steady-state drawdown value, pumping rate, and other parameters in order to calculate a hydraulic conductivity (see Appendix B-11, Attachment 2). The Ogden method does not make use of the transient water levels during purging; it only uses the final drawdown value. This type of data analysis was performed for data from 15 of the monitoring wells that were sampled. There was zero drawdown in well 03-21 during purging; the hydraulic conductivity is presumably too great to be calculated with testing data available. The results of the 15 other tests are reported in Appendix B-11 (Attachment 3) and Table 1-2.

The second method used for data analysis is the Jacob straight-line method, as described by Fetter (1988). The transient water levels measured during purging were used to construct a graph on semi-log paper, and the straight-line portion of each graph was used to calculate a hydraulic conductivity value for the well (see Appendix B-11, Attachment 4). Data from only eight of the wells resulted in straight-line

sections that could be evaluated. The results of these analyses are presented in Appendix B-11 (Attachment 5) and Table 1-2.

Hydraulic conductivity values resulting from the low-flow purge tests range from 0.058 to 4.08 feet/day. For the eight monitoring wells where the drawdown data could be analyzed by two different methods, the results were very comparable for each well.

## 2.8 FIELD CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or "out of quality control" performance that can affect data quality.

Corrective action in the field resulted when the sample network was changed (i.e., more or fewer samples collected, sampling locations other than those specified, etc.) and sampling procedures and/or field analytical procedures required modification. Project personnel were responsible for reporting all suspected technical or quality assurance (QA) nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the FOL or designee. The task order manager (TOM) was responsible for assessing the suspected problems in consultation with the project QA/QC manager and for making a decision based on the potential for the situation to affect the quality of the data. If it was determined that the situation warranted a reportable nonconformance requiring corrective action, then a nonconformance report was initiated by the TOM. Nonconformances, suspected deficiencies, or field task modification requests did not occur during this field investigation.

During the field sampling activities, several site conditions were encountered that altered the locations where borings were placed, increased the total number of borings that were drilled, and increased the total number of soil samples that were collected. Metallic objects, including empty shell casing fragments, were identified in the burn area and the burn pit by geophysical tools and visual observations. Because of the risk of possibly encountering UXO, some of the boring locations were relocated. The need to collect soil samples from additional locations arose as a result of information that was obtained from interviews with NSWC Crane personnel that occurred on June 21, 2001, during Round 1 site characterization work. These situations are described in previous sections of this report (see Section 2.3.1).

## 2.9 SURVEYING

All monitoring wells, soil borings, staff gages in the creek, and surface soil, surface water, and sediment sample locations associated with this RFI were surveyed by an Indiana-licensed surveyor. All ground surface elevations were surveyed to the nearest 0.01 foot. Vertical elevations were referenced to the 1929 National Geodetic Vertical Datum (NGVD29). Existing survey monuments around NSWC Crane were used as reference points. Horizontal locations of samples, borings, and wells were surveyed to Indiana State Plane coordinates within the nearest 0.10 foot and referenced to the 1927 North American Datum (NAD27). The results of the engineering survey are included as Appendix D.

## 2.10 DECONTAMINATION

The equipment involved in field sampling activities was decontaminated before beginning work, during drilling and sampling activities, and at the completion of the project. This equipment included the DPT rig and down-hole tools and soil, sediment, and ground water sampling equipment.

All nondedicated reusable sampling equipment used to collect samples was decontaminated both before field sampling, between samples, and before leaving the site. This equipment included DPT rods, macro-core sampler, and bladder pumps. The following decontamination steps were taken:

- Potable water, phosphate-free detergent wash (scrub if necessary)
- Potable water rinse
- Deionized (DI) water rinse
- Air dry (if possible)
- Wrap in aluminum foil (if not used immediately)

The DPT rig was cleaned upon site arrival and prior to leaving the site. Additional guidance for decontamination was supplied in SOP CTO126-17 (Appendix H of the QAPP).

Disposable equipment used for sampling activities was decontaminated using a detergent wash and potable water rinse, placed in plastic garbage bags, and discarded in dumpsters on the NSWC Crane facility in accordance with procedures described in SOP CTO126-15 of the QAPP.

Field analytical equipment such as pH, conductivity, and temperature probes was rinsed with analyte-free water. Water-level measurement devices were also rinsed with analyte-free water after each use.

## 2.11 INVESTIGATION-DERIVED WASTE HANDLING

This investigation generated four types of potentially contaminated residues or investigation-derived waste (IDW):

- Personal protection equipment (PPE)
- Teflon ground water sample tubing, teflon well bladders, DPT soil core liners, and plastic trowels
- Well development and purge fluids
- Equipment decontamination fluids

IDW was handled as described below and in SOP CTO126-15:

PPE, Tubing, Teflon Pump Bladders, DPT Soil Core Liners, Plastic Trowels - All PPE, tubing, DPT sample liners, and plastic trowels were decontaminated and double bagged and placed in trash receptacles at the facility

Well Development and Purge Fluids - All well development and purge fluids were collected and stored on site in a 500-gallon plastic holding tank. The development and purge fluids were discharged into the NSWC-permitted sanitary sewer system, in accordance with the QAPP.

Equipment Decontamination Fluids - All DPT and sampling decontamination fluids were combined with well development and purge fluids and handled in the same manner as described for well development and purge fluids.

## 2.12 SITE MANAGEMENT AND FACILITY SUPPORT

The FOL was designated as the lead in coordinating all day-to-day activities during the investigation. The FOL was responsible for ensuring that all field team members (including subcontractors) were familiar with the FSP and site-specific HASP. Additionally, the FOL was responsible for all sampling operations, QA/QC, field documentation requirements, and field change orders. The FOL regularly reported to the TOM regarding the status of fieldwork.

All site preparation, mobilization/demobilization, and sampling activities were coordinated through NSWC Crane personnel.

## 2.13 RECORDKEEPING

Various hardcover, bound record books were maintained for each field activity in accordance with SOP CTO126-03 (Appendix H of the QAPP). The Master Site Logbook served as the overall record of field activities. Information recorded daily in the Master Site Logbook included daily field activities, weather conditions, identity of and arrival and departure times of personnel, management issues, etc. Various field notebooks were also maintained. For example, the site geologist supervising DPT operations maintained a field notebook and recorded all relevant field activities associated with DPT operations and hand augering. Copies of field logbooks are included in Appendix C.

The FOL was responsible for the maintenance and security of all field records. Eventually, all field records (chain-of-custody forms, sample log sheets, field forms, logbooks, and notebooks) were docketed and incorporated in the central project file.

**TABLE 2-1**

**DATES AND DEPTHS OF SOIL BORINGS AND SOIL SAMPLES COLLECTED**
**SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

| Boring No. | Total Depth (feet bgs) | Drilling Method [1] | Date Drilled | Depth Interval(s) of Soil Samples (feet bgs) |
|---|---|---|---|---|
| 03SB01 | 2 | HA | 8-Jun-01 | 0-2 |
| 03SB02 | 10 | DPT | 19-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB03 | 2 | HA | 8-Jun-01 | 0-2 |
| 03SB04 | 10 | DPT | 19-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB05 | 10 | DPT | 19-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB06 | 10 | DPT | 19-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB07 | 10 | DPT | 19-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB08 | 10 | DPT | 19-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB09 | 3.5 | HA | 23-Jun-01 | 0-2, 2-3.5 |
| 03SB10 | 10 | DPT | 20-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB11 | 10 | DPT | 19-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB12 | 2 | HA | 8-Jun-01 | 0-2 |
| 03SB13 | 10 | DPT | 20-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB14 | 10 | DPT | 20-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB15 | 10 | DPT | 20-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB16 | 10 | DPT | 20-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB17 | 15 | DPT | 20-Jun-01 | 0-2, 4-6, 12-14 |
| 03SB18 | 4 | HA | 24-Jun-01 | 0-2, 2-4 |
| 03SB19 | 15 | DPT | 21-Jun-01 | 0-2, 2-4, 12-15 |
| 03SB20 | 15 | DPT | 20-Jun-01 | 0-2, 8-10, 12-15 |
| 03SB21 | 15 | DPT | 20-Jun-01 | 0-2,10-12, 12-15 |
| 03SB22 | 15 | DPT | 21-Jun-01 | 0-2, 2-4, 12-15 |
| 03SB23 | 10 | HA | 24-Jun-01 | 0-2, 6-10 |
| 03SB24 | 15 | DPT | 21-Jun-01 | 0-2, 4-6, 12-15 |
| 03SB25 | 13 5 | DPT | 20-Jun-01 | 0-2, 6-8 |
| 03SB26 | 10 | HA | 24-Jun-01 | 0-2, 6-10 |
| 03SB27 | 7 | HA | 24-Jun-01 | 0-2, 2-6, 6-7 |
| 03SB28 | 4 | HA | 24-Jun-01 | 0-2, 2-4 |
| 03SB29 | 1 1 | HA | 8-Jun-01 | 0-1.1 |
| 03SB30 | 1 65 | HA | 8-Jun-01 | 0-1.65 |
| 03SB31 | 2 | HA | 8-Jun-01 | 0-2 |
| 03SB32 | 2 | HA | 8-Jun-01 | 0-2 |
| 03SB33 | 1.1 | HA | 8-Jun-01 | 0-1.1 |
| 03SB34 | 10 | DPT | 22-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB35 | 2 | HA | 23-Jun-01 | 0-2 |
| 03SB36 | 10 | DPT | 22-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB37 | 2 | HA | 23-Jun-01 | 0-2 |
| 03SB38 | 2 | HA | 23-Jun-01 | 0-2 |
| 03SB39 | 10 | DPT | 22-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB40 | 10 | DPT | 22-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB41 | 2 | HA | 23-Jun-01 | 0-2 |
| 03SB42 | 10 | DPT | 22-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB43 | 1 | HA | 23-Jun-01 | 0-1.0 |
| 03SB44 | 10 | DPT | 20-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB45 | 2 | HA | 23-Jun-01 | 0-2 |
| 03SB46 | 10 | DPT | 22-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB47 | 10 | DPT | 22-Jun-01 | 0-2, 2-6, 6-10 |
| 03SB48 | 10 | DPT | 22-Jun-01 | 0-2, 2-6, 6-10 |

1 HA = Hand auger, DPT = Direct-push technology

TABLE 2-2

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSES
SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Sample Number[1] | Analytical Fraction | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dioxin | EXP | HERB | Metals | NTA | NTI | NTIA | OS | OV | PCB | PCL | PEST | pH | PAH | TOC | TSS |
| **Surface Soil Samples** | | | | | | | | | | | | | | | | |
| 03SS010002 | | X | | | X | X | X | | | | X | | | | | |
| 03SS020002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS030002 | | X | | | X | X | X | | | | X | | | | | |
| 03SS040002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS050002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS060002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS070002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS080002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS090002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS100002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS110002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS120002 | | X | | | X | X | X | | | | X | | | | | |
| 03SS130002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS140002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS150002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS160002 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SS170002 | X | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS180002 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS190002 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS200002 | X | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS210002 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS220002 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS230002 | X | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS240002 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS250002 | X | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS260002 | X | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS270002 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS280002 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS290002 | X | X | X | X | X | X | X | X | | X | X | X | | X | | |
| 03SS300002 | X | X | X | X | X | X | X | X | | X | X | X | | X | | |
| 03SS310002 | X | X | X | X | X | X | X | X | | X | X | X | | X | | |
| 03SS320002 | X | X | X | X | X | X | X | X | | X | X | X | | X | | |
| 03SS330002 | X | X | X | X | X | X | X | X | | X | X | X | | X | | |
| 03SS340002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS350002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS360002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS370002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS380002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS390002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS400002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS410002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS420002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS430002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS440002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS450002 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SS460002 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS470002 | X | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SS480002 | | X | | X | X | X | X | X | X | | X | | | X | | |

TABLE 2-2

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSES
SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Sample Number[1] | Analytical Fraction | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dioxin | EXP | HERB | Metals | NTA | NTI | NTIA | OS | OV | PCB | PCL | PEST | pH | PAH | TOC | TSS |
| **Subsurface Soil Samples** | | | | | | | | | | | | | | | | |
| 03SB020206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB020610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB040206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB040610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB050206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB050610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB060206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB060610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB070206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB070610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB080206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB080610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB090204 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB100206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB100610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB110206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB110610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB130206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB130610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB140206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB140610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB150206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB150610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB160206 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB160610 | | X | | | X | X | X | X | | | X | | | X | | |
| 03SB170406 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB171214 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB180204 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB190204 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB191215 | X | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB200810 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB201215 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB211012 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB211215 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB220204 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB221215 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB230610 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB240406 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB241215 | X | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB250608 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB260610 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB270206 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB270607 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB280204 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB340206 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB340610 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB360206 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB360610 | | X | | X | X | X | X | X | | | X | | | X | | |

TABLE 2-2

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSES
SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Sample Number[1] | Analytical Fraction | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dioxin | EXP | HERB | Metals | NTA | NTI | NTIA | OS | OV | PCB | PCL | PEST | pH | PAH | TOC | TSS |
| 03SB390206 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB390610 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB400206 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB400610 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB420206 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB420610 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB440206 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB440610 | | X | | X | X | X | X | X | | | X | | | X | | |
| 03SB460206 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB460610 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB470206 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB470610 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB480206 | | X | | X | X | X | X | X | X | | X | | | X | | |
| 03SB480610 | | X | | X | X | X | X | X | X | | X | | | X | | |
| **Sediment Samples** | | | | | | | | | | | | | | | | |
| 03SD010006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD010612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD020006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD020612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD030006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD030612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD040006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD040612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD050006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD050612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD060006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD060612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD070006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD070612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD080006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD080612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD090006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD090612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD100006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD100612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD110006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD110612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD120006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD120612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD130006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD130612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD140006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD140612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD150006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD150612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD160006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD160612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD170006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD170612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |

TABLE 2-2

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSES
SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Sample Number[1] | Analytical Fraction | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dioxin | EXP | HERB | Metals | NTA | NTI | NTIA | OS | OV | PCB | PCL | PEST | pH | PAH | TOC | TSS |
| 03SD180006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD180612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD190006 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 03SD190612 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| **Ground Water Samples** | | | | | | | | | | | | | | | | |
| 03GW0701 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW1001 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW1101 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW1201 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW1301 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW1401 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW1501 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW1601 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW1701 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW1801 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW2001 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW2101 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW2201 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW2301 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW2401 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW2501 | | X | | X | X | X | | X | X | | X | | | X | | |
| 03GW2501-F | | | | X | | | | | | | | | | | | |
| **Surface Water Samples[1]** | | | | | | | | | | | | | | | | |
| 03SW0101 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0101-F | | | | X | | | | | | | | | | | | |
| 03SW0102 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0102-F | | | | X | | | | | | | | | | | | |
| 03SW0201 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0201-F | | | | X | | | | | | | | | | | | |
| 03SW0202 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0202-F | | | | X | | | | | | | | | | | | |
| 03SW0301 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0301-F | | | | X | | | | | | | | | | | | |
| 03SW0302 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0302-F | | | | X | | | | | | | | | | | | |
| 03SW0601 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0601-F | | | | X | | | | | | | | | | | | |
| 03SW0602 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0602-F | | | | X | | | | | | | | | | | | |
| 03SW0802 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0802-F | | | | X | | | | | | | | | | | | |
| 03SW0902 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW0902-F | | | | X | | | | | | | | | | | | |
| 03SW1102 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1102-F | | | | X | | | | | | | | | | | | |
| 03SW1302 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1302-F | | | | X | | | | | | | | | | | | |
| 03SW1402 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1402-F | | | | X | | | | | | | | | | | | |

TABLE 2-2

SUMMARY OF ENVIRONMENTAL SAMPLES AND LABORATORY ANALYSES
SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Sample Number[1] | Analytical Fraction | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dioxin | EXP | HERB | Metals | NTA | NTI | NTIA | OS | OV | PCB | PCL | PEST | pH | PAH | TOC | TSS |
| 03SW1501 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1501-F | | | | X | | | | | | | | | | | | |
| 03SW1502 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1502-F | | | | X | | | | | | | | | | | | |
| 03SW1601 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1601-F | | | | X | | | | | | | | | | | | |
| 03SW1602 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1602-F | | | | X | | | | | | | | | | | | |
| 03SW1701 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1701-F | | | | X | | | | | | | | | | | | |
| 03SW1702 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1702-F | | | | X | | | | | | | | | | | | |
| 03SW1801 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1801-F | | | | X | | | | | | | | | | | | |
| 03SW1802 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1802-F | | | | X | | | | | | | | | | | | |
| 03SW1901 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1901-F | | | | X | | | | | | | | | | | | |
| 03SW1902 | | X | X | X | | | | X | X | X | X | X | | X | | X |
| 03SW1902-F | | | | X | | | | | | | | | | | | |

EXP - Explosives
HERB - Herbicides
NTA - Nitrate
NTI - Nitrite
NTIA - Nitrate/nitrite
OS - Semivolatiles
OV - Volatiles
PCB - Polychlorinated biphenyls
PCL - Perchlorate
PEST - Pesticide
PAH - Polynuclear aromatic hydrocarbon
TOC - Total organic carbon
TSS - Total suspended solids

1 - Low flow samples end with 01 and high flow samples end with 02. "-F" indicates a filtered sample aliquot was analyzed for dissolved metals

# 3.0 DATA QUALITY REVIEW

This section contains a description of the data review procedures used to determine whether analytical laboratory data are of acceptable technical quality before decisions are made. The review begins with data validation, which is a comparison of data quality indicators against prescribed acceptance criteria. The data quality indicators are measures used to assess the bias and precision of the analytical calibrations and sample analyses. The output of this review is a set of alphabetic flags such as "U," "J," "R," or combinations thereof that may be assigned to each result based on the validation effort. These flags are used to infer the general quality of the data. The data validation is followed by a summary of quantitative data quality measures to provide the user with a more quantitative estimate of any bias or imprecision associated with the data. Also evaluated are the measures of data completeness, sensitivity, comparability and representativeness.

Sections 3.1 and 3.2 provide an overview of the data validation process. Section 3.3 presents an evaluation of the data quality beyond data validation. Appendix E contains all the qualified data and the associated reasons for the data qualifications.

## 3.1 DATA VALIDATION PROCESS

Assignment of data qualification flags conformed to the U.S. EPA Region 5 Standard Operating Procedures for Validation of Contract Laboratory Program Organic Data (U.S. EPA, 1993c) and Region 5 Standard Operating Procedures for Validation of Contract Laboratory Program (CLP) Inorganic Data (U.S. EPA, 1993d), the U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (U.S. EPA, 1994a), and the U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (U.S. EPA, 1994b) to the greatest extent practicable for non-CLP data.

One hundred percent of the analytical laboratory samples were validated according to these data validation specifications. The various data qualifiers are defined, as follows:

U - Indicates that the chemical was not detected at the numerical detection limit (sample-specific detection limit) noted. Non-detected 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 detection limit) is considered 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 necessarily an accurate 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 non-detected 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 non-compliances, and extremely low analyte 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.

The preceding data qualifiers may be categorized as indicative of major or minor problems. Major problems are defined as issues that result in the rejection of data, qualified with UR and R data validation qualifiers. These data are considered invalid and are not used for decision-making purposes unless they are used in a qualitative way and the use is justified and documented. Minor problems are defined as issues resulting in the estimation of data, qualified with U, J, or UJ data validation qualifiers. Estimated analytical results are considered to be suitable for decision-making purposes unless the data use requirements are very stringent and the qualifier indicates a deficiency that is incompatible with the intended data use. It is noteworthy that a "U" qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the "U" qualifier even when no deficiency exists.

A "B" flag is assigned by the laboratory to organic analysis results that could represent an influence from laboratory contamination. In accordance with the EPA Region 5 organic data validation criteria, no "Bs" were removed from the laboratory data. Therefore, organic data qualified due to blank contamination contain combinations of the "B" qualifier (B, BU, or BJ).

## 3.2 DATA VALIDATION OUTPUTS

After data were validated, a list was developed of non-conformities requiring data qualifier flags, which were used to alert the data user to inaccurate or imprecise data. For situations in which several quality

control criteria were out of specification, the data validator made professional judgments and/or comments on the validity of the overall data package. The reviewer then prepared a technical memorandum presenting qualification of the data, if necessary, and the rationale for making such qualifications. The net result is a data package that has been carefully reviewed for its adherence to prescribed technical requirements. Validators incorporated data qualifiers into the electronic database and submitted the information to the data management group. A complete printout of the data with validation flags is presented in Appendix E. Some of these results are summarized in a more quantitative and manageable format in the following section.

## 3.3 GENERAL DATA QUALITY REVIEW

Data quality indicators (DQIs) are parameters that are monitored to help establish the quality of data generated during an investigation. Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). Taken together, the DQIs provide a more quantitative measure of the overall analytical performance than that provided by data validation flags.

All individual QC results have been considered in qualifying the data. If no outliers are discussed for a particular DQI, all data associated with that DQI were acceptable as compared to DQ control criteria specified by the laboratory performing the analysis or by the analytical method performed. However, the data quality review is not meant to identify data that are acceptable or unacceptable according to DQ control criteria. Instead, it is designed to provide a quantitative measure of analytical performance that is not provided by data validation. The use of average RPDs is explicitly identified in the text of this section; in all other cases, RPDs refer to individual RPD values for individual analytes.

The data for the OJT/LSC site were of generally good quality, with the following exceptions:

Nitrite - The percent completeness for the nitrite analyses was 72.9 percent due to an extremely low matrix spike recovery. However, the nitrite analyses were not used in the risk assessment and were not considered critical to the success of the project.

Semivolatile - The compounds 1,4-phenylenediamine, 4-nitroquinoline-1-oxide, and kepone constitute the majority of the results rejected for the semivolatile analyses. The rejections were because these compounds yield poor analytical responses. This is a systematic problem that occurs in the majority of the samples analyzed from OJT/LSC.

Volatile - The compounds acrolein and acrylonitrile were the majority of the results rejected for the volatile analyses. The rejections were because these compounds yield poor analytical responses. This is a systematic problem that occurs in the majority of the samples analyzed from the OJT/LSC.

Herbicides - The percent difference between chromatographic columns of greater than 100 percent for compounds 2,4-D and pentachlorophenol was the reason for their rejection in the majority of samples analyzed from the OJT/LSC. Spot checks of several chromatograms show interferences co-eluting with these compounds.

Several data were rejected and the rejected data are identified in the following sections. Rejection of data for this project does not appear to have adversely affected the achievement of project objectives for one or more of the following reasons·

- The affected compound (e.g., 1,4-phenylenediamine, 3,3'-dimethylbenzidine, 4-nitroquinoline-1-oxide, acrolein, acrylonitrile, methacrylonitrile, kepone, and methyl iodide) is not expected to have been associated with SWMU 03 operations or otherwise released at the SWMU.

- The affected compound is inherently unstable, volatile, or reactive (e.g., acrolein and acrylonitrile in all media and 2-butanone in surface water) and not likely to persist in the environment unless large quantities had been released.

- Just a few data points were rejected (4-chloroaniline, cis-1,2-dichloroethene, HMX, and select phenols) at a few locations.

- The rejected data were primarily for field QC samples or common laboratory contaminants (acetone).

Nitrite, a chemical for which several data points were rejected, is not critical to the success of the project so rejection of that data is unfortunate but not a serious handicap.

Rejection of data for these chemicals is not discussed further unless such discussion is warranted in a particular context.

The various DQIs are discussed in detail below. In addition to the DQIs discussed below, temperature blanks that accompanied each cooler containing samples were used to assess whether the samples had

been stored at the appropriate temperature during shipping. All temperature blanks fell within the acceptance range of 4°C ± 2°C, indicating no deficiencies with regard to shipping temperature.

### 3.3.1 Completeness

Completeness is measured according to sample completeness, field completeness, and laboratory completeness. Completeness is expressed as a percentage.

#### Sample Completeness

Sample completeness is a measure of the number of samples proposed in the OJT/LSC QAPP (TtNUS, 2001b) and the number of samples actually collected. Table 3-1 compares the samples collected to the samples proposed in the Jeep Trail QAPP (TtNUS, 2001b). The percent completeness for ground water and sediment samples was 100 percent. The percent completeness for soil samples was 94.8 percent; six soil boring samples (5.2 percent of the total number of samples) were not collected because refusal was encountered before the planned sampling depth was reached. There is no negative impact; the entire soil column will be represented adequately by the samples that were collected. The calculated percent completeness for surface water samples was 76.7 percent; seven samples were not collected due to dry sample locations. The samples not collected were samples of opportunity that were to be collected if water was available, and they do not adversely affect attainment of project objectives.

#### Field Completeness

Field completeness is a measure of the amount of valid field measurements obtained. A completeness criterion of 100 percent applies to these measurements. The percent completeness for field measurements was 100 percent with one exception. The DO result for well 03-25 ground water was reported as 19.3 mg/L, but the field crew had difficulty with the field instrument during the analysis of this sample. The DO result was rejected. All other field measurements were valid.

#### Laboratory Completeness

Laboratory completeness is a measure of the amount of usable, valid laboratory measurements per matrix obtained for each target analyte. Usable, valid results are those that are judged, after data assessment, to represent the sampling populations and to have not been disqualified for use through data validation or data assessment. Completeness is typically expressed as a percentage and is determined using the following equation:

$$\%C = \frac{V}{T} \times 100$$

where %C = percent completeness
V = number of results determined to be valid
T = total number of results

Under ideal conditions, the laboratory completeness objective would be 100 percent. However, samples can be rendered unusable during shipping and preparation (e.g., bottles broken or extracts accidentally destroyed) or analysis (e.g., loss of instrument sensitivity or strong matrix effects). Laboratory completeness objectives are 90 percent for each critical target analyte per sample matrix. Table 3-2 presents the percent completeness between analytical fractions for solid samples and aqueous samples. It is possible for individual analytes to exhibit very low completeness values but for the overall completeness goals to be satisfied on the basis of analytical fraction. This occurred in a few cases and is discussed in more detail below for the affected analytes and fractions.

Percent completeness for laboratory analytical data collected during the field investigation is greater than the 90 percent completeness required by the OJT/LSC QAPP (TtNUS, 2001b), with the exception of nitrite in sediment samples. The calculated percent completeness for laboratory analytical data is 72.9 percent for nitrite in sediment samples. The nitrite results were rejected due to an extremely low matrix spike recovery (8 percent). Low matrix spike recoveries are indications that the analyte (in this case, nitrite) results may be biased low. The nitrite analyses are not considered to be critical to the success of the project and are not used in risk assessment. Therefore, failure to attain the completeness goal in the case of nitrite analyses does not adversely affect attainment of project objectives. The herbicide analyses just met the completeness requirement at 90.3 percent. The majority of herbicide rejections were due to a percent difference between chromatographic columns of greater than 100 percent for 2,4-D and pentachlorophenol. A spot check of the associated chromatograms for the rejected samples shows interferences co-eluting with the compounds of concern. This imposes a significant degree of uncertainty in the identification and the quantification of these two compounds. The volatile and semivolatile rejections were mostly due to poor calibration responses for acrolein and acrylonitrile for the volatile analyses and 1,4-phenylenediamine, 4-nitroquinoline-1-oxide, and kepone for the semivolatile analyses. Table 3-3 lists all the rejected data and the reasons for the rejections. The 1,4-phenylenediamine, 4-nitroquinoline-1-oxide, and kepone compounds are known to yield poor analytical responses and are likely only to be detectable at high concentrations. The impact of not having attained completeness goals because of these few compounds is discussed in Sections 7.6.1 and 8.6 of the human health and ecological risk assessments, respectively.

### 3.3.2 Sensitivity

Table 3-4 compares the observed minimum and maximum reporting limits achieved during laboratory analyses to the target laboratory reporting limits contained in Table 1-11 of the OJT/LSC QAPP (TtNUS, 2001b). Exceedance of the target laboratory reporting limits occurs in several instances. The impact of these exceedances is discussed in Sections 7.6.4 and 8.7.6 of the human health and ecological risk assessments, respectively.

### 3.3.3 Precision

Precision is a measure of the degree to which two or more measurements are in agreement and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions.

Precision is expressed as a relative percent difference (RPD), which is defined as the absolute value of the ratio of the data range to the data mean. RPDs, which are typically expressed as percentages, are used to evaluate both field and laboratory duplicate precision and are calculated as follows:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where RPD = relative percent difference
V1, V2 = two results obtained by analyzing duplicate samples

Field duplicates for OJT/LSC soils and sediments were a single sample that was homogenized, split into two portions, and placed into separate sample bottles. Each sample bottle was assigned a unique nomenclature so as to be blind to the laboratory. Field duplicates were collected during a single act of sampling and analyzed for chemical constituents to measure the precision of the sampling and analysis program. Field duplicates were collected at a rate of no less than one duplicate per 10 environmental samples. Eighteen field duplicates were collected for 110 surface/subsurface soil samples and 38 sediment samples. Five field duplicates were collected for 16 ground water and 23 surface water samples. Therefore, the 10 percent frequency criterion for field duplicates specified in the OJT/LSC QAPP (TtNUS, 2001b) was achieved. The precision estimates encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from

analyzing duplicate laboratory samples incorporate only homogenization, subsampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

Laboratory precision QC samples (i.e., laboratory duplicates for inorganic chemicals and MSDs for organic chemicals) were scheduled to be analyzed at a rate of no fewer than one QC sample per 20 environmental samples. This 5 percent rate, as specified in the OJT/LSC QAPP (TtNUS, 2001b), was achieved for aqueous, soil, and sediment samples; six aqueous laboratory duplicates were analyzed per 39 aqueous samples and eight soil laboratory duplicates were analyzed per 148 soil and sediment samples. Laboratory precision is measured by comparing RPD values to precision control limits specified in the applicable analytical SOPs.

For this general data quality review, the precision points of reference of ±50 percent for solid matrices and ±30 percent for aqueous matrices were employed for both field and laboratory duplicates to assess the degree of precision. An RPD value of zero percent indicates perfect repeatability; increasingly greater values represent increasingly greater degrees of imprecision.

**Explosives in Soil and Sediment**

RPD values for the spiked compounds ranged from 0 percent to 94.1 percent across all spiked analytes in MS/MSD pairs. The compound HMX exhibited a single occurrence of 94.1 RPD, whereas the 10 other RPD values were less than 8 percent, indicating generally good performance.

The high RPD value for HMX is not indicative of the overall recoveries. It is an indication that the HMX result for sample 03SD110006 may exhibit greater uncertainty than the other target analytes. However, the potential for a high degree of imprecision is very limited.

**Explosives in Ground Water and Surface Water**

RPD values for the spiked target compounds ranged from 0 percent to 30.8 percent across all spiked analytes in MS/MSD pairs; most values were less than 10 percent. These RPD values indicate no unexpected uncertainty associated with the analysis of ground water and surface water.

**Volatiles in Soil and Sediment**

RPD values for the spiked target compounds ranged from 0 percent to 200 percent across all spiked analytes in the MS/MSD pairs. Aside from a single value for acetone of 200 percent, the next greatest RPD was 93.6 percent. All other RPD values were less than 45 percent, indicating generally good

performance. The high RPD values were associated with acetone (200 percent in sample 03SB241215MS) and methylene chloride (93.6 percent in sample 03SB241215MS). The high RPD values for acetone and methylene chloride are not indicative of the overall recoveries. It is an indication that acetone and methylene chloride results for sample 03SB241215 and other samples analyzed with that sample exhibit greater uncertainty than the other target analytes.

The field duplicates associated with samples 03SB280204 and 03SD050006 had high RPDs for 1,1,1-trichloroethane (167 percent) and acetone (74 percent). The high RPD value for 1,1,1-trichloroethane is because the results are near the laboratory detection limit and the uncertainty of the values is therefore greater than would otherwise be expected. The high RPD value for 1,1,1-trichloroethane is an indication that the 1,1,1-trichloroethane result for sample 03SD050006 exhibits greater uncertainty than the other target analytes.

No unexpected uncertainty is observed for volatiles in soil or sediment except for the samples specified above.

**Volatiles in Ground Water and Surface Water**

No RPD values in the MS/MSD pairs were greater than 30 percent and most RPD values were less than 10 percent. This kind of performance is typical for water samples, which are relatively homogeneous by nature. Based on these results, no unexpected uncertainty is observed for volatiles in aqueous samples.

**Semivolatiles in Soil and Sediment**

RPD values for the spiked target compounds ranged from 0 percent to 200 percent across all spiked analytes in the MS/MSD pairs. The greatest RPD values are all associated with 3,3'-dichlorobenzidine and 2,4-dimethylphenol. The next greatest RPD value, excluding these two compounds, was 108.9 percent for bis(2-ethylhexyl) phthalate in sample 03SB470206. Sample 03SB260610 had a high RPD for anthracene (71 percent). Soil can exhibit RPD values greater than 50 percent due to the lack of homogeneity present in most samples. With the number of analytes quantified in the number of samples collected, an occasional exceedance of an RPD criterion is not unexpected, although repeated exceedance of a criterion for a particular analyte indicates a systematic imprecision for the affected analyte.

The high RPD values (and the low percent recoveries, discussed in Section 3.3.4) in the majority of MS/MSD pairs for 3,3'-dichlorobenzidine and 2,4-dimethylphenol indicate that these compounds have

poor extraction efficiencies and exhibit greater uncertainty than the other target analytes in all solid samples. The high RPD value for anthracene in sample 03SB260610 and the associated field duplicate indicates uncertainty in the anthracene result for these samples and potentially in the anthracene results of other samples analyzed with sample 03SB260610. The effects of the imprecision are addressed in the risk assessment uncertainty sections of this report (Sections 7.6.1 and 8.6).

**Semivolatiles in Ground Water and Surface Water**

RPD values for the spiked target compounds ranged from 0 percent to 60 percent across all spiked analytes in three MS/MSD pairs. All the RPD values greater than 32 percent were associated with acidic compounds except for a single 60 percent RPD for hexachlorocyclopentadiene and a single 34 percent RPD for hexachloroethane.

The 34 percent RPD for hexachloroethane is no cause for concern because it is barely greater than 30 percent and the two other RPD values for this compound were less than 5 percent.

Hexachlorocyclopentadiene is a special case. One of three RPD values is 60 percent and the other two values are disqualified because the percent recoveries used to compute the RPDs were reported as "-1." Hexachlorocyclopentadiene is known to yield a poor response, and it appears from the poor recoveries that this compound would not be detected consistently unless the sample concentration was greater than the spike concentration. Poor recoveries are discussed in Section 3.3.4.

The high RPD values in the MS/MSD pairs for acid compounds indicate that these compounds exhibit greater uncertainty than the other target analytes.

**Pesticide/PCB in Soil and Sediment**

The MS/MSD performed on sample 03SD100612 was not used for precision analysis because the MS extract was boiled to dryness during the solvent evaporation extraction step.

RPD values for the spiked target compounds ranged from 0.8 percent to 46.7 percent across all spiked analytes in the MS/MSD pairs. All the RPD values greater than 20 percent were associated with one MS/MSD pair.

The MS/MSD performed on sample 03SS310002 had RPD values between 30 and 40 percent for most compounds. This indicates that the results for sample 03SS310002 may exhibit greater uncertainty than

results from other samples, although the observed RPDs are within expectations for soil and sediment samples.

**Pesticide/PCB in Ground Water and Surface Water**

RPD values for the spiked target compounds ranged from 0 percent to 20 percent across all spiked analytes in the MS/MSD pairs. These RPD values indicate no unexpected uncertainty associated with the analysis of ground water and surface water.

**Herbicide in Soil and Sediment**

RPD values for the spiked target compounds ranged from 0 percent to 67 percent across all spiked analytes in the MS/MSD pairs The highest RPD values were associated with dinoseb (66.7 percent) and silvex (55.4 percent) in sample 03SD110006; all other RPD values were less than 25 percent indicating generally good performance. Soils occasionally exhibit RPD values greater than 50 percent due to general lack of homogeneity, and occasional individual exceedances of 50 percent RPD for a particular analyte are not a concern.

Based on these results, no unexpected uncertainty is observed for herbicides in soil and sediment.

**Herbicide in Ground Water and Surface Water**

RPD values for the spiked target compounds ranged from 3.1 percent to 45.3 percent across all spiked analytes in the MS/MSD pairs. The single high RPD value (45.3 percent) was associated with dinoseb; all other RPD values were less than 15 percent, indicating generally good performance.

Based on these results, no unexpected uncertainty is observed for herbicides in ground water and surface water.

**Metals in Soil and Sediment**

All average RPDs were less than 50 percent for individual metals across laboratory and field duplicates except for antimony (76.6 percent) and silver (86.7 percent) in a laboratory duplicate and antimony (64.2 percent) and calcium (51.5 percent) in a field duplicate pair. Individual RPD values ranged from 0 percent to 162.9 percent across laboratory duplicates and 0 percent to 169.7 percent across field duplicates. The laboratory and field RPD values are comparable, indicating that the observed data variability is a manifestation of sample heterogeneity on a relatively small scale (sub-samples of

approximately 1 gram are removed from each soil sample for analysis). Although several individual RPD values indicate moderate uncertainty, the average RPD for individual metals is less than 50 percent indicating uncertainty typical of soil samples.

**Metals in Ground Water and Surface Water**

All average RPDs were less than 30 percent for individual metals except for aluminum (35.1 percent) and zinc (35.7 percent) in a single pair of laboratory duplicates and chromium (60.3 percent), iron (31.5 percent), and zinc (44.2 percent) in a single pair of field duplicates. Individual RPD values ranged from 0 percent to 150.7 percent in the laboratory duplicates and 0 percent to 191.4 percent in the field duplicates.

Although there are two notable exceptions, the RPDs that showed the greatest variance occurred in samples that had results near the laboratory's detection limit where uncertainty increases. Based on these results, no unexpected uncertainty is generally observed for metals in aqueous samples. Two exceptions are chromium and nickel in sample 03GW01. The replicate chromium values were 2 µg/L and 90.8 µg/L. The replicate nickel values were 2.4 µg/L and 91.2 µg/L. Given that the large RPD values occurred only once out of five duplicate pairs for each of these metals, widespread imprecision is not expected. Nevertheless, a potential for wide variations in the measurement of chromium and nickel concentrations in aqueous samples has been demonstrated and should be considered during data use.

**Dioxins in Soil and Sediment**

RPD values for the spiked target compounds ranged from 0.1 percent to 149.5 percent across all spiked analytes in the single MS/MSD performed on sample 03SS310002 and from 0 percent to 12 percent across all spiked analytes in the laboratory control sample/laboratory control sample duplicate (LCS/LCSD). The greatest RPD value in the MS/MSD is associated with 1,2,3,4,6,7,8,9-OCDD. No other RPD values exceed 21 percent in that sample.

These RPD values indicate no unexpected uncertainty associated with the dioxin results, with the possible exception of 1,2,3,4,6,7,8,9-OCDD in sample 03SS310002 and potentially in other samples analyzed with that sample.

**Dioxins in Ground Water and Surface Water**

Dioxins were not analyzed in the ground water or surface water samples and are not discussed in this data quality review.

**Miscellaneous Parameters in Soil and Sediment**

Perchlorate - Perchlorate was not detected in any field duplicate samples so precision could not be evaluated.

TOC - RPD values for the spikes ranged from 5.0 percent to 13.7 percent in the MS/MSDs. Field duplicate RPD values for TOC (four results) ranged from 5.8 percent to 26.7 percent.

Based on these results, no unexpected uncertainty is observed for the TOC analyses.

Nitrate/nitrite - Field duplicate RPD values for nitrate (17 values) ranged from 0 percent to 76.5 percent, indicating generally good performance. Three RPD values greater than 50 percent occurred in the nitrate analyses for the following samples: 03SS430002 (61.2 percent), 03SD050006 (66.7 percent), and 03SB191215 (76.5 percent).

Overall, no unexpected uncertainty is observed for the nitrate/nitrite analyses, with the exception of the nitrate results for samples 03SS430002, 03SD050006, and 03SB191215.

pH - pH is a logarithmic measurement and RPD, which is a linear measure of precision, was not assessed.

**Miscellaneous Parameters in Ground Water and Surface Water**

Perchlorate - Perchlorate was not detected in any field duplicate samples so imprecision could not be determined.

Nitrate/nitrite - The RPD value for the MS/MSD associated with the nitrite analyses was 1.1 percent, indicating no unexpected uncertainty in aqueous nitrate/nitrite data.

TSS - Field duplicate RPD values (two results) ranged from 13.3 percent to 148.7 percent. The 148.7 RPD is based on values of 5 mg/L and 34 mg/L. The other field duplicate values were 8 mg/L and 7 mg/L. The 34 mg/L value indicates a potential for widely varying suspended solids content of surface water samples and is consistent with the variability in TSS values observed across the site (2 mg/L to 100 mg/L).

pH - pH is a logarithmic measurement and RPD, which is a linear measure of precision, was not assessed.

### 3.3.4 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy measurements are designed to detect biases resulting from sample handling and analysis. This parameter is assessed by measuring spiked samples (e.g., MSs) or well-characterized samples of certified analyte concentrations (e.g., LCSs) and by measuring blanks.

Accuracy requirements for field measurements are typically ensured through control over the sample collection and handling and through routine instrument calibration. Field accuracies were monitored through the use of blanks to detect cross-contamination and by monitoring adherence to procedures that prevent sample contamination or degradation. Source blanks were collected from analyte-free water and potable water sources to assess the water sources used to decontaminate sampling equipment. Equipment rinsate blanks were collected for this investigation to assess cross-contamination via sample collection equipment. These blanks were obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through sample collection equipment after decontamination and before use. Rinsate blanks were obtained for each type of sampling equipment for each day that the sampling equipment was decontaminated. Where pre-cleaned, dedicated sampling equipment was used, one rinsate blank was collected as a "batch blank." Rinsate blanks were analyzed for the same chemical constituents as the associated environmental samples. Qualification of data due to laboratory blank contamination was limited mostly to the common laboratory contaminants (i.e., acetone, methylene chloride, bis(2-ethylhexyl) phthalate, etc.). Although common laboratory contaminants were detected at low levels sporadically throughout the OJT/LSC no significant bias is anticipated from blank contamination. Tables 3-5 and 3-6 present the soil and aqueous qualification rates for all the data qualified, including data qualified due to laboratory or field blank contamination. Accuracy was also assured qualitatively through adherence to all sample handling, preservation, and holding time requirements.

Accuracy in the laboratory is measured through the comparison of a spiked sample or LCS result to a known or calculated value and is expressed as a percent recovery (%R). It was also assessed by monitoring the analytical recovery of select surrogate compounds added to samples that are analyzed by organic chromatographic methods. LCSs were used to assess the accuracy of laboratory operations with minimal sample matrix effects. MS and surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. Spiking concentrations

equaled or approximated the default concentrations detailed in the applicable sample preparation or analysis SOPs. LCS and MS analyses were performed at a frequency of one per 20 associated samples of like matrix, as required by the OJT/LSC QAPP (TtNUS, 2001b). Laboratory accuracy was assessed by comparing calculated percent recoveries to accuracy control limits specified in the applicable laboratory SOP.

Percent recovery is calculated using the following equation:

$$\%R = \frac{Ss - So}{S} \times 100$$

| | | | |
|---|---|---|---|
| where | %R | = | percent recovery |
| | Ss | = | result of spiked sample |
| | So | = | result of non-spiked sample |
| | S | = | concentration of spiked amount. |

In general, a percent recovery range of 75 percent to 125 percent defines the accuracy objective for the analytical data It should be noted, however, that the analytical laboratory establishes analyte-specific percent recoveries when evaluating performance.

Surrogate data for these samples were not included in the laboratory electronic deliverable and were not assessed in the data quality review; however, the surrogate results were contained in the data hard copies used in the data validation process Data were still validated with regard to surrogate recoveries, and those qualifications are depicted along with qualifications for MS and LCS recoveries in Appendix E.

Consistent with industry standards, the bias indicator analyses are reported in terms of percent recovery. Absence of bias is represented as a recovery of 100 percent. Mean recovery values less than 100 percent indicate a low bias, and recovery values greater than 100 percent indicate a high bias. Because measurement uncertainty exists in all bias estimates, a bias is not considered to be significant unless it falls outside the range of 100% ± 25%. The more extreme the bias value, the more significant the bias. When evaluating biases greater weight is given to matrix spike recoveries than LCS recoveries because matrix spikes reflect the actual sample matrix.

**Explosives in Soil and Sediment**

The mean explosives target compound recoveries in soil and sediment LCS, MS, and MSD samples were generally acceptable. LCS recoveries ranged from 86.5 percent to 118.4 percent, and MS/MSD target compound recoveries ranged from 95.2 percent to 125.4 percent, with the exception of nitrocellulose. The mean nitrocellulose recovery in LCS samples was 24.9 percent and in matrix spike samples it was 75.5 percent. The mean LCS and MS recoveries for nitrocellulose are low but within the laboratory-stated quality control limits.

Excluding nitrocellulose, no significant bias is anticipated for explosives in soil or sediment samples. Nitrocellulose results appear to exhibit a slight to moderate low bias.

**Explosives in Ground water and Surface Water**

The mean explosives target compound recoveries in ground water and surface water LCS, MS, and MSD samples were acceptable. LCS target analyte recoveries ranged from 83.8 percent to 100.7 percent and MS/MSD target analyte recoveries ranged from 65.0 percent to 102.7 percent.

Based on these results, no significant bias is anticipated for explosives in ground water or surface water samples.

**Volatiles in Soil and Sediment**

The mean volatiles target compound recoveries in soil and sediment LCS, MS, and MSD samples were generally acceptable. LCS target analyte recoveries ranged from 71.6 percent to 90.8 percent, and MS/MSD target analyte recoveries ranged from 60.5 percent to 118.8 percent, with the exception of methylene chloride. The mean methylene chloride recoveries ranged from 40.3 percent to 44.8 percent in MS/MSD samples, respectively. The mean MS/MSD recoveries indicate a moderately low bias for methylene chloride. Acetone had zero percent recovery in three of 12 matrix spikes. The low recoveries are attributed to contamination in the laboratory method blanks, which, in the cases of the three matrix spikes with 0 percent recovery, were at concentrations comparable to the spike amount. Due to the concentration of the laboratory method blank contamination, all acetone results are considered to be suspect and potentially less than reported. Otherwise, for the remaining VOCs there could be a slight low bias.

**Volatiles in Ground Water and Surface Water**

The mean volatiles target compound recoveries in ground water and surface water LCS, MS, and MSD samples were acceptable. LCS target analyte recoveries ranged from 82.6 percent to 105.6 percent, and MS/MSD target analyte recoveries ranged from 72.7 percent to 123.7 percent.

Based on these results, no significant bias is anticipated for volatiles in ground water or surface water samples.

**Semivolatiles in Soil and Sediment**

The mean semivolatiles target compound recoveries in soil and sediment LCS, MS, and MSD samples were moderately low and typical for this class of compounds. LCS target analyte recoveries ranged from 43.9 percent to 57.2 percent, and MS/MSD target analyte recoveries ranged from 7.3 percent to 68.6 percent.

The following mean recovery values for MS/MSD samples show the poorest performing compounds:

| | MS | MSD |
|---|---|---|
| 2,4-Dimethylphenol | 9.3% | 7.3% |
| 2,4-Dinitrophenol | 39.3% | 38.3% |
| 2-Methylphenol | 32.0% | 32.7% |
| 3&4-Methylphenol | 31.3% | 29.0% |
| 3-Nitroaniline | 33.0% | 32.0% |
| 4-Nitroaniline | 37.0% | 34.7% |
| 4-Chloroaniline | 26.7% | 25.3% |
| 3,3'-Dichlorobenzidine | 8.3% | 7.4% |
| Hexachlorocyclopentadiene | 23.0% | 23.9% |
| N-nitrosodiphenylamine | 13.0% | 14.3% |

These compounds generally exhibit a moderate low bias, with 2,4-dimethylphenol, 3,3'-dichlorobenzidine, and N-nitrosodiphenylamine indicating a severe low bias.

The mean polynuclear aromatic hydrocarbon target compound recoveries in soil and sediment LCS, MS, and MSD samples were slightly low. LCS target analyte recoveries ranged from 65.7 percent to 83.4 percent, and MS/MSD target analyte recoveries ranged from 56.5 percent to 83.3 percent.

A slight to moderately low bias exists for semivolatiles in general, with a severe low bias for 2,4-dimethylphenol, 3,3'-dichlorobenzidine, and N-nitrosodiphenylamine in soil and sediment samples.

**Semivolatiles in Ground Water and Surface Water**

The mean semivolatiles target compound recoveries in ground water and surface water LCS, MS, and MSD samples were moderately low, with one occurrence of an extremely low bias. Moderate low biases with occasional extreme low biases are typical with this class of compounds. LCS target analyte recoveries ranged from 33.0 percent to 69.4 percent, and MS/MSD target analyte recoveries ranged from 1.7 percent to 78.0 percent.

The following mean recovery values for MS/MSD samples show the poorest performing compounds:

| | MS | MSD |
|---|---|---|
| 1,2,4-Trichlorobenzene | 37.0% | 39.7% |
| 1,2-Dichlorobenzene | 33.7% | 36.0% |
| 1,3-Dichlorobenzene | 28.7% | 31.7% |
| 1,4-Dichlorobenzene | 29.0% | 33.0% |
| 2,4-Dinitrophenol | 32.7% | 39.0% |
| 3,3'-Dichlorobenzidine | 33.0% | 32.3% |
| Hexachlorobutadiene | 31.7% | 31.0% |
| Hexachlorocyclopentadiene | 1.7% | 3.7% |
| Hexachloroehtane | 24.7% | 27.3% |
| N-nitrosodiphenylamine | 32.3% | 31.7% |

These compounds exhibit a moderate low bias, with hexachlorocyclopentadiene indicating an extreme low bias.

The mean polynuclear aromatic hydrocarbon target compound recoveries in ground water and surface water LCS, MS, and MSD samples were slightly low. LCS target analyte recoveries ranged from 49.1 percent to 86.6 percent, and MS/MSD target analyte recoveries ranged from 39.3 percent to 84.7 percent.

A slight to moderately low bias exists for semivolatiles in general, with a severe low bias for 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dinitrophenol, 3,3'-dichlorobenzidiene, hexachlorobutadiene, hexachloroethane, and N-nitrosodiphenylamine and an extremely low bias for hexachlorocyclopentadiene.

**Pesticide/PCB in Soil and Sediment**

The mean pesticide/PCB target compound recoveries in ground water and surface water LCS, MS, and MSD samples were acceptable. LCS target analyte recoveries ranged from 92.8 percent to 100.4 percent, and MS/MSD target analyte recoveries ranged from 49.8 percent to 116.8 percent.

Based on these results, a slightly low bias is anticipated for pesticide/PCB in soil or sediment samples.

**Pesticide/PCB in Ground Water and Surface Water**

The mean pesticide/PCB target compound recoveries in soil and sediment LCS, MS, and MSD samples were generally acceptable. LCS target analyte recoveries ranged from 46.7 percent to 95.7 percent, and MS/MSD target analyte recoveries ranged from 90 percent to 124.5 percent.

Based on these results, no significant bias is anticipated for pesticide/PCB in ground water or surface water samples.

**Herbicide in Soil and Sediment**

The mean herbicide target compound recoveries in soil and sediment LCS, MS, and MSD samples were low to moderately low. LCS recoveries ranged from 76.8 percent to 97.3 percent, and MS/MSD target compound recoveries ranged from 13.8 percent to 59.3 percent. The LCS recoveries were acceptable in all cases, but the MS/MSDs were low in all cases. This could be an indicator of a difficult sample matrix as opposed to laboratory problems.

Based on these results, the herbicide analyses exhibit a severe to moderately low bias for soil and sediment samples.

**Herbicide in Ground Water and Surface Water**

The mean herbicides target compound recoveries in soil and sediment LCS, MS, and MSD samples were generally acceptable with a slightly low bias in select cases. LCS recoveries ranged from 56.7 percent to 124.7 percent, and MS/MSD target compound recoveries ranged from 39.0 percent to 102.0 percent. The mean MS/MSD recoveries for dinoseb (48.5 percent and 39.0 percent), hexachlorophene (46.0 percent and 47.0 percent), and pentachlorophenol (45.5 percent and 47.0 percent) exhibit a moderately low bias.

Overall, a slight to moderate low bias is anticipated for herbicides in soil and sediment samples.

**Metals in Soil and Sediment**

One or more of the matrix spike percent recoveries was not included in the mean matrix spike percent recovery calculation because the spike amount was not appropriate for the spiked sample concentration for the following metals: aluminum, arsenic, calcium, iron, lead, magnesium, manganese, nickel, and potassium. The inappropriateness of the spiking level is a consequence of the relatively high native analyte concentration in the sample and is not a laboratory deficiency.

Excluding the inappropriate spikes, the mean metals percent recoveries in soil and sediment LCS and MS samples were within the acceptable range. LCS recoveries ranged from 90.8 percent to 105.6 percent, and MS recoveries ranged from 77.2 percent to 105.8 percent.

Based on these results, no significant bias is anticipated for metals in soil or sediment samples.

**Metals in Ground Water and Surface Water**

The mean LCS and MS percent recoveries for total metals were within the acceptable ranges across all ground waters and surface water sample delivery groups (SDGs) except for tin. The tin mean LCS percent recovery was 72.7 percent. This recovery is barely outside the expected recovery limits of 100 percent ±25 percent so no adverse impact to data usability is expected.

The mean filtered metals percent recoveries in ground water and surface water MS samples were within the acceptable range. MS recoveries ranged from 83.7 percent to 113.2 percent.

Based on these results, no significant bias is anticipated for metals in ground water or surface water samples.

**Dioxins in Soil and Sediment**

The mean dioxin target compound recoveries in soil and sediment LCS, LCSD, MS, and MSD samples were generally acceptable. LCS/LCSD target analyte recoveries ranged from 91.0 percent to 112.5 percent, and MS/MSD target analyte recoveries ranged from 83.9 percent to 110 percent, with the exception of 1,2,3,4,6,7,8,9-OCDD. The 1,2,3,4,6,7,8,9-OCDD recoveries were 19.2 percent and

133 percent in the MS/MSD sample, respectively. Only one MS/MSD pair was analyzed and no directional bias can be obtained from the recovery range.

Based on the LCS/LCSD results, no significant bias is anticipated for dioxin in soil or sediment samples. Based on the MS/MSD results, an unexpectedly high degree of imprecision is anticipated but no significant net bias.

**Dioxins in Ground Water and Surface Water**

Dioxins were not analyzed in the ground water or surface water samples and are not discussed in this data quality review.

**Miscellaneous Parameters in Soil and Sediment**

Perchlorate - The mean perchlorate percent recoveries in soil and sediment LCS and MS samples were within the 75 percent to 125 percent range, indicating no significant bias in the perchlorate analyses.

TOC - The mean TOC percent recoveries in soil and sediment LCS and MS/MSD samples were within the 75 percent to 125 percent range, indicating no significant bias in the TOC analyses.

Nitrate/nitrite - The mean nitrite percent recoveries in soil and sediment MS samples for nitrite analyses was 46.5 percent, below the 75 percent to 125 percent range, indicating a moderately low bias. The nitrate and the nitrate + nitrite analysis percent recoveries were within the 75 percent to 125 percent range.

Based on these results, a moderately low bias exists for the nitrite analyses.

pH - Bias indicators are not analyzed.

**Miscellaneous Parameters in Ground Water and Surface Water**

Perchlorate - The mean perchlorate percent recoveries in ground water and surface water LCS and MS samples were within the 75 percent to 125 percent range, indicating no significant bias in the perchlorate analyses.

TSS - Bias indicators are not analyzed.

Nitrate/nitrite - The mean nitrite percent recoveries in ground water and surface water MS samples was 46.5 percent, below the 75 percent to 125 percent range, indicating a moderately low bias. The nitrate percent recoveries were within the 75 percent to 125 percent range.

Based on these results, a moderately low bias exists for the nitrite analyses.

pH - Bias indicators are not analyzed.

### 3.3.5 Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., among sampling points; among sampling events). Comparability was achieved by using standardized sampling and analysis methods, as well as data reporting formats. Comparability of laboratory measurements was achieved primarily through the use and documentation of standard sampling and analytical methods. Results were reported in units that ensure comparability with previous data and with current state and federal standards and guidelines. Comparability of field data was ensured by following the OJT/LSC (FSP) and the associated SOPs. Comparability of laboratory measurements was assessed primarily through the use of spike recoveries and RPD values and through adherence to the laboratory quality assurance plan No comparability problems were detected. The previous sections of this report provide data quality summaries that may be used to assess future comparability.

Laboratory data were generated using methodologies specified in the OJT/LSC QAPP (TtNUS, 2001b). All data qualified in the data validation process are located in Tables 3-5 and 3-6. These tables use qualification codes to indicate the reasons certain parameters have been qualified. An explanation of the qualification codes accompanies the tables.

### 3.3.6 Representativeness

Representativeness is an expression of the degree to which the data accurately and precisely depict the actual characteristics of a population or environmental condition existing at an individual sampling point and is contingent on a good design for the sampling program. The project planning documents (work plan, field and laboratory SOPs) and the use of standardized sampling, handling, analytical, and reporting procedures were designed so that the final data are accurate representations of actual site conditions. Data were collected from the specified locations using sampling, handling, analytical, and reporting procedures, as specified in the OJT/LSC QAPP (TtNUS, 2001b). Therefore, no data representativeness

concerns have been raised, and the data are suitable for use as part of the monitoring program. Consideration should be given to precision and bias concerns identified in Sections 3.3.3 and 3.3.4.

## 3.4 STATISTICAL METHODOLOGY AND RESULTS OF STATISTICAL ANALYSES

Data from this investigation were subjected to statistical analyses to determine whether the concentrations at the sites represented by the sampling are similar to background/upgradient concentrations. Tables summarizing these statistical results are in Appendix F. Contrary to Section 1.4.2.2 of the QAPP, duplicate sample results were not averaged per past agreements with U.S. EPA Region 5 to use duplicate samples as QC samples only. The QAPP is in error. This was corrected in Section 1.5.1 of the QAPP.

### 3.4.1 Outlier Analysis

After data validation, the data sets for this investigation were compiled based on similarities of factors such as environmental matrix and geographical location in order to yield data sets representing distinguishable populations of environmental media and time frames. The data sets were then analyzed for statistical outliers Outliers are extreme high or low measurements that are very different from the main pool of data Because outliers may confound the statistical analyses, they are sought out with the intention of expunging them from the data set. Detected outliers were scrutinized for non-statistical causes such as transcription errors, errors in sampling technique, and analysis errors. If a verifiable and correctable cause was identified, the affected data were corrected. If a non-statistical cause for an outlier could not be found, the outlier was retained in its data set. All data outliers detected for this project either could not be verified to be the result of a non-statistical error or they were reporting errors that were corrected.

To conduct the outlier testing, the discordance test for outliers was performed, as recommended in the Guidance for Environmental Background Analysis – Volume I: Soil (NAVFAC, 2002). This process is described below.

1. Let x(1), x(2), ..., x(n) be the n measurements in the dataset after they have been listed in order from smallest to largest. The parenthetical values indicate the measurements are ordered from smallest to largest.

2. x(n) (the largest measurement) is suspected of being an outlier.

3. Specify the tolerable decision error rate, α (or significance level), desired for the test. α may only be set to 0.01 or 0.05 for the Discordance test. A value of 0.05 was chosen as a tolerable decision error rate. This represents a 5% probability or less of classifying a result as an outlier when it is not an outlier.

4. Compute the sample arithmetic mean, $\bar{x}$, and the sample standard deviation, s.

5. Compute D = [xn-x]/s

If D exceeds the critical value for the specified n and α, then declare that xn is a statistical outlier and should be investigated further.

### 3.4.2 Background Comparisons for Soil

Soil samples for this investigation were classified according to the soil types defined in the NSWC Crane Basewide Soil Background Study (TtNUS, 2001a). Each soil type is defined by the characteristics of soil parent material (depositional environment), depth (surface or subsurface), and dominant grain size (sand, silt, or clay). The soil types were gathered into soil groups that reflect different classifications of soil throughout NSWC Crane There are nine different background soil groups; however, only three soil types were found within OJT/LSC: Soil Group 3 - Alluvial, Mississippian, and Pennsylvanian surface soil; Soil Group 6 - Mississippian silt subsurface soil; and Soil Group 7 - Mississippian clay subsurface soil. Metal concentrations in each soil group sampled at the OJT/LSC 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 analyzed for metals of the corresponding soil group. The outcome of each comparison was a statistical determination of each metal at the OJT/LSC as being elevated or not elevated relative to background concentrations. Summary statistics for chemicals in background soils are presented in Appendix F for each of the three soil groups found at SWMU 03 and for all soils combined (Tables F-9 through F-12). A list of SWMU 03 soil samples and associated soil groups is also presented in Appendix F (Table F-13).

It was assumed that the concentrations of all organic compounds are zero in each of the background soil groups. Therefore, the detections of organic compounds at OJT/LSC are considered to be site related unless data indicate that they are contaminants (e.g., laboratory contaminated) from non-site-related sources.

The analysis of variance (ANOVA) technique is generally the basic approach used to compare data from background (upgradient or upstream) and site locations. The ANOVA technique is used to test whether there is statistically significant evidence of contamination associated with site activities.

There are two types of ANOVA: parametric and non-parametric. Parametric ANOVA methods make two important assumptions: The data residuals are normally (or lognormally) distributed, and the group variances are homogeneous. If these assumptions are not met, the parametric ANOVA is a less powerful test than the non-parametric ANOVA and, typically, the assumptions are not met for a majority of the data sets. The parametric ANOVA is only marginally more powerful than the non-parametric ANOVA even when these assumptions are met. For these reasons, a non-parametric ANOVA technique was chosen to compare site and background concentrations.

The Wilcoxon Rank-Sum (WRS) test (also known as the Mann-Whitney U test) was employed as the non-parametric ANOVA technique. The following equations present a step-by-step procedure for conducting the WRS test.

The null hypothesis (H0) that is tested is

$H_0$ *The site concentration <u>IS NOT</u> statistically higher than the background concentration.*

The alternate hypothesis (HA) is

$H_A$ *The site concentration <u>IS</u> statistically higher than the background concentration.*

If $H_0$ is rejected, then $H_A$ is accepted. If $H_0$ is not rejected, the data set is consistent with the $H_0$ hypothesis.

- Step 1. Combine the background and site data and rank the ordered values from 1 to N. Assume there are n site samples and m background samples so that N = m + n.

- Step 2. Compute the Wilcoxon statistic W:

$$W = \sum_{i=1}^{n} E_i - \frac{1}{2} n(n+1)$$

where $E_i$ are the ranks of the site samples (large values of the statistic W give evidence of contamination in site locations).

- Step 3. Compute an approximate Z-score. To find the critical value of W, a normal approximation to its distribution is used. The expected value and standard deviation (SD) of W under the null hypothesis (i.e., no contamination exists) are given by the formulas:

$$E(W) = \frac{1}{2}mn; \qquad SD(W) = \sqrt{\frac{1}{12}mn(N+1)}$$

An approximate Z-score for the WRS test may be calculated by the following equations

$$Z = \frac{W - E(W) - \frac{1}{2}}{SD(W)}$$

The factor of 1/2 in the numerator serves as a continuity correction because the discrete distribution of the statistic W is being approximated by the continuous normal distribution. If n or m is greater than 10 and ties are present, an adjustment to the approximate Z-score must be made:

$$Z_{RS} = \frac{W - E(W) - \frac{1}{2}}{SD'(W)}$$

where: $$SD'(W) = \left(\frac{mn}{12}\left[N + 1 - \frac{\sum_{j=1}^{g} t_j(t_j^2 - 1)}{N(N-1)}\right]\right)^{\frac{1}{2}}$$

g = the number of tied groups and tj is the number of tied data in the jth group.

- Step 4. Reject $H_0$ when $Z_{ADJUSTED} > +1.645$, which corresponds to the 95th percentile of the normal distribution.

### 3.4.3 Upgradient Comparisons for Ground Water

Wells from the most recent sampling effort were scrutinized for relationship of the wells to the ground water flow direction using potentiometric surface contour maps. The upgradient well 03GW160 was selected to represent chemical concentrations unaffected by OJT/LSC operations because it is immediately upgradient of the OJT/LSC. Analytical data for the sample collected from this well were used as a point of reference to determine whether OJT/.LSC ground water has been affected by site operations.

Because there was only one concentration for each parameter for this well, no rigorous statistical comparison of site conditions to upgradient or downgradient concentrations could be performed. Instead, individual downgradient concentrations were compared to the lone upgradient concentration. If the downgradient concentration was greater than the upgradient concentration, the alternate hypothesis, that the site concentration is statistically greater than the upgradient concentration, was accepted. If the downgradient concentration was less than or equal to the upgradient concentration, the null hypothesis, that the site concentration is not statistically greater than the upgradient concentration, was accepted.

### 3.4.4 Upstream Comparisons for Surface Water

Locations from the most recent sampling effort were examined to determine which surface water locations were upstream of the OJT/LSC. The three upstream locations chosen for surface water were 03SW01, 03SW02, and 03SW03

A fourth surface water sample at sampling location 03SW/SD04 was planned, but no water was present at the time of sampling.

Surface water results were compared to background results using the WRS test described in Section 3.4.2.

### 3.4.5 Upstream Comparisons for Sediment

Locations from the most recent sampling effort were examined to determine which sediment locations were upstream of the OJT/LSC. The four upgradient locations chosen for sediment were 03SD01, 03SD02, 03SD03, and 03SD04

Sediment results were compared to upgradient results using the WRS test outlined in Section 3.4.2.

### 3.4.6 Additional Scrutiny of Background and Upstream/Upgradient Comparisons

In some cases where the WRS test showed that site chemical concentrations were not statistically greater than background concentrations, the site concentrations appeared to be incongruous with the background concentrations. In an effort not to ignore any chemicals whose concentrations truly exceed background levels, further investigation was undertaken in those cases.

Probability plots were created using both site and background concentrations. Figures 3-1 and 3-2 are examples of the plots that were made. In such plots, if the data sets being compared come from a statistically similar population, then the plotted points should approximate a straight line. Furthermore, the ranges of site and background concentrations should be comparable, especially when the data sets contain many data values. If the data sets derive from dissimilar populations, the plots will exhibit an inflection point or break point and the values in one data set will tend to be greater than the values of the other data set. The prominence of an inflection point depends on the degree of dissimilarity between the data sets, with very dissimilar data sets, yielding a very pronounced inflection. The probability plot in Figure 3-1 shows data for mercury in surface soil. This plot supports the theory that two distinct populations exist. A significant inflection point occurs near 0.03 mg/kg. All background concentrations fall into the lowest 25 percent of the concentration range. The linear regression line for all the data is represented by a dashed line, and the best-fit linear regression line for the two individual populations is represented by solid lines. The result of the WRS test was rejected; mercury in surface soil was considered to have site concentrations greater than background levels. The probability plot in Figure 3-2 shows data for zinc in low flow surface water. This plot supports a one-population theory. Background concentrations fall in both ends of the concentration range. All points fall along the best-fit linear regression line for all the data, which are represented by a solid line. The result of the WRS test was accepted; mercury in surface soil was considered to have site concentrations similar to background levels.

All of the plots were inspected and professional judgment was used to determine whether site results displayed significant inflection points and whether differences between site and background concentrations were significant If the background and site data were judged to be significantly different, the result of the WRS test was rejected and the parameter being investigated was considered to have site concentrations greater than background levels. The parameters that were evaluated in this manner are represented in Table 3-7.

**TABLE 3-1**

**SAMPLES COLLECTED VERSUS SAMPLES PROPOSED**
**SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

| Analytical Fraction | Soil[1,2] (collected/ proposed) | SD[1] (collected/ proposed) | GW (collected/ proposed) | SW[4] (collected/ proposed) |
|---|---|---|---|---|
| **Explosives** | 110/116 | 38/38 | 16/16 | 23/30 |
| **Volatiles** | 40/45 | 38/38 | 16/16 | 23/30 |
| **Semivolatiles** | 107/113 | 38/38 | 16/16 | 23/30 |
| **Pesticide/PCB** | 5/5 | 38/38 | NA | 23/30 |
| **Herbicide** | 5/5 | 38/38 | NA | 23/30 |
| **Dioxins** | 13/13 | NA | NA | NA |
| **Metals** | 69/75 | 38/38 | 16/16 | 23/30 |
| **Metals (F)** | NA | NA | 1/1[3] | 23/30 |
| **Perchorate** | 110/116 | 38/38 | 16/16 | 23/30 |
| **TOC** | NA | 38/38 | NA | NA |
| **Nitrate/Nitrite** | NA | 38/38 | 16/16 | 23/30 |
| **TSS** | NA | NA | NA | 23/30 |
| **pH** | NA | 38/38 | NA | NA |

TOC - Total organic carbon.
TSS - Total suspended solids.
SS - Surface soil samples.
SB - Soil boring samples.
SD - Sediment samples.
GW - Ground water samples.
SW - Surface water samples.

1 - All samples analyzed for 40 Code of Federal Regulations Part 264 Appendix IX organics and U.S. EPA Target Analyte List + tin for metals.
2 - Missing samples were due to encountering refusual at six soil boring locations (03-SB-09, 03-SB-18, 03-SB-23, 03-SB-25, 03-SB-26, and 03-SB-28).
3 - Sample required filtered metals analyses due to high turbidity.
4 - Seven out of 30 sample locations were dry.

TABLE 3-2

PERCENT COMPLETENESS FOR ANALYTICAL FRACTIONS
SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

| | Soil and Sediment | | | Ground water and Surface water | | |
|---|---|---|---|---|---|---|
| Analytical Fraction | Total Data Points | Rejected Data Points | % Completeness | Total Data Points | Rejected Data Points | % Completeness |
| Dioxin | 375 | 0 | 100% | 150 | 0 | 100% |
| Explosive | 2,805 | 3 | 99.9% | 918 | 2 | 99.8% |
| Herbicide | 288 | 28 | 90.3% | 162 | 11 | 93.2% |
| Metals | 2,856 | 0 | 100% | 1,944 | 0 | 100% |
| Nitrite | 166 | 45 | 72.9% | 8 | 0 | 100% |
| Nitrate | 166 | 0 | 100% | 8 | 0 | 100% |
| Nitrate/nitrite | 166 | 0 | 100% | 8 | 0 | 100% |
| Semivolatile | 14,647 | 367 | 97.5% | 4,860 | 128 | 97.4% |
| Volatile | 4,784 | 168 | 96.5% | 3,300 | 156 | 95.3% |
| Pesticide/PCB | 1,344 | 3 | 99.8% | 740 | 0 | 100% |
| Perchlorate | 166 | 0 | 100% | 54 | 0 | 100% |
| TSS | NA | NA | NA | 26 | 0 | 100% |
| TOC | 42 | 0 | 100% | NA | NA | NA |
| pH | 42 | 0 | 100% | NA | NA | NA |

NA - Not applicable.

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03GW0701 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITROBENZENE | %D between columns >100% |
| 03GW0701-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW1001 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHYL IODIDE | Calibration noncompliance |
| 03GW1101 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW1201 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW1201-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW1301 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2-AMINO-4,6-DINITROTOLUENE | %D between columns >100% |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | HEXACHLOROCYCLOPENTADIENE | MS/MSD noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW1401 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW1501 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHYL IODIDE | Calibration noncompliance |
| 03GW1601 | 1,4-PHENYLENEDIAMINE | Calibration and hold time noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration and hold time noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration and hold time noncompliance |
| | METHYL IODIDE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03GW1701 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW1801 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW2001 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW2101 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHYL IODIDE | Calibration noncompliance |
| 03GW2201 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHYL IODIDE | Calibration noncompliance |
| 03GW2301 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW2401 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03GW2501 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB020206 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB020610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB040206 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB040610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB040610-D | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SB050206 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB050610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB060206 | 2,4-DIMETHYLPHENOL | Calibration noncompliance |
| | 3,3'-DICHLOROBENZIDINE | MS/MSD noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | BIS(2-ETHYLHEXYL)PHTHALATE | MS/MSD noncompliance |
| | DI-N-BUTYL PHTHALATE | MS/MSD noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB060610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB070206 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB070610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB080206 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB080206-D | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB080610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB090204 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB100206 | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB100610 | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB100610-D | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB110206 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB110610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB130206 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB130610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB140206 | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SB140610 | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB150206 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB150206-D | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB150610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB160206 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB160610 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB170406 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB171214 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB180204 | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB190204 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration and surrogate noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB191215 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB191215-D | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SB200810 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB200810-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB201215 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB211012 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB211215 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB220204 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | HMX | %D between columns >100% |
| | KEPONE | Calibration noncompliance |
| 03SB221215 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB230610 | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB240406 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | HMX | %D between columns >100% |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SB241215 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB250608 | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB260610 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB260610-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB270206 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB270607 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB280204 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB280204-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB340206 | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB340610 | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB360206 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB360610 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB390206 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SB390610 | 1,4-PHENYLENEDIAMINE | Calibration and hold time noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration and hold time noncompliance |
| | KEPONE | Calibration and hold time noncompliance |
| 03SB400206 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB400610 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB420206 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB420610 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB440206 | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB440610 | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB460206 | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB460610 | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB460610-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SB470206 | 2,4-DIMETHYLPHENOL | MS/MSD noncompliance |
| | 3,3'-DICHLOROBENZIDINE | MS/MSD noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | HEXACHLOROCYCLOPENTADIENE | MS/MSD noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SB470610 | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB480206 | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SB480610 | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD010006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD010612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD020006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-DINITROPHENOL | Calibration and surrogate noncompliance |
| | 3,3'-DICHLOROBENZIDINE | MS/MSD noncompliance |
| | 4-CHLOROANILINE | MS/MSD noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD020612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD030006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SD030612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD040006 | 2,4-D | %D between columns >100% |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD040612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD050006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD050006-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4,5-T | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD050612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD060006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD060612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SD070006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SD070612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD080006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SD080612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SD090006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DINOSEB | %D between columns >100% |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD090006-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | CIS-1,2-DICHLOROETHENE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SD090612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SD100006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD100612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | ENDRIN | %D between columns >100% |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD110006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 3,3'-DICHLOROBENZIDINE | MS/MSD noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD110612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | GAMMA-CHLORDANE | %D between columns >100% |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SD120006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SD120612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | METHAPYRILENE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SD130006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD130612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SD140006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4,5-TP (SILVEX) | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD140006-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | Field Duplicate / %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD140612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SD150006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SD150612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SD160006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD160612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD170006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | ALDRIN | %D between columns >100% |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SD170612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD180006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD180612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD190006 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD190006-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SD190612 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS020002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS040002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS050002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SS060002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS060002-D | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS070002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS080002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS090002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SS090002-D | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS100002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SS110002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS130002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SS140002 | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS150002 | 2,4-DIMETHYLPHENOL | MS/MSD noncompliance |
| | 3,3'-DICHLOROBENZIDINE | MS/MSD noncompliance |
| | 4-CHLOROANILINE | MS/MSD noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SS160002 | 3,3'-DICHLOROBENZIDINE | MS/MSD noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SS170002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS180002 | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS190002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS200002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS210002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SS220002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS230002 | ACETONE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS240002 | 1,4-PHENYLENEDIAMINE | Calibration and surrogate noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration and surrogate noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration and surrogate noncompliance |
| 03SS250002 | 2,3,4,6-TETRACHLOROPHENOL | surrogate noncompliance |
| | 2-CHLOROPHENOL | surrogate noncompliance |
| | 2-METHYLPHENOL | surrogate noncompliance |
| | 2-NITROPHENOL | surrogate noncompliance |
| | 3&4-METHYLPHENOL | surrogate noncompliance |
| | 4,6-DINITRO-2-METHYLPHENOL | surrogate noncompliance |
| | 4-CHLORO-3-METHYLPHENOL | surrogate noncompliance |
| | 4-NITROPHENOL | surrogate noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | PHENOL | surrogate noncompliance |
| 03SS260002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS270002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS280002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS290002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS300002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | DINOSEB | %D between columns >100% |
| | KEPONE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SS310002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SS310002-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS320002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | DINOSEB | %D between columns >100% |
| | KEPONE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SS330002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS340002 | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS350002 | KEPONE | Calibration noncompliance |
| 03SS360002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SS370002 | 3,3'-DICHLOROBENZIDINE | MS/MSD noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS370002-D | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS380002 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | HMX | %D between columns >100% |
| | KEPONE | Calibration noncompliance |
| 03SS390002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SS400002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SS410002 | KEPONE | Calibration noncompliance |
| 03SS420002 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | NITRITE | MS/MSD noncompliance |
| 03SS430002 | KEPONE | Calibration noncompliance |
| 03SS430002-D | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS440002 | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS450002 | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SS460002 | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS470002 | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SS480002 | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | DI-N-OCTYL PHTHALATE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SW0101 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2-BUTANONE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | CIS-1,2-DICHLOROETHENE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW0102 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW0201 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2-BUTANONE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | CIS-1,2-DICHLOROETHENE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW0202 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SW0301 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2-BUTANONE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | CIS-1,2-DICHLOROETHENE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW0302 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SW0601 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2-BUTANONE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | CIS-1,2-DICHLOROETHENE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW0602 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SW0602-D | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SW0802 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW0902 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SW1102 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW1302 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW1402 | 2,4,5-T | %D between columns >100% |
| | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| | PENTACHLOROPHENOL | %D between columns >100% |
| 03SW1501 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SW1502 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW1601 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SW1602 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW1701 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4,5-T | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SW1702 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW1801 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SW1802 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW1901 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| 03SW1901-D | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 2,4-D | %D between columns >100% |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| 03SW1902 | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | HEXACHLOROCYCLOPENTADIENE | Calibration and MS/MSD noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| 03SW1902-D | 2-BUTANONE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| RB06080101 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| RB06080102 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | DINOSEB | %D between columns >100% |
| | KEPONE | Calibration noncompliance |
| RB06200101 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| RB06200102 | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| RB06220101 | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| RB06230101 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| RB06240101 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| RB07110101 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| | METHYL IODIDE | Calibration noncompliance |

TABLE 3-3

REJECTED DATA
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| SAMPLE ID | PARAMETER | BASIS OF REJECTION |
|---|---|---|
| SB06230101 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| SB06230102 | 1,4-PHENYLENEDIAMINE | Calibration noncompliance |
| | 4-NITROQUINOLINE-1-OXIDE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | KEPONE | Calibration noncompliance |
| TB06070101 | ACROLEIN | Calibration noncompliance |
| TB06090101 | ACROLEIN | Calibration noncompliance |
| TB06110101 | 2-BUTANONE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | CIS-1,2-DICHLOROETHENE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |
| TB06200101 | ACROLEIN | Calibration noncompliance |
| TB06220101 | ACROLEIN | Calibration noncompliance |
| TB06230101 | ACROLEIN | Calibration noncompliance |
| TB06250101 | ACROLEIN | Calibration noncompliance |
| TB07100101 | ACROLEIN | Calibration noncompliance |
| | METHYL IODIDE | Calibration noncompliance |
| TB09090101 | 2-BUTANONE | Calibration noncompliance |
| | ACETONE | Calibration noncompliance |
| | ACROLEIN | Calibration noncompliance |
| | ACRYLONITRILE | Calibration noncompliance |
| | METHACRYLONITRILE | Calibration noncompliance |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| **EXPLOSIVES (SW-846 METHOD 8330)** | | | | | | | | |
| 1,3,5-Trinitrobenzene | 0 35 | 0 35 | 0 35 | 1100 | 0 25 | 0 25 | 0 25 | 1800 |
| 1,3-Dinitrobenzene | 0 35 | 0 35 | 0 35 | 2 36 | 0 25 | 0 25 | 0 25 | 0 000924 |
| 2,4,6-Trinitrotoluene (TNT) | 0 35 | 0 35 | 0 35 | 2 2 | 0 25 | 0 25 | 0 25 | 16 |
| 2,4-Dinitrotoluene | 0 35 | 0 35 | 0 35 | 1 2 | 0 25 | 0.33 | 0 25 | 0 00004 |
| 2,6-Dinitrotoluene | 0 35 | 0 35 | 0.35 | 1 2 | 0 25 | 0 25 | 0 25 | 0 00003 |
| 2-Amino-4,6-dinitrotoluene | 0 12 | 0 35 | 0 35 | 2 | 0 25 | 0 25 | 0 25 | -- |
| 2-Nitrotoluene | 0.35 | 0 35 | 0 35 | 61 | 0 25 | 0.25 | 0 25 | 370 |
| 3-Nitrotoluene | 0 35 | 0 35 | 0 35 | 61 | 0 25 | 0 25 | 0 25 | 370 |
| 4-Amino-2,6-dinitrotoluene | 0 35 | 0 35 | 0 35 | -- | 0 25 | 1 | 0 25 | -- |
| 4-Nitrotoluene | 0 35 | 0 35 | 0 35 | 61 | 0 25 | 0.25 | 0 25 | 370 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) | 0 35 | 0 35 | 0.35 | 0 61 | 0 25 | 0 25 | 0 25 | 4 4 |
| Methyl-2,4,6-trinitrophenylnitramine (Tetryl) | 0 35 | 0 35 | 0 35 | 360 | 0 25 | 0 25 | 0 25 | 610 |
| Nitrobenzene | 0 35 | 0 35 | 0 35 | 3 4 | 0 25 | 0 25 | 0 25 | 0 007 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 0 35 | 0 35 | 0 35 | 1800 | 0.25 | 0.34 | 0 25 | 3100 |
| Pentaerythritol Tetranitrate (PETN) | 0.35 | 0.35 | | | 0.025 | 2.1 | | |
| Nitroglycerin | 3 50 | 3 50 | 3 50 | --- | 2 5 | 2 5 | 2 5 | --- |
| **EXPLOSIVES (EPA METHOD 353.2/MODIFIED ARMY CORPS METHOD)** | | | | | | | | |
| Nitrocellulose | 750 | 1000 | | --- | 0.25 | 830 | | --- |
| **APPENDIX IX METALS (SW-846 Method 6020 ICP/MS)** | | | | | | | | |
| Antimony | 0 02 | 0.96 | 0 1 | 6 | 0.08 | 3.5 | 0 05 | 0 1423 |
| Arsenic | 0.20 | 1.00 | 0 1 | 0 045 | 2.80 | 4.4 | 0 05 | 0.0059 |
| Barium | --- | --- | 0 1 | 2000 | --- | --- | 0 05 | 1.04 |
| Beryllium | 0.20 | 0.50 | 0 1 | 4 | 0.20 | 0.2 | 0 05 | 0 1 |
| Cadmium | 0.28 | 3.50 | 0 1 | 0.66 | 0.28 | 0.33 | 0 05 | 0 00222 |
| Chromium (total) | 0 10 | 0.49 | 0 1 | 11 | --- | --- | 0 05 | 2 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| Cobalt | 0 10 | 0.50 | 0 1 | 5 | --- | --- | 0 05 | 0 14033 |
| Copper | 0.19 | 0.87 | 0 1 | 5 | --- | --- | 0 05 | 2.96 |
| Lead | 0 10 | 0.50 | 0 1 | 1 3 | --- | --- | 0 05 | 0 05373 |
| Mercury (SW-846 Method 7470A/7471A) | 0 08 | 0 10 | 0 1 | 0 0013 | 0 015 | 0.03 | 0 02 | 0 073 |
| Nickel | --- | --- | 0 1 | 29 | --- | --- | 0.05 | 7 |
| Selenium | 0 16 | 2.00 | 0 3 | 5 | 0.16 | 0.8 | 0 15 | 0 02765 |
| Silver | 0 04 | 0.50 | 0 1 | 1 | 0 04 | 0.92 | 0 05 | 0 5 |
| Thallium | 0 10 | 0.50 | 0 1 | 0 56 | 0 04 | 0.08 | 0 05 | 0 04 |
| Tin | 0 07 | 7.00 | 0 1 | 73 | 0.07 | 11 | 0 05 | 7 62 |
| Vanadium | 0 10 | 0.78 | 0 1 | 19 | --- | --- | 0 05 | 1 59 |
| Zinc | 0.50 | 9.70 | 0 4 | 58 9 | --- | --- | 0 2 | 6 62 |
| **MISCELLANEOUS METALS (SW-846 METHOD 6010B Trace) [3]** | | | | | | | | |
| Aluminum | 2 6 | 200 | 81 | 87 | --- | --- | 8 1 | 76000 |
| Calcium | 5000 | 5000 | 150 | -- | --- | --- | 15 | -- |
| Iron | 100 | 100 | 13 | 300 | --- | --- | 1.3 | 23000 |
| Magnesium | 5000 | 5000 | 7 6 | -- | --- | --- | 0 76 | -- |
| Manganese | 0.540 | 15.00 | 0 2 | 50 | --- | --- | 0 02 | 1800 |
| Potassium | 5000 | 5000 | 16 | -- | --- | --- | 1.6 | -- |
| Sodium | 5000 | 5000 | 76 | -- | 3 40 | 237 | 7 6 | -- |
| **APPENDIX IX VOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8260B WITH 25 mL PURGE FOR WATER, 5 g PURGE FOR SOIL or 8015B)** | | | | | | | | |
| 1,1,1-Trichloroethane | 0 50 | 0 50 | 0 5 | 88 | 0 0009 | 0.013 | 0 001 | 0 1 |
| 1,1,1,2-Tetrachloroethane | 0 30 | 0 30 | 0 3 | 0 43 | 0 0009 | 0.013 | 0.001 | 0 01089 |
| 1,1,2,2-Tetrachloroethane | 0 30 | 0 30 | 0.3 | 0 055 | 0 0009 | 0.013 | 0 001 | 0.0002 |
| 1,1,2-Trichloroethane | 0 30 | 0 30 | 0 3 | 0 2 | 0.0009 | 0.013 | 0 001 | 0 0009 |
| 1,2,3-Trichloropropane | 0 30 | 0 30 | 0 3 | 0 0016 | 0.0009 | 0.013 | 0.001 | 0 0014 |
| 1,1-Dichloroethane | 0 50 | 0 50 | 0 5 | 47 | 0.0009 | 0.013 | 0 001 | 0 000575 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| 1,1-Dichloroethene | 0 30 | 0 30 | 0 3 | 0 046 | 0 0009 | 0.013 | 0 001 | 0 003 |
| 1,2-Dibromo-3-chloropropane | 0 30 | 0 30 | 0 3 | 0 048 | 0 0009 | 0.013 | 0.001 | 0 01998 |
| 1,2-Dibromoethane | 0 30 | 0 30 | 0.3 | 0 00076 | 0 0009 | 0.013 | 0 001 | 0 0069 |
| 1,2-Dichloroethane | 0 30 | 0 30 | 0 3 | 0 12 | 0.0009 | 0.013 | 0 001 | 0.001 |
| 1,2-Dichloropropane | 0 30 | 0 30 | 0.3 | 0 16 | 0 0009 | 0.013 | 0.001 | 0 001 |
| 1,4-Dioxane (8015B) | 44 | 44 | 44 | 6 1 | 0 085 | 0.27 | 0 1 | 0·00000543 |
| 2-Butanone | 0.50 | 0 50 | 0.5 | 1900 | 0.0009 | 0.013 | 0 001 | 0.13696 |
| 2-Chloro-1,3-butadiene (chloroprene) | 0 50 | 0 50 | 0 5 | 14 | 0.000001 | 0.013 | 0 001 | 0.00106 |
| 2-Hexanone | 0 50 | 0 50 | 0 5 | 1500 | 0 0009 | 0.013 | 0 001 | 1 01 |
| 4-Methyl-2-pentanone | 0 50 | 0 50 | 0 5 | 160 | 0.0009 | 0.013 | 0.001 | 0 54437 |
| Acetone | 0 50 | 26.0 | 0 5 | 610 | 0 00093 | 0.32 | 0 001 | 0 45337 |
| Acetonitrile (8015B) | 0 50 | 0 50 | 3 7 | 79 | 0 00008 | 0.11 | 0 04 | 0.13905 |
| Acrolein | --- | --- | 0 5 | 0.042 | 0 00096 | 0.013 | 0 001 | 0.0000144 |
| Acrylonitrile | 0 50 | 0 50 | 0 5 | 0 039 | --- | --- | 0.001 | 0.0000157 |
| Allyl chloride (3-chloro-1-propene) | 0 50 | 0 50 | 0 5 | 1800 | 0 0009 | 0.013 | 0 001 | 0 000266 |
| Benzene | 0 30 | 0 30 | 0 3 | 0 41 | 0 0009 | 0.013 | 0 001 | 0.002 |
| Bromodichloromethane | 0 30 | 0 30 | 0 3 | 0 18 | 0 0009 | 0.013 | 0.001 | 0 00113 |
| Bromoform | 0 50 | 0 50 | 0 5 | 8 5 | 0.0009 | 0.013 | 0 001 | 0 04 |
| Bromomethane | 0 50 | 0 50 | 0 5 | 8 7 | 0 0009 | 0.013 | 0 001 | 0.01 |
| Carbon disulfide | 0 50 | 0 50 | 0 5 | 84 1 | 0 0009 | 0.013 | 0 001 | 0 09412 |
| Carbon tetrachloride | 0 30 | 0 30 | 0 3 | 0 17 | 0 0009 | 0.013 | 0 001 | 0.003 |
| Chlorobenzene | 0 50 | 0 50 | 0 5 | 10 | 0 0009 | 0.013 | 0.001 | 0 06194 |
| Chloroethane | 0 50 | 0 50 | 0 5 | 4 6 | 0 0009 | 0.013 | 0 001 | 3 |
| Chloroform | 0 30 | 0 30 | 0 3 | 0.16 | 0 0009 | 0.013 | 0 001 | 0 027 |
| Chloromethane | 0.50 | 0 50 | 0 5 | 1.5 | 0.0009 | 0.013 | 0.001 | 0 0000785 |
| cis-1,2-Dichloroethene | 0 50 | 0 50 | 0.5 | 61 | 0 0009 | 0.013 | 0.001 | 0.02 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| cis-1,3-Dichloropropene | 0 30 | 0 30 | 0 3 | 0 081 | 0 0009 | 0.013 | 0 001 | 0 0002 |
| Dibromochloromethane | 0 30 | 0 30 | 0 3 | 0 13 | 0.0009 | 0.013 | 0 001 | 0 02 |
| Dibromomethane | 0 50 | 0 50 | 0 5 | 61 | 0 0009 | 0.013 | 0 001 | 0 0000859 |
| Dichlorodifluoromethane | 0 50 | 0.50 | 0 5 | 390 | 0.0009 | 0.013 | 0 001 | 0 00133 |
| Ethylbenzene | 0 50 | 0 50 | 0 5 | 17 2 | 0.0009 | 0.013 | 0 001 | 0 0001 |
| Ethyl methacrylate | 0 50 | 0.50 | 0 5 | 550 | 0 0009 | 0.013 | 0 001 | 0 000602 |
| Isobutanol (8015B) | 6 3 | 6.3 | 6 3 | 1800 | 0 0335 | 0.11 | 0.04 | 3.35 |
| Methacrylonitrile | 0 50 | 0.50 | 0 5 | 1 | 0 0009 | 0.013 | 0.001 | 0 0000297 |
| Methylene chloride | 0 50 | 5.30 | 0 5 | 4.3 | 0 001 | 0.064 | 0 001 | 0 001 |
| Methyl iodide | 0 50 | 0 50 | 0 5 | -- | 0 0009 | 0.013 | 0 001 | -- |
| Methyl methacrylate | 0.50 | 0 50 | 0 5 | 1400 | 0 0009 | 0.013 | 0.001 | 0 16756 |
| Propionitrile (8015B) | 4 6 | 4 6 | 4.6 | 6080 | 0 0335 | 0.11 | 0 04 | 0.04983 |
| Styrene | 0 50 | 0 50 | 0 5 | 56 | 0 0009 | 0.013 | 0 001 | 0 2 |
| Tetrachloroethene | 0 50 | 0 50 | 0 5 | 1 1 | 0 0009 | 0.013 | 0 001 | 0 003 |
| Toluene | 0 50 | 0.50 | 0 5 | 253 | 0 0009 | 0.013 | 0 001 | 0 6 |
| trans-1,2-Dichloroethene | 0 50 | 0 50 | 0 5 | 100 | 0 0009 | 0.013 | 0 001 | 0 03 |
| trans-1,3-Dichloropropene | 0 30 | 0 30 | 0 3 | 0 081 | 0 0009 | 0.013 | 0 001 | 0.0002 |
| trans-1,4-Dichloro-2-butene | 0 50 | 0 50 | 0 5 | 0 0012 | 0 0009 | 0.013 | 0.001 | 0.00182 |
| Trichloroethene | 0 50 | 1.60 | 0 5 | 1 6 | 0 0009 | 0.013 | 0 001 | 0.003 |
| Trichlorofluoromethane | 0 50 | 0 50 | 0 5 | 1300 | 0 0009 | 0.013 | 0.001 | 0 00307 |
| Vinyl acetate | 0 50 | 0 50 | 0 5 | 248 03 | 0.0009 | 0.013 | 0.001 | 0.01295 |
| Vinyl chloride | 0 30 | 0 30 | 0 3 | 0 02 | 0.0009 | 0.013 | 0 001 | 0 0007 |
| Total Xylenes | 0 50 | 0 50 | 0 5 | 117 | 0 0009 | 0.013 | 0 001 | 1 88 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| APPENDIX IX SEMIVOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8270C OR 8270C - SELECTIVE ION MONITORING) | | | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | 0 94 | 1:10 | 1 | 11 | 0 067 | 0.11 | 0 067 | 2 02 |
| 1,2,4-Trichlorobenzene | 0 94 | 1.10 | 1 | 69 2 | 0 067 | 0.11 | 0 067 | 0 3 |
| 1,2-Dichlorobenzene | 0 94 | 1:10 | 1 | 11 | 0 067 | 0.11 | 0 067 | 0 23132 |
| 1,3-Dichlorobenzene | 0 94 | 1:10 | 1 | 5 5 | 0 067 | 0.11 | 0 067 | 0 42 |
| 1,4-Dichlorobenzene | 0 94 | 1:10 | 1 | 0 5 | 0 067 | 0.11 | 0 067 | 0.1 |
| 1,4-Naphthoquinone | 0 94 | 1:10 | 1 | -- | 0 067 | 0.11 | 0 067 | -- |
| 1,4-Phenylenediamine | 0 94 | 1 00 | 1 | 6900 | 0 067 | 0.098 | 0 067 | 0 00000568 |
| 1-Naphthylamine | 0 94 | 1:10 | 1 | 0 67 | 0 067 | 0.11 | 0 067 | -- |
| 2,3,4,6-Tetrachlorophenol | 0 94 | 1:10 | 1 | 14 06 | 0.067 | 0.11 | 0 067 | 0 19878 |
| 2,4,5-Trichlorophenol | 0 94 | 1:10 | 1 | 3600 | 0 067 | 0.11 | 0 067 | 0 08556 |
| 2,4,6-Trichlorophenol | 0 94 | 1:10 | 1 | 2 | 0 067 | 0.11 | 0 067 | 0 008 |
| 2,4-Dichlorophenol | 0 94 | 1:10 | 1 | 18 | 0 067 | 0.11 | 0 067 | 0 05 |
| 2,4-Dimethylphenol | 0 94 | 1.10 | 1 | 100 17 | 0 067 | 0.11 | 0 067 | 0 01 |
| 2,4-Dinitrophenol | 0 94 | 1:10 | 1 | 4 07 | 0 067 | 0.11 | 0 067 | 0 00133 |
| 2,6-Dichlorophenol | 0 94 | 1:10 | 1 | -- | 0 067 | 0.11 | 0 067 | 0.00394 |
| 2-Acetylaminofluorene | 0 94 | 1:10 | 1 | 534 97 | 0 067 | 0.11 | 0 067 | 0 01532 |
| 2-Chloronaphthalene | 0 94 | 1:10 | 1 | 0 396 | 0 067 | 0.11 | 0.067 | 0 01218 |
| 2-Chlorophenol | 0 94 | 1:10 | 1 | 8 8 | 0 067 | 0.11 | 0 067 | 0.0117 |
| 2-Methylnaphthalene (SIM) | 0 019 | 0.021 | 0 02 | 329 55 | 0 0013 | 0.055 | 0 0013 | 0 0202 |
| 2-Methylphenol | 0 94 | 1:10 | 1 | 1800 | 0 067 | 0.11 | 0 067 | 0 000826 |
| 2-Naphthylamine | 0 94 | 1:10 | 1 | -- | 0 067 | 0.11 | 0 067 | 0.00174 |
| 2-Nitroaniline | 0 94 | 1.10 | 1 | 2 1 | 0 067 | 0.11 | 0 067 | 0 000222 |
| 2-Nitrophenol | 0 94 | 1:10 | 1 | 13 5 | 0 067 | 0.11 | 0 067 | 0 00777 |
| 2-Picoline | 0 94 | 1:10 | 1 | 3790 | 0 067 | 0.11 | 0.067 | 0 75305 |
| 3,3'-Dichlorobenzidine | 0 94 | 1:10 | 1 | 0 15 | 0.067 | 0.11 | 0 067 | 0 0003 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| 3,3'-Dimethylbenzidine | 0 94 | 1.10 | 1 | 0 0073 | 0 067 | 0.11 | 0 067 | 0 002 |
| 3-Methylcholanthrene | 0 94 | 1.10 | 1 | 0 0891 | 0 067 | 0.11 | 0 067 | 0 07794 |
| 3-Methylphenol[4] | 0 94 | 1.10 | 1 | 1800 | 0 067 | 0.11 | 0 067 | 0 000808 |
| 4-Methylphenol[4] | 0 94 | 1.10 | 1 | 180 | 0 067 | 0.11 | 0 067 | 0 000845 |
| 3-Nitroaniline | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | 0 000222 |
| 4,6-Dinitro-2-methylphenol | 0 94 | 1.10 | 1 | 2 3 | 0 067 | 0.11 | 0 067 | 0 01038 |
| 4-Aminobiphenyl | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | 0 00305 |
| 4-Bromophenyl phenyl ether | 0 94 | 1.10 | 1 | 1 5 | 0 067 | 0.11 | 0 067 | 1.68 |
| 4-Chloro-3-methylphenol | 0 94 | 1.10 | 1 | 20 | 0 067 | 0.11 | 0 067 | 0 38818 |
| 4-Chloroaniline | 0 94 | 1.10 | 1 | 150 | 0 067 | 0.11 | 0 067 | 0.03 |
| 4-Chlorophenyl phenyl ether | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | 0 656112 |
| 4-Nitroaniline | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | 0 000222 |
| 4-Nitrophenol | 0 94 | 1.10 | 1 | 35 | 0 067 | 0.11 | 0 067 | 0 00778 |
| 4-Nitroquinoline-1-oxide | 0 94 | 1.10 | 1 | -- | 0.073 | 0.11 | 0 067 | 0.00124 |
| 5-Nitro-o-toluidine | 0 94 | 1.10 | 1 | 2 | 0 067 | 0.11 | 0 067 | 0 000845 |
| 7,12-Dimethylbenz(a)anthracene | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0.067 | -- |
| Acenaphthene (SIM) | 0 019 | 0.021 | 0 02 | 9 9 | 0 0013 | 0.055 | 0 0013 | 0.00671 |
| Acenaphthylene (SIM) | 0 019 | 0.021 | 0 02 | 370 | 0 0013 | 0.055 | 0 0013 | 0 00587 |
| Acetophenone | 0 94 | 1.10 | 1 | 0 042 | 0 067 | 0.22 | 0 067 | 0 246 |
| Aniline | 0 94 | 1.10 | 1 | 0 44 | 0.067 | 0.11 | 0 067 | 0 0000338 |
| Aramite | 0 94 | 1.10 | 1 | 2 7 | 0.067 | 0.11 | 0 067 | 0 00000111 |
| Anthracene (SIM) | 0 019 | 0.021 | 0 02 | 0 029 | 0 0013 | 0.38 | 0 0013 | 0.0469 |
| Benzo(a)anthracene (SIM) | 0 019 | 0.021 | 0 02 | 0 092 | 0.0013 | 0.38 | 0.0013 | 0 0317 |
| Benzo(a)pyrene (SIM) | 0.019 | 0.021 | 0 02 | 0 0092 | 0 0013 | 0.055 | 0 0013 | 0 0319 |
| Benzo(b)fluoranthene (SIM) | 0 019 | 0.021 | 0.02 | 0 092 | 0 0013 | 0.055 | 0.0013 | 0 2 |
| Benzo(g,h,i)perylene (SIM) | 0 019 | 0.021 | 0 02 | 6 2 | 0 0013 | 0.055 | 0 0013 | 0 17 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| Benzo(k)fluoranthene (SIM) | 0 019 | 0.021 | 0 02 | 0 0056 | 0 0013 | 0.055 | 0 0013 | 0.24 |
| Benzyl alcohol | 0 94 | 1.10 | 1 | 281 24 | 0 067 | 0.11 | 0 067 | 0 03394 |
| Bis(2-chloroethoxy)methane | 0 94 | 1.10 | 1 | 6400 | 0 067 | 0.11 | 0 067 | 0 34971 |
| Bis(2-chloroethyl)ether | 0 94 | 1.10 | 1 | 0 0098 | 0 067 | 0.11 | 0 067 | 0 00002 |
| Bis(2-chloroisopropyl)ether | 0 94 | 1.10 | 1 | 0 27 | 0 067 | 0.11 | 0 067 | 0 027 |
| Bis(2-ethylhexyl)phthalate | 0 94 | 1.10 | 1 | 2 1 | 0 067 | 0.26 | 0 067 | 0 182 |
| Butyl benzyl phthalate | 0 94 | 1.10 | 1 | 49 | 0 067 | 0.11 | 0 067 | 0 23889 |
| Chlorobenzilate | 0 94 | 1.10 | 1 | 0 25 | 0 067 | 0.11 | 0 067 | 0.86029 |
| Chrysene (SIM) | 0 019 | 0.021 | 0 02 | 0.033 | 0 0013 | 0.38 | 0 0013 | 0 0571 |
| Diallate | 0 94 | 1.10 | 1 | 1 1 | 0 067 | 0.11 | 0.067 | 0 00151 |
| Di-n-butyl phthalate | 0 94 | 1.10 | 1 | 3 | 0 067 | 0.49 | 0 067 | 0 1105 |
| Di-n-octyl phthalate | 0 94 | 1.10 | 1 | 20 | 0 067 | 0.11 | 0 067 | 40 6 |
| Dibenzo(a,h)anthracene (SIM) | 0 019 | 0.021 | 0 02 | 0 0016 | 0 0013 | 0.055 | 0 0013 | 0 00622 |
| Dibenzofuran | 0 94 | 1.10 | 1 | 20 | 0 067 | 0.11 | 0 067 | 1 52 |
| Diethyl phthalate | 0 94 | 1.10 | 1 | 3 | 0 067 | 0.11 | 0 067 | 0.00804 |
| p-(Dimethylamino)azobenzene | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | -- |
| a,a-Dimethylphenethylamine [5] | 0 94 | 1.10 | 1 | 37 | 0 067 | 0.11 | 0 067 | 61 |
| Dimethyl phthalate | 0 94 | 1.10 | 1 | 73 | 0 067 | 0.11 | 0 067 | 0 02495 |
| Diphenylamine [6] | 0 94 | 1.10 | 1 | 412 51 | 0 067 | 0.11 | 0 067 | 0 0346 |
| Ethyl methane sulfonate | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | -- |
| Ethyl parathion | 0 94 | 1.10 | 1 | 0 008 | 0 067 | 0.11 | 0 067 | 0 00034 |
| Fluoranthene (SIM) | 0 019 | 0.021 | 0 02 | 8 1 | 0 0013 | 0.055 | 0 0013 | 0 1113 |
| Fluorene (SIM) | 0 019 | 0.021 | 0 02 | 3 9 | 0 0013 | 0.055 | 0 0013 | 0 0212 |
| Hexachlorobenzene | 0 94 | 1.10 | 1 | 0 00024 | 0.067 | 0.11 | 0 067 | 0 02 |
| Hexachlorobutadiene | 0 94 | 1.10 | 1 | 0 223 | 0 067 | 0.11 | 0.067 | 0 03976 |
| Hexachlorocyclopentadiene | 0 94 | 1.10 | 1 | 50 | 0 067 | 0.11 | 0 067 | 0 75537 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| Hexachloroethane | 0 94 | 1.10 | 1 | 4 8 | 0 067 | 0.11 | 0 067 | 0 02 |
| Hexachlorophene | 0 01 | 0 01 | 1 | 0 228 | 0 0073 | 0 011 | 0 067 | 0 19878 |
| Hexachloropropene | 0 94 | 1.10 | 1 | 20 | 0 067 | 0.11 | 0 067 | 0 0002 |
| Indeno(1,2,3-cd)pyrene (SIM) | 0 019 | 0.021 | 0 02 | 0 092 | 0 0013 | 0.055 | 0 0013 | 0 2 |
| Isodrin | 0 94 | 1.10 | 1 | 0 0309 | 0 067 | 0.11 | 0 067 | 0 00332 |
| Isophorone | 0 94 | 1.10 | 1 | 71 | 0 067 | 0.11 | 0 067 | 0 03 |
| Isosafrole | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | 0 00412 |
| Kepone | --- | --- | 1 | 0 0037 | 0.081 | 0.081 | 0.067 | 0 00331 |
| Methapyrilene | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | 0 0000144 |
| Methyl methane sulfonate | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | -- |
| Methyl parathion | 0 94 | 1.10 | 1 | 9.1 | 0 067 | 0.11 | 0 067 | 0 000292 |
| n-Nitrosodi-n-butylamine | 0 94 | 1.10 | 1 | 0 002 | 0 067 | 0.11 | 0 067 | 0 024 |
| n-Nitrosodiethylamine | 0 94 | 1.10 | 1 | 0 00045 | 0 067 | 0.11 | 0 067 | 0 0032 |
| n-Nitrosodimethylamine | 0 94 | 1.10 | 1 | 0 0013 | 0 067 | 0.11 | 0 067 | 0 00000275 |
| n-Nitrosodi-n-propylamine | 0 94 | 1.10 | 1 | 0 0096 | 0 067 | 0.11 | 0 067 | 0 000002 |
| n-Nitrosomethylethylamine | 0 94 | 1.10 | 1 | 0 0031 | 0 067 | 0.11 | 0 067 | 0 00000485 |
| n-Nitrosomorpholine | 0 94 | 1.10 | 1 | -- | 0.067 | 0.11 | 0 067 | 0 0000037 |
| n-Nitrosopiperidine | 0 94 | 1.10 | 1 | -- | 0.067 | 0.11 | 0 067 | 0 0000226 |
| n-Nitrosopyrrolidine | 0 94 | 1.10 | 1 | 0 032 | 0 067 | 0.11 | 0 067 | 0 000000908 |
| Naphthalene (SIM) | 0 019 | 0.021 | 0 02 | 6 2 | 0.0013 | 0.055 | 0 0013 | 0.0346 |
| Pentachlorobenzene | 0 94 | 1.10 | 1 | 0 47 | 0 067 | 0.11 | 0.067 | 0 49695 |
| Pentachloroethane | 0 94 | 1.10 | 1 | 56 42 | 0 067 | 0.11 | 0.067 | 0 68918 |
| Pentachloronitrobenzene | 0 94 | 1.10 | 1 | 0.26 | 0.067 | 0.11 | 0 067 | 1 9 |
| Phenacetin | 0 94 | 1.10 | 1 | -- | 0 067 | 0.11 | 0 067 | 0 00225 |
| Phenanthrene (SIM) | 0 019 | 0.021 | 0.02 | 2 1 | 0 0013 | 0.055 | 0 0013 | 0 0419 |
| Phenol | 0 94 | 1.10 | 1 | 100 | 0 067 | 0.11 | 0 067 | 0 02726 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| Pronamide | 0 94 | 1.10 | 1 | 160 | 0.067 | 0.11 | 0 067 | 0 0016 |
| Pyrene (SIM) | 0 019 | 0.021 | 0 02 | 0 3 | 0 0013 | 0.081 | 0 0013 | 0 053 |
| Pyridine | 0 94 | 1.10 | 1 | 37 | 0.067 | 0.11 | 0 0013 | 0.10617 |
| Safrole | 0 94 | 1.10 | 1 | 40 | 0 067 | 0.11 | 0 067 | 0 16486 |
| o-Toluidine | 0 94 | 1.10 | 1 | 0 28 | 0.067 | 0.11 | 0 067 | 0 000199 |
| O,O,O-Triethyl phosphorothioate | 0 94 | 1.10 | 1 | 58 25 | 0 067 | 0.11 | 0 067 | -- |
| **APPENDIX IX ORGANOCHLORINE PESTICIDES and PCBs (SW-846 METHOD 8081A and 8082)** | | | | | | | | |
| Aldrin | 0 0047 | 0.006 | 0 005 | 0.004 | 0.00098 | 0.0015 | 0.0009 | 0 002 |
| Alpha-BHC | 0 0047 | 0.006 | 0 005 | 0 011 | 0.00098 | 0.0015 | 0 0009 | 0.00003 |
| Alpha-chlordane | 0 014 | 0.017 | 0.015 | 0 00029 | 0.00098 | 0.0015 | 0.0009 | 0 0045 |
| Beta-BHC | 0 014 | 0.017 | 0 015 | 0 037 | 0.00098 | 0.0015 | 0.0009 | 0.0001 |
| 4,4'-DDD | 0 024 | 0.028 | 0 025 | 0 0011 | 0.0019 | 0.0028 | 0 0017 | 0 00553 |
| 4,4'-DDE | 0 024 | 0.028 | 0 025 | 4.51E-09 | 0.0019 | 0.0028 | 0.0017 | 0 00142 |
| 4,4'-DDT | 0 024 | 0.028 | 0 025 | 0 001 | 0.0019 | 0.0028 | 0 0017 | 0.00119 |
| Delta-BHC | 0 024 | 0.028 | 0 025 | 0 011 | 0.00098 | 0.0015 | 0 0009 | 9 94 |
| Dieldrin | 0 009 | 0.011 | 0 01 | 0.000026 | 0.0019 | 0.0028 | 0 0017 | 0 0002 |
| Endosulfan I | 0 024 | 0.028 | 0 025 | 0 003 | 0.00098 | 0.0015 | 0 0009 | 0.000175 |
| Endosulfan II | 0 024 | 0.028 | 0 025 | 0 003 | 0.0019 | 0.0028 | 0 0017 | 0 000104 |
| Endosulfan sulfate | 0 047 | 0.056 | 0.05 | 0 22 | 0.0019 | 0.0028 | 0 0017 | 0 0346 |
| Endrin | 0 028 | 0.033 | 0 03 | 0 002 | 0.0019 | 0.0028 | 0 0017 | 0 00267 |
| Endrin aldehyde | 0 047 | 0.056 | 0 05 | 0 15 | 0.0019 | 0.0028 | 0.0017 | 0.0105 |
| Gamma-BHC (Lindane) | 0 024 | 0.028 | 0 025 | 0 01 | 0.00098 | 0.0015 | 0 0009 | 0 0005 |
| Gamma-chlordane | 0 014 | 0.017 | 0 015 | 0 00029 | 0.00098 | 0.0015 | 0 0009 | 0.0045 |
| Heptachlor | 0 014 | 0.017 | 0 015 | 0 00039 | 0.00098 | 0.0015 | 0 0009 | 0.0006 |
| Heptachlor epoxide | 0 0047 | 0.006 | 0 005 | 0.00048 | 0.00098 | 0.0015 | 0 0009 | 0 0006 |
| Methoxychlor | 0 057 | 0.067 | 0 06 | 0 005 | 0.0098 | 0.015 | 0 009 | 0 00359 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| Toxaphene | 1 4 | 1.7 | 1.5 | 0 0002 | 0.098 | 0.15 | 0 09 | 0 000109 |
| Aroclor-1016 | 0 24 | 0.28 | 0 25 | 0 000029 | 0.019 | 0.028 | 0 017 | 0 0341 |
| Aroclor-1221 | 0 24 | 0.28 | 0 25 | 0 000029 | 0.037 | 0.056 | 0 034 | 0 0341 |
| Aroclor-1232 | 0 24 | 0.28 | 0 25 | 0.000029 | 0.019 | 0.028 | 0 017 | 0 0341 |
| Aroclor-1242 | 0 24 | 0.28 | 0 25 | 0 000029 | 0.019 | 0.028 | 0 017 | 0.0341 |
| Aroclor-1248 | 0 24 | 0.28 | 0 25 | 0 000029 | 0.019 | 0.028 | 0 017 | 0 0341 |
| Aroclor-1254 | 0 24 | 0.28 | 0 25 | 0.000029 | 0.019 | 0.028 | 0.017 | 0 0341 |
| Aroclor-1260 | 0 24 | 0.28 | 0 25 | 0 000029 | 0.019 | 0.028 | 0 017 | 0 0341 |
| **APPENDIX IX HERBICIDES (SW-846 METHOD 8151A)** | | | | | | | | |
| 2,4-D | 0 04 | 0 04 | 0 04 | 70 | 0.0015 | 0.002 | 0 0014 | 0 00579 |
| 2,4,5-T | 0 04 | 0 04 | 0 04 | 360 | 0.0015 | 0.0023 | 0.0014 | 0 59634 |
| 2,4,5-TP (Silvex) | 0 04 | 0 04 | 0 04 | 50 | 0.0015 | 0.0023 | 0 0014 | 0 1088 |
| Dinoseb[7] | 0 04 | 0 04 | 0 04 | 0 39 | 0.0015 | 0.0023 | 0 0014 | 0.01178 |
| Pentachlorophenol | 0 01 | 0 01 | 0 01 | 0 56 | 0.00037 | 0.00048 | 0 00034 | 0 001 |
| **DIOXINS/FURANS (SW-846 METHOD 8290)[8]** | | | | | | | | |
| 2,3,7,8-Tetrachlorodibenzodioxin (2,3,7,8-TCDD) | ANR | ANR | | | 6 00E-08 | 2 00E-04 | | 3 90E-06 |
| 1 2 3 7.8-Pentachlorodibenzodioxin (1,2,3,7,8-PeCDD) | ANR | ANR | | | 7 00E-08 | 2 00E-04 | | 3 90E-06 |
| 1,2,3,6,7,8-Hexachlorodibenzodioxin (1,2,3,6,7,8-HxCDD) | ANR | ANR | | | 1 00E-07 | 7 60E-04 | | 3 90E-05 |
| 1,2,3,4,7,8-Hexachlorodibenzodioxin (1,2,3,4,7,8-HxCDD) | ANR | ANR | | | 1 00E-07 | 7 40E-04 | | 3 90E-05 |
| 1,2,3,7,8,9-Hexachlorodibenzodioxin (1,2,3,7,8,9-HxCDD) | ANR | ANR | | | 1.00E-07 | 7 60E-04 | | 3 90E-05 |
| 1,2,3,4,6,7,8-Heptachlorodibenzodioxin (1,2,3,4,6,7,8-HpCDD) | ANR | ANR | | | --- | --- | | 3 90E-04 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzodioxin (OCDD) | ANR | ANR | | | --- | --- | | 3 90E-02 |
| 2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF) | ANR | ANR | | | 5.00E-08 | 8 50E-04 | | 3 90E-05 |
| 1 2 3 7 8-Pentachlorodibenzofuran (1,2,3,7,8-PeCDF) | ANR | ANR | | | 6 00E-08 | 3 80E-04 | | 7 80E-05 |
| 2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8-PeCDF) | ANR | ANR | | | 6.00E-08 | 6 70E-04 | | 7 80E-06 |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-HxCDF) | ANR | ANR | | | 6 00E-08 | 2 00E-04 | | 3 90E-05 |

TABLE 3-4

SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-HxCDF) | ANR | ANR | | | 8 00E-08 | 6 50E-04 | | 3 90E-05 |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF) | ANR | ANR | | | 7 00E-08 | 2 10E-03 | | 3 90E-05 |
| 2,3,4,6,7,8- Hexachlorodibenzofuran (2,3,4,6,7,8-HxCDF) | ANR | ANR | | | 7 00E-08 | 1 30E-04 | | 3 90E-05 |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-HpCDF) | ANR | ANR | | | 1 00E-07 | 7 10E-04 | | 5E-6 |
| 1,2,3,4,7,8,9- Heptachlorodibenzofuran (1,2,3,4,7,8,9-HpCDF) | ANR | ANR | | | 1 00E-07 | 4 00E-04 | | 5E-6 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | ANR | ANR | | | 2 00E-07 | 2 10E-03 | | 1E-5 |
| Total Tetrachlorodibenzodioxin (Total TCDD) | ANR | ANR | | 1E-5 | 8 00E-08 | 7 50E-03 | | 1E-6 |
| Total Pentachlorodibenzodioxin (Total PCDD) | ANR | ANR | | 5E-5 | 8.00E-08 | 1 04E-02 | | 5E-6 |
| Total Hexachlorodibenzodioxin (Total HxCDD) | ANR | ANR | | 5E-5 | 1 60E-07 | 5 91E-02 | | 5E-6 |
| Total Heptachlorodibenzodioxin (Total HpCDD) | ANR | ANR | | 5E-5 | 2 00E-07 | 6 90E-03 | | 5E-6 |
| Total Tetrachlorodibenzofuran (Total TCDF) | ANR | ANR | | 1E-5 | 5 00E-08 | 2 59E-02 | | 1E-6 |
| Total Pentachlorodibenzofuran (Total PCDF) | ANR | ANR | | 5E-5 | 6 00E-08 | 2 09E-02 | | 5E-6 |
| Total Hexachlorodibenzofuran (Total HxCDF) | ANR | ANR | | 5E-5 | 7 00E-08 | 6 12E-02 | | 5E-6 |
| Total Heptachlorodibenzofuran (Total HpCDF) | ANR | ANR | | 5E-5 | 1 00E-07 | 9 39E-02 | | 5E-6 |

## TABLE 3-4

## SOLID AND AQUEOUS MINIMUM AND MAXIMUM DETECTION LIMITS VERSUS RBTLs AND EDQLs
## SWMU 03- OLD JEEP TRAIL/LITTLE SULPHUR CREEK
## NSWC CRANE
## CRANE, INDIANA


| Parameter | Aqueous Matrix | | | | Solid Matrix | | | |
|---|---|---|---|---|---|---|---|---|
| | Observed Min DL (µg/L) | Observed Max DL (µg/L) | Laboratory MDL/IDL[1] (µg/L) | Risk-Based Target Level [2] (µg/L) | Observed Min DL (mg/kg) | Observed Max DL (mg/kg) | Laboratory MDL/IDL[1] (mg/kg) | Lower of Soil and Sediment RBTLs (mg/kg) |
| **MISCELLANEOUS PARAMETERS** | | | | | | | | |
| Perchlorate (EPA Method 314 0) | 4 | 4 | | 18 | 0 02 | 0 033 | | --- |
| Nitrate (SW-846 Method 9056) | ANR | ANR | | --- | 0 6 | 1 3 | | |
| Nitrite (SW-846 Method 9056) | ANR | ANR | | --- | 2 | 110 | | |

MDL = Method detection limit
IDL = Instrument detection limit
RL = Reporting limit
µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter

TBD = To be determined.
NA = Not applicable
ANR = Analyte not required

Shaded cells indicate observed minimum or maximum DLs that exceed laboratory MDL/IDLs.

1 Method Detection Limits (MDLs) (all parameters except metals) and instrument detection limits (IDLs) (metals only) as provided by Laucks Testing Laboratories, Inc and Triangle Laboratories, Inc (dioxins/furans only)
2 Value is based on the lowest human health or ecological risk-based criteria as presented in Appendix B, Tables B-1 (aqueous) and B-2 (solids) OJT / LSC QAPP (TtNUS April, 2001)
3 These are not Appendix 9 metals They are being analyzed for general ground-water-quality information If these elements are within linear range on the ICPMS analysis, they will be quantitated by ICPMS, rather than ICP Trace.
4 3-Methylphenol and 4-methylphenol coelute, therefore, one analytical result for 3-methylphenol plus 4-methylphenol will be reported
5 This compound does not recover well through the extraction technique Periodically, the extraction exhibits zero recoveries at low spiking levels (typical of MDL determination levels)
6 N-Nitrosodiphenylamine is more toxic than diphenylamine However, n-nitrosodiphenylamine rapidly degrades to diphenylamine Therefore, only diphenylamine will be reported, but results for diphenylamine will be treated as n-nitrosodiphenylamine during risk assessment
7 Laucks Low Calibration Standard is 2 7 ug/kg (soil) for Dinoseb, but Laucks prefers not to report below 5 4 ug/kg (soil)
8 The target level is calculated using the target level for 2,3,7,8-TCDD and the toxicity equivalent factor (TEF) presented in current U S. EPA guidance (U.S. EPA, March 1989)

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| EXPLOSIVES | | | | | | | | | |
| | 1,3,5-TRINITROBENZENE | R | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2,4,6-TRINITROTOLUENE | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2,4-DINITROTOLUENE | B | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | | R | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | U | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2-AMINO-4,6-DINITROTOLUENE | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2-NITROTOLUENE | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 4-AMINO-2,6-DINITROTOLUENE | B | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | UR | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | HMX | B | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | U | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| | NITROCELLULOSE | E | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | NITROGLYCERIN | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PETN | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | RDX | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | U | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| HERBICIDES | | | | | | | | | |
| | 2,4,5-T | G | 0 | 0 | 50 | 0 | 0 | 50 | 0 |
| | | GU | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | U | 0 | 0 | 100 | 0 | 0 | 0 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| HERBICIDES (Continued) | | | | | | | | | |
| | 2,4,5-TP (SILVEX) | G | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | U | 0 | 0 | 83.3 | 16 7 | 0 | 0 | 0 |
| | 2,4-D | G | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | U | 0 | 0 | 58 3 | 41.7 | 0 | 0 | 0 |
| | | UR | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | DINOSEB | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | DU | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | G | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | GP | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | U | 0 | 0 | 57.1 | 42.9 | 0 | 0 | 0 |
| | HEXACHLOROPHENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | U | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | PENTACHLOROPHENOL | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | U | 0 | 0 | 28.6 | 71 4 | 0 | 0 | 0 |
| | | UR | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| METALS | | | | | | | | | |
| | ALUMINUM | AF | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | B | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | F | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | FA | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| METALS (Continued) | | | | | | | | | |
| | ANTIMONY | A | 0 | 0 | 23.4 | 0 | 76.6 | 0 | 0 |
| | | AFG | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AG | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | | F | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | FA | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | ARSENIC | A | 0 | 0 | 86.7 | 0 | 13.3 | 0 | 0 |
| | | ADFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | D | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | DFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | BARIUM | A | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AD | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | B | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BG | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | F | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | FI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | BERYLLIUM | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CADMIUM | F | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CALCIUM | A | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | ADGI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | ADI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AGI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | G | 0 | 0 | 100 | 0 | 0 | 0 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| METALS (Continued) | | | | | | | | | |
| | CHROMIUM | AFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | B | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BDI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BG | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | COBALT | AI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | FI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | G | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | COPPER | A | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AD | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | ADF | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | ADFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | ADG | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | B | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | IRON | A | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AF | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| METALS (Continued) | | | | | | | | | |
| | LEAD | A | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | ADFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AG | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | D | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | DF | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | DFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MAGNESIUM | AFGI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AGI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BDF | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | F | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MANGANESE | A | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AF | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AFGI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BFGI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MERCURY | DH | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | E | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | EH | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | H | 0 | 0 | 85.7 | 0 | 0 | 14.3 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| METALS (Continued) | | | | | | | | | |
| | NICKEL | AFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | B | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BDI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | POTASSIUM | A | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | ADI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | ADIK | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AFI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | B | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | SELENIUM | A | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | | D | 0 | 0 | 70.6 | 0 | 0 | 29.4 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | SILVER | A | 0 | 0 | 29.3 | 0 | 70.7 | 0 | 0 |
| | | AD | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | SODIUM | A | 0 | 0 | 10.9 | 0 | 89.1 | 0 | 0 |
| | | AE | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | B | 0 | 0 | 42.9 | 0 | 57.1 | 0 | 0 |
| | TIN | A | 0 | 0 | 11.1 | 0 | 88.9 | 0 | 0 |
| | | B | 0 | 0 | 6.8 | 0 | 93.2 | 0 | 0 |
| | | BF | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | VANADIUM | ADI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | AI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | FI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | I | 0 | 0 | 100 | 0 | 0 | 0 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| **METALS (Continued)** | | | | | | | | | |
| | ZINC | B | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BD | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BDK | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BGD | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BIK | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | FI | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| **MISCELLANOUS** | | | | | | | | | |
| | NITRATE | H | 0 | 0 | 66.7 | 0 | 0 | 33.3 | 0 |
| | NITRITE | D | 0 | 0 | 5 6 | 0 | 0 | 18.5 | 75.9 |
| | | DH | 0 | 0 | 16 7 | 0 | 0 | 83.3 | 0 |
| | | H | 0 | 0 | 7.1 | 0 | 0 | 92.9 | 0 |
| | | HD | 0 | 0 | 25 | 0 | 0 | 75 | 0 |
| | NITRITE/NITRATE | H | 0 | 0 | 97.1 | 0 | 0 | 2.9 | 0 |
| | PERCHLORATE | C | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | H | 0 | 0 | 4 3 | 0 | 0 | 95.7 | 0 |
| | PH | H | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TOTAL ORGANIC CARBON | D | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| **SEMIVOLATILES** | | | | | | | | | |
| | 1,2,4,5-TETRACHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,2,4-TRICHLOROBENZENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,2-DICHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | 1,3-DICHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,4-DICHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,4-NAPHTHOQUINONE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,4-PHENYLENEDIAMINE | C | 0 | 0 | 0 | 0 | 0 | 37.6 | 62.4 |
| | | CH | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | CP | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 80 | 20 |
| | 1-NAPHTHYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,2'-OXYBIS(100-CHLOROPROPANE) | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,3,4,6-TETRACHLOROPHENOL | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 93.8 | 6.3 |
| | 2,4,5-TRICHLOROPHENOL | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4,6-TRICHLOROPHENOL | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | 2,4-DICHLOROPHENOL | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4-DIMETHYLPHENOL | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | D | 0 | 0 | 0 | 0 | 0 | 71.4 | 28.6 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4-DINITROPHENOL | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CH | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 90.9 | 9.1 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,6-DICHLOROPHENOL | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-ACETYLAMINOFLUORENE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-CHLORONAPHTHALENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | DR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-CHLOROPHENOL | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | DR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 93.3 | 7.7 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | 2-METHYLNAPHTHALENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-METHYLPHENOL | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | DR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 92 3 | 7.7 |
| | 2-NAPHTHYLAMINE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-NITROANILINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-NITROPHENOL | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 93 3 | 6.7 |
| | 2-PICOLINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3&4-METHYLPHENOL | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | DR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 92.9 | 7.1 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | 3,3'-DICHLOROBENZIDINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 12.5 | 87.5 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3-METHYLCHOLANTHRENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3-NITROANILINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | DR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | NR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4,6-DINITRO-2-METHYLPHENOL | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CH | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 92 9 | 7.1 |
| | 4-AMINOBIPHENYL | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-BROMOPHENYL PHENYL ETHER | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | 4-CHLORO-3-METHYLPHENOL | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | DR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 92.9 | 7 1 |
| | 4-CHLOROANILINE | D | 0 | 0 | 0 | 0 | 0 | 71.4 | 28.6 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-CHLOROPHENYL PHENYL ETHER | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-NITROANILINE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-NITROPHENOL | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CH | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 93.3 | 6.7 |
| | 4-NITROQUINOLINE-100-OXIDE | C | 0 | 0 | 0 | 0 | 0 | 42 5 | 57.5 |
| | | CH | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 80 | 20 |
| | 5-NITRO-O-TOLUIDINE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | 7,1002-DIMETHYLBENZ(A)ANTHRACENE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | NR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | A,A-DIMETHYLPHENETHYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ACENAPHTHENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ACENAPHTHYLENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ACETOPHENONE | A | 0 | 100 | 0 | 0 | 0 | 0 | 0 |
| | | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ANILINE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ANTHRACENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ARAMITE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BENZO(A)ANTHRACENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BENZO(A)PYRENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | BENZO(B)FLUORANTHENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BENZO(G,H,I)PERYLENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BENZO(K)FLUORANTHENE | CH | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BENZYL ALCOHOL | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BIS(2-CHLOROETHOXY)METHANE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BIS(2-CHLOROETHYL)ETHER | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BIS(2-ETHYLHEXYL) PHTHALATE | A | 0 | 58.3 | 8.3 | 0 | 33.3 | 0 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 50 | 50 |
| | | G | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | PR | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BUTYL BENZYL PHTHALATE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLOROBENZILATE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | CHRYSENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIALLATE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIBENZO(A,H)ANTHRACENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIBENZOFURAN | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIETHYL PHTHALATE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIMETHYL PHTHALATE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DI-N-BUTYL PHTHALATE | A | 0 | 100 | 0 | 0 | 0 | 0 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | CPR | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | G | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | NR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILE (continued) | | | | | | | | | |
| | DIPHENYLAMINE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ETHYL METHANE SULFONATE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ETHYL PARATHION | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | FLUORANTHENE | G | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | FLUORENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROBUTADIENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROCYCLOPENTADIENE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CD | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CH | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 80 | 20 |
| | | DR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROETHANE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILE (continued) | | | | | | | | | |
| | HEXACHLOROPROPENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | INDENO(100,2,3-CD)PYRENE | C | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ISODRIN | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ISOPHORONE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ISOSAFROLE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | KEPONE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | CH | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | METHAPYRILENE | C | 0 | 0 | 0 | 0 | 0 | 97 6 | 2.4 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYL METHANE SULFONATE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYL PARATHION | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | NAPHTHALENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILE (continued) | | | | | | | | | |
| | N-NITROSODIETHYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSODIMETHYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSO-DI-N-BUTYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSO-DI-N-PROPYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | DR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOMETHYLETHYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOMORPHOLINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOPIPERIDINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | N-NITROSOPYRROLIDINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CH | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | O,O,O-TRIETHYL PHOSPHOROTHIOATE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | O-TOLUIDINE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | P-(DIMETHYLAMINO)AZOBENZENE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PENTACHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PENTACHLOROETHANE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PENTACHLORONITROBENZENE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PHENACETIN | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PHENANTHRENE | G | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PHENOL | DR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 92.3 | 7.7 |
| | PRONAMIDE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| SEMIVOLATILES (continued) | | | | | | | | | |
| | PYRENE | C | 0 | 0 | 16 7 | 0 | 0 | 83.3 | 0 |
| | | CH | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PYRIDINE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | SAFROLE | H | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| VOLATILES | | | | | | | | | |
| | 1,1,1-TRICHLOROETHANE | G | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 1,1,2,2-TETRACHLOROETHANE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 1,1,2-TRICHLOROETHANE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,1-DICHLOROETHANE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,2-DICHLOROPROPANE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,4-DIOXANE | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-BUTANONE | C | 0 | 0 | 5 | 0 | 0 | 95 | 0 |
| | | CD | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CP | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| VOLATILES (Continued) | | | | | | | | | |
| | 2-HEXANONE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CD | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | G | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 3-CHLOROPROPENE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-METHYL-2-PENTANONE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CD | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CGP | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | ACETONE | A | 0 | 64 | 12 | 0 | 24 | 0 | 0 |
| | | AC | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | C | 0 | 0 | 0 | 0 | 0 | 50 | 50 |
| | ACETONITRILE | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ACROLEIN | C | 0 | 0 | 0 | 0 | 0 | 1 5 | 98.5 |
| | ACRYLONITRILE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | | CR | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | BENZENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BROMOFORM | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BROMOMETHANE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CD | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CARBON DISULFIDE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CG | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CP | 0 | 0 | 83.3 | 0 | 0 | 16.7 | 0 |
| | | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| VOLATILES (Continued) | | | | | | | | | |
| | CARBON TETRACHLORIDE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLOROBENZENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLORODIBROMOMETHANE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLOROETHANE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLOROMETHANE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLOROPRENE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CIS-100,2-DICHLOROETHENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CIS-100,3-DICHLOROPROPENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DICHLORODIFLUOROMETHANE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ETHYLBENZENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ISOBUTANOL | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYL IODIDE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | CV | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYLENE CHLORIDE | A | 0 | 81.8 | 0 | 0 | 18 2 | 0 | 0 |
| | PROPIONITRILE | R | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | STYRENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | TETRACHLOROETHENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | DP | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TOLUENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | TOTAL XYLENES | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | TRANS-100,2-DICHLOROETHENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | TRANS-100,3-DICHLOROPROPENE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | TRANS-100,4-DICHLORO-2-BUTENE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| **VOLATILES (Continued)** | | | | | | | | | |
| | TRICHLOROETHENE | B | 0 | 16 7 | 83.3 | 0 | 0 | 0 | 0 |
| | | BD | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | BP | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | | D | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TRICHLOROFLUOROMETHANE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | P | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | VINYL ACETATE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| **PESTICIDES/PCBs** | | | | | | | | | |
| | 4,4'-DDD | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4,4'-DDT | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ALDRIN | U | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| | ALPHA-BHC | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | AROCLOR-100260 | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIELDRIN | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ENDOSULFAN I | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ENDOSULFAN II | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ENDRIN | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | U | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| | ENDRIN ALDEHYDE | D | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ENDRIN KETONE | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | GAMMA-BHC (LINDANE) | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | GAMMA-CHLORDANE | U | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| | HEPTACHLOR | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-5

SOIL AND SEDIMENT PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| FRACTION | PARAMETER | QUALIFICATION CODE | QUALIFIER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | BJ | BU | J | R | U | UJ | UR |
| PESTICIDES/PCBs (Continued) | | | | | | | | | |
| | METHOXYCHLOR | C | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | U | 0 | 0 | 100 | 0 | 0 | 0 | 0 |

**Qualifier Code Definitions:**

%Ds = Percent difference.
%Rs = Percent recovery.
%RSDs = Percent relative standard deviations.
A = Lab blank contamination.
B = Field blank contamination.
C = Calibration (i.e., % RSDs, %Ds, ICVs, CCVs, RPDs, or RRFs, etc.) are noncompliant with analytical method requirements.
CRQL = Contract-required quantitation limit.
D = MS/MSD noncompliance.
E = LCS/LCSD noncompliance.
F = Lab duplicate imprecision.
G = Field duplicate imprecision.
GC = Gas chromatography.
H = Holding time exceedance.
HPLC = High performance liquid chromatography.
I = ICP serial dilution noncompliance.
ICP = Inductively coupled plasma.
ICSAB = Interference check sample A and B.
ICVs = Initial calibration verification.
IDL = Instrument detection limit.
K = ICP interference -
LCS = Laboratory control
MS = Matrix spike.
MSD = Matrix spike
N = Internal standard
P = Uncertainty near detection limit (< 2 x IDL for inorganics and
R = Surrogates recovery
RPDs = Relative percent
RRFs = Relative
U = Percent difference between columns / detectors for positive results is >25% for GC / HPLC methods.

**For Qualifier Definitions - see Section 3.1, Data Validation Process of the RFI Report**

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| EXPLOSIVE | 1,3,5-TRINITROBENZENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,3-DINITROBENZENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4,6-TRINITROTOLUENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4-DINITROTOLUENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4-DINITROTOLUENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4-DINITROTOLUENE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2,6-DINITROTOLUENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,6-DINITROTOLUENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-AMINO-4,6-DINITROTOLUENE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2-AMINO-4,6-DINITROTOLUENE | PU | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2-AMINO-4,6-DINITROTOLUENE | U | 0 | 0 | 0 | 50 | 50 | 0 | 0 | 0 |
| | 2-NITROTOLUENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-AMINO-2,6-DINITROTOLUENE | GU | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 4-AMINO-2,6-DINITROTOLUENE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 4-AMINO-2,6-DINITROTOLUENE | U | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 4-NITROTOLUENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HMX | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | HMX | U | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | NITROBENZENE | U | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| | NITROGLYCERIN | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | RDX | D | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | RDX | U | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2,4-D | C | 0 | 0 | 0 | 7 7 | 0 | 0 | 92 3 | 0 |
| | 2,4-D | CU | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2,4-D | U | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| | DINOSEB | U | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| | PENTACHLOROPHENOL | U | 0 | 0 | 0 | 20 | 80 | 0 | 0 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| METALS | ALUMINUM | A | 0 | 0 | 0 | 20 | 0 | 80 | 0 | 0 |
| | ALUMINUM | AI | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | ANTIMONY | A | 0 | 0 | 0 | 13 3 | 0 | 86 7 | 0 | 0 |
| | BARIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | BARIUM | B | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CALCIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CALCIUM | B | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CALCIUM | BI | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CALCIUM | I | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CHROMIUM | A | 0 | 0 | 0 | 59 1 | 0 | 40 9 | 0 | 0 |
| | CHROMIUM | B | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | CHROMIUM | G | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | COBALT | A | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | COPPER | A | 0 | 0 | 0 | 54 5 | 0 | 45.5 | 0 | 0 |
| | COPPER | B | 0 | 0 | 0 | 33 3 | 0 | 66 7 | 0 | 0 |
| | IRON | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | IRON | B | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | IRON | DF | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | IRON | DFG | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | IRON | E | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | IRON | EG | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | IRON | I | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | LEAD | A | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | MAGNESIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MAGNESIUM | AI | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MAGNESIUM | B | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MAGNESIUM | BI | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| | MAGNESIUM | I | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MANGANESE | A | 0 | 0 | 0 | 85 7 | 0 | 14 3 | 0 | 0 |
| | MANGANESE | AG | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MANGANESE | AK | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MANGANESE | B | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MERCURY | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | NICKEL | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | NICKEL | AG | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | NICKEL | B | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | POTASSIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | POTASSIUM | B | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | POTASSIUM | BA | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | POTASSIUM | D | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | POTASSIUM | I | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | SELENIUM | E | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | SILVER | A | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | SODIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | SODIUM | B | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | THALLIUM | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | TIN | A | 0 | 0 | 0 | 36 7 | 0 | 63 3 | 0 | 0 |
| | TIN | B | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | VANADIUM | A | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | ZINC | A | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | ZINC | B | 0 | 0 | 0 | 50 | 0 | 50 | 0 | 0 |
| METALS (FILTERED) | ALUMINUM | A | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | ANTIMONY | A | 0 | 0 | 0 | 22 7 | 0 | 77 3 | 0 | 0 |
| | BARIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| | CALCIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CHROMIUM | A | 0 | 0 | 0 | 50 | 0 | 50 | 0 | 0 |
| | CHROMIUM | G | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | COPPER | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | IRON | DF | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | IRON | F | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | LEAD | E | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MAGNESIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MAGNESIUM | DI | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MANGANESE | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MANGANESE | AK | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | MERCURY | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | NICKEL | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | POTASSIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | POTASSIUM | I | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | SELENIUM | E | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | SILVER | A | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | SODIUM | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TIN | A | 0 | 0 | 0 | 78 9 | 0 | 21 1 | 0 | 0 |
| | TIN | AI | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TIN | I | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | ZINC | A | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| | ZINC | K | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| MISCELLANOUS | NITRATE | H | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | NITRITE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PERCHLORATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| | TOTAL SUSPENDED SOLIDS | G | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TOTAL SUSPENDED SOLIDS | H | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| SEMIVOLATILE | 1,2,4,5-TETRACHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,2,4-TRICHLOROBENZENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,2,4-TRICHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,2-DICHLOROBENZENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,2-DICHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,3-DICHLOROBENZENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,3-DICHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,4-DICHLOROBENZENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,4-DICHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,4-NAPHTHOQUINONE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,4-PHENYLENEDIAMINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 31 1 | 68 9 |
| | 1,4-PHENYLENEDIAMINE | CH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | 1-NAPHTHYLAMINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,2'-OXYBIS(1-CHLOROPROPANE) | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,2'-OXYBIS(1-CHLOROPROPANE) | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,3,4,6-TETRACHLOROPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4,5-TRICHLOROPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4,6-TRICHLOROPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4-DICHLOROPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4-DIMETHYLPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4-DINITROPHENOL | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,4-DINITROPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2,6-DICHLOROPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-ACETYLAMINOFLUORENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-CHLORONAPHTHALENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| | 2-CHLORONAPHTHALENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-CHLOROPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-METHYLNAPHTHALENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-METHYLPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-NAPHTHYLAMINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-NITROANILINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-NITROANILINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-NITROPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-PICOLINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3&4-METHYLPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3,3'-DICHLOROBENZIDINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3,3'-DICHLOROBENZIDINE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3,3'-DICHLOROBENZIDINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3,3'-DIMETHYLBENZIDINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3,3'-DIMETHYLBENZIDINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3-METHYLCHOLANTHRENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3-NITROANILINE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 3-NITROANILINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4,6-DINITRO-2-METHYLPHENOL | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4,6-DINITRO-2-METHYLPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-AMINOBIPHENYL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-BROMOPHENYL PHENYL ETHER | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-CHLORO-3-METHYLPHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-CHLOROANILINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-CHLOROPHENYL PHENYL ETHER | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-NITROANILINE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-NITROANILINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| | 4-NITROPHENOL | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-NITROPHENOL | CH | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-NITROPHENOL | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-NITROQUINOLINE-1-OXIDE | C | 0 | 0 | 0 | 0 | 0 | 0 | 8 3 | 91 7 |
| | 4-NITROQUINOLINE-1-OXIDE | CH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | 4-NITROQUINOLINE-1-OXIDE | CP | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 5-NITRO-O-TOLUIDINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 7,12-DIMETHYLBENZ(A)ANTHRACENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | A,A-DIMETHYLPHENETHYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | A,A-DIMETHYLPHENETHYLAMINE | CH | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ACETOPHENONE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ANILINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ARAMITE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BENZO(A)ANTHRACENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BENZO(G,H,I)PERYLENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BENZYL ALCOHOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BIS(2-CHLOROETHOXY)METHANE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BIS(2-CHLOROETHOXY)METHANE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BIS(2-CHLOROETHYL)ETHER | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BIS(2-ETHYLHEXYL)PHTHALATE | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | BIS(2-ETHYLHEXYL)PHTHALATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | BUTYL BENZYL PHTHALATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLOROBENZILATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIALLATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIBENZO(A,H)ANTHRACENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIBENZOFURAN | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIETHYL PHTHALATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| | DIMETHYL PHTHALATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DI-N-BUTYL PHTHALATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DI-N-OCTYL PHTHALATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DIPHENYLAMINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ETHYL METHANE SULFONATE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ETHYL METHANE SULFONATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ETHYL PARATHION | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROBUTADIENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROCYCLOPENTADIENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROCYCLOPENTADIENE | CD | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | HEXACHLOROCYCLOPENTADIENE | CH | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROCYCLOPENTADIENE | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | HEXACHLOROETHANE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROETHANE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | HEXACHLOROPROPENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ISODRIN | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ISOPHORONE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ISOSAFROLE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | KEPONE | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | KEPONE | CH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | METHAPYRILENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYL METHANE SULFONATE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYL METHANE SULFONATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYL PARATHION | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYL PARATHION | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSODIETHYLAMINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| | N-NITROSODIMETHYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSODIMETHYLAMINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSO-DI-N-BUTYLAMINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSO-DI-N-PROPYLAMINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOMETHYLETHYLAMINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOMETHYLETHYLAMINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOMORPHOLINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOMORPHOLINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOPIPERIDINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOPIPERIDINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | N-NITROSOPYRROLIDINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | O,O,O-TRIETHYL PHOSPHOROTHIOATE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | O-TOLUIDINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | P-(DIMETHYLAMINO)AZOBENZENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PENTACHLOROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PENTACHLOROETHANE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PENTACHLORONITROBENZENE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PHENACETIN | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PHENACETIN | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PHENOL | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PHENOL | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | PRONAMIDE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PYRENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PYRIDINE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | PYRIDINE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | SAFROLE | H | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| VOLATILE | 1,1,1,2-TETRACHLOROETHANE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,1,2,2-TETRACHLOROETHANE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 1,1,2-TRICHLOROETHANE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 1,1-DICHLOROETHENE | G | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 1,2-DIBROMO-3-CHLOROPROPANE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 1,2-DIBROMOETHANE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-BUTANONE | C | 0 | 0 | 0 | 0 | 0 | 0 | 53.5 | 46 5 |
| | 2-BUTANONE | CP | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2-BUTANONE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 2-HEXANONE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 2-HEXANONE | CP | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | 4-METHYL-2-PENTANONE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | 4-METHYL-2-PENTANONE | CD | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ACETONE | A | 0 | 12 5 | 37 5 | 0 | 0 | 0 5 | 0 | 0 |
| | ACETONE | C | 0 | 0 | 0 | 5 4 | 0 | 0 | 48 6 | 45 9 |
| | ACETONE | CP | 0 | 80 | 0 | 20 | 0 | 0 | 0 | 0 |
| | ACETONE | P | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ACROLEIN | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | ACRYLONITRILE | C | 0 | 0 | 0 | 0 | 0 | 0 | 55 8 | 44 2 |
| | BROMOMETHANE | C | 0 | 0 | 0 | 6 7 | 0 | 0 | 93 3 | 0 |
| | BROMOMETHANE | CP | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | BROMOMETHANE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CARBON TETRACHLORIDE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLORODIBROMOMETHANE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CHLOROETHANE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLOROFORM | G | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | CHLOROMETHANE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |
| | CIS-1,2-DICHLOROETHENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | CIS-1,2-DICHLOROETHENE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | CIS-1,3-DICHLOROPROPENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | DICHLORODIFLUOROMETHANE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ETHYL METHACRYLATE | C | 0 | 0 | 0 | 20 | 0 | 0 | 80 | 0 |
| | METHACRYLONITRILE | C | 0 | 0 | 0 | 0 | 0 | 0 | 45 9 | 54 1 |
| | METHYL IODIDE | C | 0 | 0 | 0 | 0 | 0 | 0 | 81 1 | 18 9 |
| | METHYL METHACRYLATE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYLENE CHLORIDE | A | 0 | 33 3 | 0 | 33 3 | 0 | 33 3 | 0 | 0 |
| | METHYLENE CHLORIDE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | METHYLENE CHLORIDE | P | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| | TETRACHLOROETHENE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TOTAL XYLENES | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | TRANS-1,2-DICHLOROETHENE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TRANS-1,3-DICHLOROPROPENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | TRANS-1,4-DICHLORO-2-BUTENE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | TRICHLOROETHENE | A | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TRICHLOROETHENE | AP | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | TRICHLOROETHENE | B | 0 | 0 | 0 | 50 | 0 | 50 | 0 | 0 |
| | TRICHLOROETHENE | P | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| | VINYL ACETATE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | VINYL CHLORIDE | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| PESTICIDE/PCB | 4,4'-DDD | C | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ALDRIN | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| | ENDOSULFAN SULFATE | D | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

TABLE 3-6

GROUND WATER AND SURFACE WATER PERCENT QUALIFICATION RATES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | | | QUALIFIER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FRACTION | PARAMETER | QUALIFICATION CODE | B | BJ | BU | J | R | U | UJ | UR |

**Qualifier Code Definitions:**

A = Lab blank contamination.
B = Field blank contamination.
C = Calibration (i.e., % RSDs, %Ds, ICVs, CCVs, RPDs, or RRFs, etc.) are noncompliant with analytical method requirements.
D = MS/MSD noncompliance.
E = LCS/LCSD noncompliance.
F = Lab duplicate imprecision.
G = Field duplicate imprecision.
H = Holding time exceedance.
I = ICP serial dilution noncompliance.
K = ICP interference - include ICSAB % Rs.
P = Uncertainty near detection limit (< 2 x IDL for inorganics and <CRQL for organics).
U = Pest/PCB percent difference between columns for positive results.

**Qualifier Definitions - see page 3-1 of text.**

TABLE 3-7

PARAMETERS AND MEDIA FOR WHICH BACKGROUND COMPARISONS WERE RE-EVALUATED
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | WRS Status | Final Status |
|---|---|---|
| **Surface Soil** | | |
| Arsenic | <BG | <BG |
| Chromium | <BG | >BG |
| Mercury | <BG | >BG |
| Silver | <BG | >BG |
| **Subsurface Soil** | | |
| Cadmium | <BG | >BG |
| Silver | <BG | >BG |
| Tin | <BG | >BG |
| **Ground Water** | | |
| Aluminum | <BG | >BG |
| Cadmium | >BG | >BG |
| Calcium | <BG | >BG |
| Chromium | <BG | >BG |
| Lead | <BG | >BG |
| Magnesium | <BG | >BG |
| Manganese | <BG | >BG |
| Sodium | <BG | >BG |
| Thallium | <BG | >BG |
| **Shallow Sediment** | | |
| Aluminum | <BG | >BG |
| Arsenic | <BG | <BG |
| Chromium | <BG | <BG |
| Mercury | <BG | <BG |
| Selenium | <BG | <BG |
| **Deep Sediments** | | |
| Antimony | <BG | >BG |
| Selenium | <BG | <BG |
| Aluminum | <BG | >BG |
| Arsenic | <BG | <BG |
| Chromium | <BG | <BG |
| Copper | <BG | >BG |
| Iron | <BG | <BG |
| **Surface Water - Low Flow** | | |
| Lead | <BG | >BG |
| Zinc | <BG | <BG |
| Dissolved Selenium | <BG | >BG |
| Dissolved Tin | <BG | >BG |
| Dissolved Zinc | <BG | >BG |

TABLE 3-7

PARAMETERS AND MEDIA FOR WHICH BACKGROUND COMPARISONS WERE RE-EVALUATED
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| | WRS Status | Final Status |
|---|---|---|
| **Surface Water - High Flow** | | |
| Aluminum | <BG | <BG |
| Chromium, Filtered | <BG | <BG |
| Copper | <BG | >BG |
| Iron | <BG | <BG |
| Lead | <BG | >BG |
| Manganese | <BG | <BG |
| Selenium | <BG | >BG |
| Total Tin | <BG | >BG |
| Zinc | <BG | >BG |
| Dissolved Copper | <BG | >BG |
| Dissolved Lead | <BG | >BG |
| Dissolved Potassium | <BG | >BG |

WRS Status = status after using Wilcoxon Rank Sum test to determine whether site concentrations exceed background concentrations

<BG = Site concentrations fall within background concentrations

>BG = Site concentrations exceed background concentrations

FIGURE 3-1

NORMAL PROBABILITY PLOT - MERCURY - SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

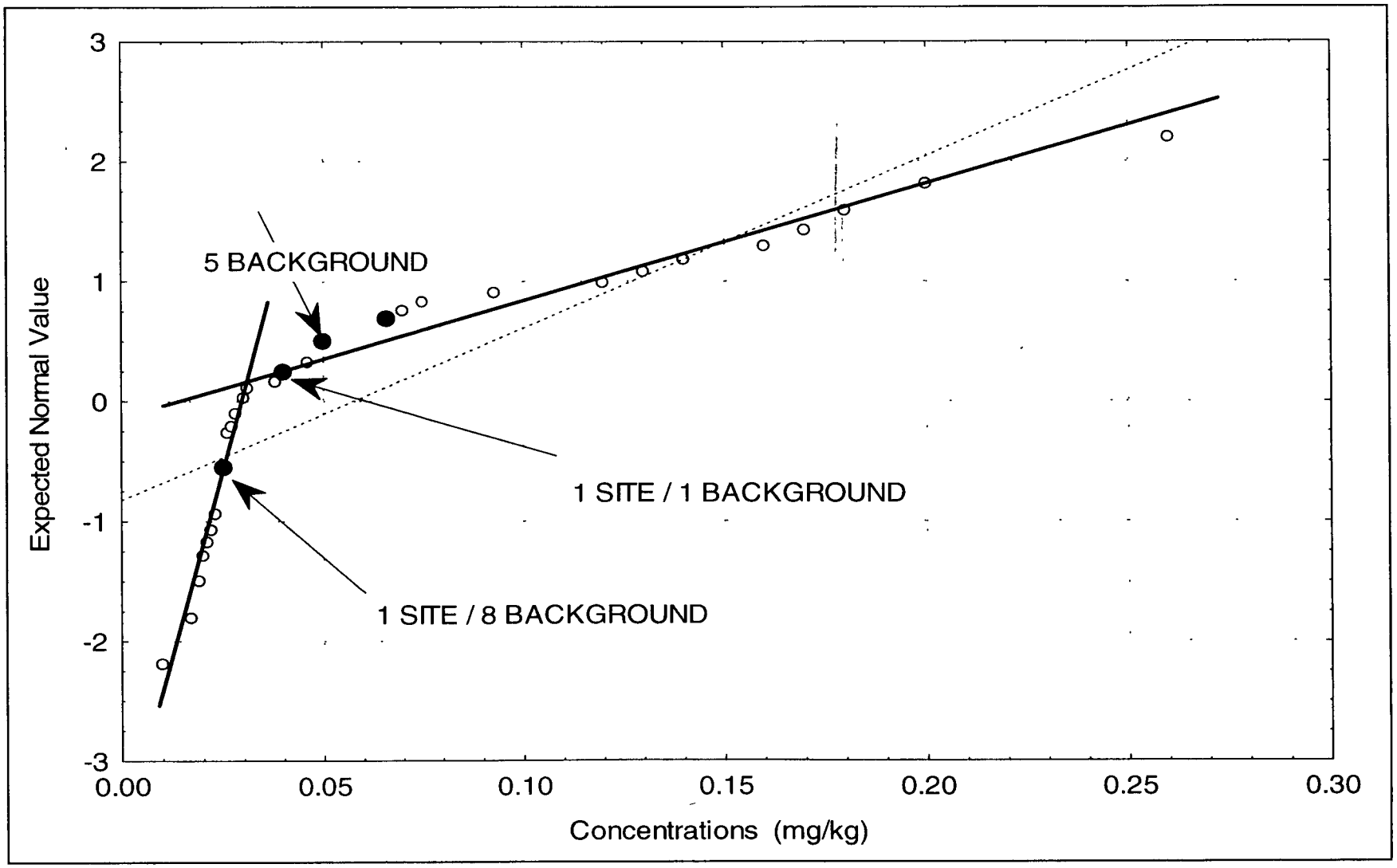
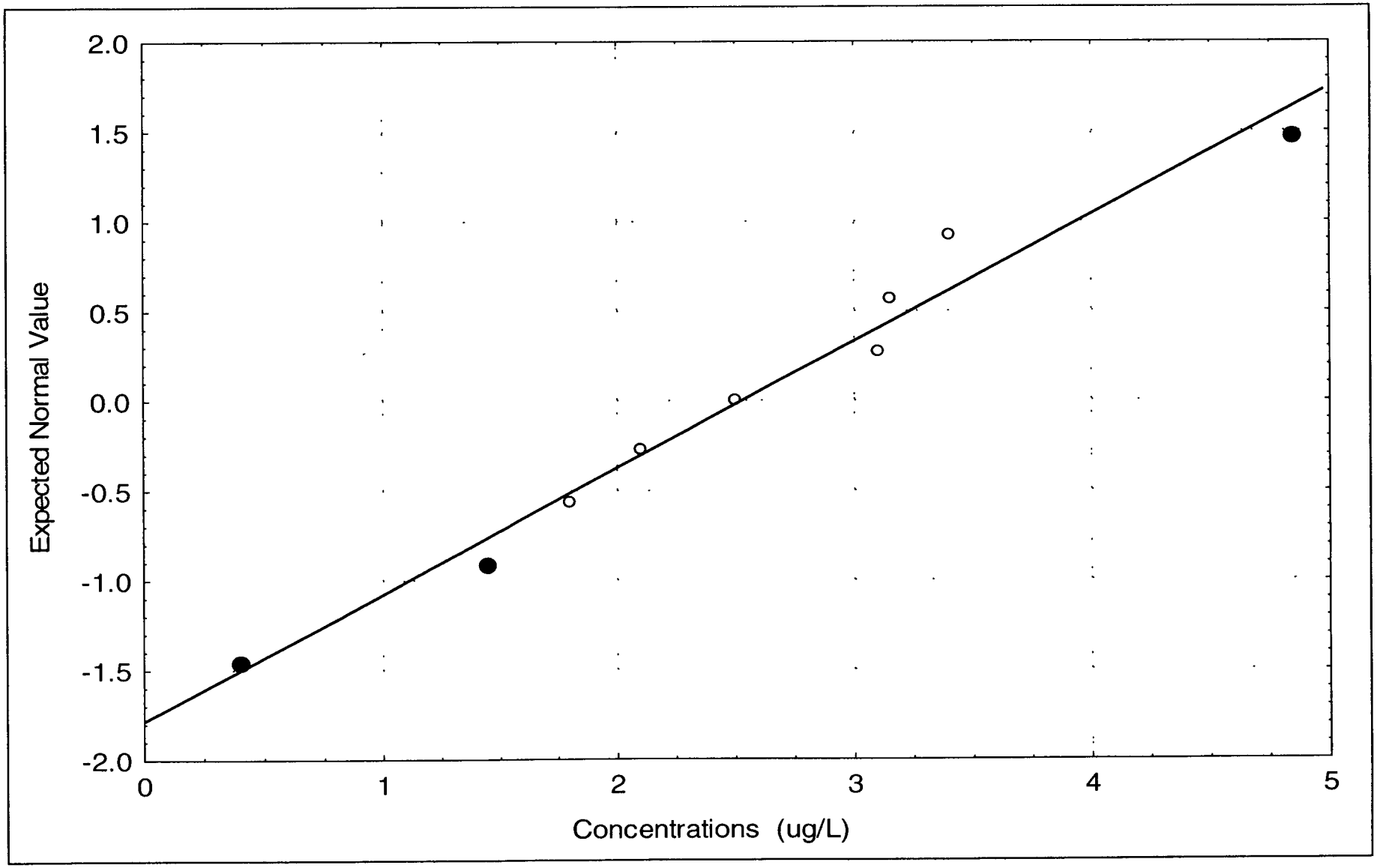


FIGURE 3-2

NORMAL PROBABILITY PLOT - ZINC - LOW FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA



# 4.0 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

## 4.1 SUMMARY OF DETECTED CHEMICALS

A summary of all detected chemicals is compiled in Tables 4-1 through 4-7. Separate tables are presented for surface soil, subsurface soil, ground water, shallow sediment, deep sediment, low-flow surface water, and high-flow surface water. Each numerical concentration was combined with its alphabetic data validation flag, if any, into a single entry to concisely show the reported concentration and its status after data validation.

Each table presents the concentrations across all samples for any chemical that exceeded its sample-specific detection limit in at least one sample. This means that at least one, but perhaps only one, of the samples in a given table shows the concentration of a particular analyte greater than the detection limit.

Table entries containing a validation flag of "R" or "UR" should be viewed with caution. Those chemicals may or may not actually be present in the sample but analytical problems were severe enough to cause those values to be rejected for quantitative use. Section 3.0 of this report addresses data validation and general data quality in more detail.

The tables show that, although the number of target analytes that were detected in at least one sample is relatively large, few analytes were detected consistently (i.e., across many samples) in a given medium. The following section describes how the analytical results and their frequencies of detection were used to select those chemicals that were used to represent the extent of site contamination and were carried forward to the quantitative risk assessments.

## 4.2 SELECTION OF HUMAN HEALTH RISK CHEMICALS OF POTENTIAL CONCERN

The selection of COPCs is a qualitative screening process used to limit the number of chemicals and exposure routes quantitatively evaluated in the HHRA to those site-related constituents that dominate overall potential risks. Screening of site data against risk-based concentrations and background levels is used to focus the risk assessment on meaningful chemicals and exposure routes.

In general, a chemical is selected as a COPC and retained for further quantitative risk evaluation in the HHRA if the maximum detection in a sampled medium exceeds a conservative screening concentration(s) and the chemical is determined to be present at concentrations exceeding background. Note that this second condition applies only to those chemicals for which background comparison is appropriate (e.g.,

inorganics). Chemicals eliminated from further evaluation at this time are assumed to present minimal risks to potential human receptors and are not further discussed in this report.

### 4.2.1 Derivation of Screening Criteria

Several types of screening levels were used to identify COPCs for the OJT/LSC. Screening concentrations based on U.S. EPA Region 9 preliminary remediation goals (PRGs) (U.S. EPA Region 9, November, 2000c) were used, as well as other Indiana Department of Environmental Management (IDEM) and U.S. EPA criteria. The risk-based screening concentrations correspond to a systemic Hazard Quotient (HQ) of 0.1 (for noncarcinogens) or a lifetime cancer risk of $1 \times 10^{-6}$ (for carcinogens). Note that the Region 9 PRGs are based on an HQ of 1.0 and the screening concentrations are based on an HQ of 0.1. PRGs used as screening levels for non-carcinogenic chemicals were conservatively divided by a factor of 10 to account for the potential cumulative effects of several (ten) chemicals affecting the same target organ or producing the same adverse noncarcinogenic health effect. The screening levels used for each medium in the risk assessment are briefly discussed below.

**Soil**

The following criteria were used to select COPCs for soil (surface and subsurface soil):

- U.S. EPA Region 9 PRGs for Residential Soil (U.S. EPA Region 9, 2000c)
- U.S. EPA generic soil screening levels (SSLs) for migration to ground water (U.S. EPA, 1996b)
- U.S. EPA generic SSLs for transfers from soil to air (U.S. EPA, 1996b)
- IDEM residential default closure levels for direct contact (IDEM, 2001)
- IDEM residential default closure levels for migration to ground water (IDEM, 2001)

If the maximum concentration of a constituent exceeds any of these criteria (and the constituent is considered to be present at concentrations greater than background levels), the chemical was selected as a COPC for soil and carried through to the quantitative risk assessment.

Because of the different exposure scenarios for potential human receptors, COPCs are identified separately for surface and subsurface soil. Surface soil is defined as soil collected from 0 to 2 feet bgs and subsurface soil is defined as soil collected from depths greater than 2 feet bgs.

Site soil data are compared to U.S. EPA generic SSLs for transfers from soil to air to identify whether a quantitative analysis of the inhalation exposure pathway is warranted. If the maximum soil concentration

of a chemical exceeds the SSL, a quantitative evaluation of potential risks from inhalation is performed. Otherwise, the risks associated with the inhalation pathway are considered insignificant, and the exposure pathway is eliminated from further evaluation.

**Sediment**

No specific screening levels exist for human exposure to sediment. COPCs for sediment are selected by comparing detected site concentrations to the following:

- U.S. EPA Region 9 PRGs for residential soil (U.S. EPA, 2000c)
- IDEM residential default closure levels for direct contact (IDEM, 2001)

A chemical detected in sediment was selected as a COPC for sediment if the maximum detected concentration exceeded the screening levels and the upstream/background concentrations. The background comparison, which was presented in Section 3.4, was limited to naturally occurring inorganics only. U.S. EPA generic SSLs for transfers from soil to air and for migration to ground water are not considered to be appropriate for sediment screening because of high moisture content associated with sediment matrices. The use of soil screening levels for sediment COPC identification is regarded as a conservative approach because anticipated exposure to sediment is less than anticipated exposure to soil.

The risk-based screening levels and health-based standards used in the COPC selection for soil and sediment are presented in Table 4-8.

**Ground Water/Surface Water**

The same screening levels are used to select COPCs for ground water and surface water. The following criteria are used:

- U.S. EPA Region 9 PRGs for tap water (U.S. EPA, 2000c)
- IDEM residential default closure levels for ground water (IDEM, 2001)
- U.S. EPA Maximum Contaminant Levels (MCLs) (U.S. EPA, 2000b)

If the maximum concentration of a constituent exceeds any of these criteria and the constituent is considered to be present at concentrations greater than background levels, the chemical was selected as a COPC and carried through to the quantitative risk assessment.

Risk-based COPC screening levels for tap water ingestion, which are based on daily, residential exposure assumptions, were 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 at the OJT/LSC because ground water at the site is not used as a potable drinking water source. Currently, there is no direct exposure to ground water at the OJT/LSC. In addition, potential human exposure to surface water at the OJT/LSC is expected to be limited to incidental exposures (such as those which occur during trespassing), which is significantly less than the daily exposure assumed during the development of the aforementioned ground water screening criteria.

AWQC were not used to select COPCs for surface water. AWQC applicable to the protection of human health assuming routine consumption of water were not used because the conservative U.S. EPA Region 9 PRGs for tap water, the IDEM default closure levels for residential ground water, and the U.S. EPA MCLs were used to select COPCs for ground water and surface water. In addition, the surface water bodies present within and downgradient of the study area do not support game fish populations because of their size and the intermittent nature of the surface water resources along much of Sulphur Creek.

The risk-based screening levels and health-based standards used in the COPC selection for ground water and surface water are presented in Table 4-9.

**Lead as a COPC**

The U.S. EPA has not published toxicity criteria (i.e., CSFs, RfDs) for lead. The 400 mg/kg screening level presented in the Region 9 PRG table for residents exposed to soil is based on the output of the Integrated Exposure Uptake Biokinetic (IEUBK) model, which is risk based. However, based on information provided by the U.S. EPA Technical Workgroup for Lead, the results of the IEUBK model were further adjusted based on other factors considered relevant to the agency (e.g., uncertainty, the analytical sensitivity of the model). Guidance from both the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and the Office of Solid Waste and Emergency Response (OSWER) recommends 400 mg/kg as the lowest screening level for lead-contaminated soil in a residential setting, where children are frequently present (U.S. EPA, 1994c). OPPTS identifies 2,000 to 5,000 mg/kg as an appropriate range for areas where contact with soil by children in a residential setting is less frequent. A value of 400 mg/kg was used as a screening level for soil and sediment.

Guidance from the U.S. EPA Technical Review Workgroup for Lead indicated that "a reasonable screening level for soil lead at commercial/industrial (i.e., non-residential) sites is 750 mg/kg" for a typical

non-contact intensive worker (U.S. EPA, 1999a/b). This value was not used as a screening level but was used to provide a qualitative evaluation of lead

The Safe Drinking Water Act action level of 15 µg/L was used as the screening level for lead in ground water and surface water.

**Dioxin/Furans as COPCs**

U.S. EPA recommends the use of a toxicity equivalence factor (TEF) approach to evaluate chlorinated dioxin and furan congeners. The total amount of toxic dioxin and furan congeners present at a site is usually expressed as toxic equivalent concentrations (TEQ) of 2,3,7,8-tetrachlorodibenzodioxin (TCDD) present. The following TEFs were used to convert concentrations of dioxin and furan congeners to TEQ of TCDD.

- 1,2,3,4,6,7,8-HPCDD – 0.01
- 1,2,3,4,6,7,8-HPCDF – 0.01
- 1,2,3,4,7,8,9-HPCDF – 0.01
- 1,2,3,4,7,8-HXCDD – 0.1
- 1,2,3,4,7,8-HXCDF – 0.1
- 1,2,3,6,7,8-HXCDD – 0.1
- 1,2,3,6,7,8-HXCDF – 0.1
- 1,2,3,7,8,9-HXCDD – 0.1
- 1,2,3,7,8,9-HXCDF – 0.1
- 1,2,3,7,8-PECDD – 1.0
- 1,2,3,7,8-PECDF – 0.05
- 2,3,4,6,7,8-HXCDF – 0.1
- 2,3,4,7,8-PECDF – 0.5
- 2,3,7,8-TCDD – 1.0
- 2,3,7,8-TCDF – 0.1
- OCDD – 0.0001
- OCDF – 0.0001

COPCs were identified for both the individual dioxin and furan congeners and 2,3,7,8-TCDD equivalent concentration, although only the 2,3,7,8-TCDD equivalent concentration was evaluated in the human health risk assessment.

### Nitrocellulose

Toxicity values are not currently available for nitrocellulose. Consequently, risk-based screening levels used for the selection of chemicals of potential concern are not currently published. However, a review of the conclusions and recommendations of the U.S. EPA Health Advisory for Nitrocellulose indicates that the chemical has a very low toxicity: "Based on available toxicity data and chemical and physical properties of the compound, nitrocellulose is apparently non-toxic to dogs, rats, and mice and is not digested or absorbed in these species. These data, along with the relative insolubility of nitrocellulose in water, suggest that Health Advisory values for nitrocellulose in drinking water are unnecessary. The physical characteristics of the drinking water as they relate to turbidity, clarity, taste and similar indicators of palatability appear to be the only guidelines necessary." Toxicity information suggests that the $LD_{50}$ (lethal dose for 50 percent of the test animals) is greater than 5 grams per kilogram. It should be noted that published risk-based concentrations for other chemicals that are considered relatively non-toxic (e.g., aluminum) typically exceed 10,000 µg/L (tap-water) and 10,000 mg/kg (residential soil). Nitrocellulose concentrations detected in the environmental media at the OJT/LSC do not exceed these concentrations.

### Essential Nutrients and Chemicals without Toxicity Criteria

The essential nutrients calcium, magnesium, potassium, and sodium were not included as COPCs for the OJT/LSC. These inorganic chemicals are naturally abundant in environmental matrices and are only toxic at high doses In addition, because of the lack of toxicity criteria, direct contact COPC screening levels are not available for some compounds [e.g., acenaphthylene, benzo(g,h,i)perylene, 2-methylnaphthalene, and phenanthrene]. Surrogates were selected for these chemicals based on similar chemical structures. Acenaphthene was used as a surrogate for acenaphthylene, naphthalene was used as a surrogate for 2-methylnaphthene, and pyrene was selected as a surrogate for benzo(g,h,i)perylene and phenanthrene. SSLs for migration from soil to air are not available for a large number of chemicals and surrogates could not be derived for these constituents. The uncertainty associated with the absence of SSLs for migration from soil to air will be discussed in Section 7.6, Uncertainty Analysis.

### Determination of Site-Related Chemicals

Inorganic chemicals found at concentrations indicative of background levels are not considered to be site-related contaminants and were not retained as COPCs for the quantitative risk assessment. The methodology for determining whether concentrations of inorganics detected in site media were within background levels was presented in Section 3.4.

### 4.2.2 Surface Soil (0 to 2 Feet Depth)

Twenty-three dioxin/furans, six VOCs, 20 SVOCs, eight energetics, three herbicides, and 23 metals were detected in surface soil samples collected at the OJT/LSC. The maximum detected surface soil concentrations are compared to U.S. EPA Region 9 PRGs for residential exposures and IDEM residential default closure levels for direct contact in Table 4-10. The following chemicals were detected in surface soil at maximum concentrations that exceeded the direct contact risk-based COPC screening levels. These chemicals were retained as COPCs for surface soil at the OJT/LSC:

- Dioxin/Furans - 2,3,7,8-TCDD equivalents, total HPCDD.
- Energetics - 2,4,6-Trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinintrotoluene, HMX, and RDX.
- Inorganics - Barium, cadmium, chromium, iron, and lead.

Concentrations of aluminum, antimony, and arsenic also exceeded the screening criteria. However, reported concentrations of these metals were within site-specific background concentrations. Therefore, aluminum, antimony, and arsenic were not retained as COPCs for direct contact exposures to surface soil at the OJT/LSC.

A comparison of the maximum detected surface soil concentrations to U.S. EPA SSLs for chemical migration from soil to air is presented in Table 4-11. Concentrations reported for all chemicals were less than the U.S. EPA SSLs for soil to air, with the exception of chromium. The concentration of chromium exceeded the SSL of 270 mg/kg in only one of 32 samples (03SS270002 – 288 mg/kg). The concentrations of chromium in the other 31 samples were less than 60 mg/kg. In addition, the 95 percent upper confidence limit on the arithmetic mean of 26 mg/kg is less than the SSL. Because only one of 32 samples had a concentration that exceeded the SSL and the remaining concentrations were less than one-fourth of the screening level, chromium was not retained as a COPC for the inhalation pathway. Therefore, exposures through inhalation of fugitive dust emissions from surface soil at the OJT/LSC were not evaluated quantitatively in the HHRA.

The maximum detected surface soil concentrations are compared to U.S. EPA SSLs for chemical migration from soil to ground water and IDEM residential default closure levels for migration to ground water in Table 4-11. The following chemicals were detected in surface soil at maximum concentrations that exceeded the COPC screening levels for migration from soil to ground water. These chemicals were retained as COPCs for surface soil at the OJT/LSC.

- Dioxins/furans - 1,2,3,4,6,7,8,9-OCDD, 1,2,3,4,6,7,8-HPCDD, 1,2,3,4,6,7,8-HPCDF, 1,2,3,4,7,8-HXCDF, 1,2,3,6,7,8-HXCDD, 1,2,3,7,8,9-HXCDD, 1,2,3,7,8-PECDD, 2,3,4,7,8-PECDF, 2,3,7,8-TCDD, 2,3,7,8-TCDD equivalents, total HPCDD, total HXCDD, total HXCDF, total PECDD, and total TCDD.
- VOCs - Trichloroethene.
- Energetics - 2,4-Dinitrotoluene.
- Inorganics - Barium, cadmium, chromium, lead, mercury, nickel, and zinc.

2,4-Dinitrotoluene was not detected in ground water at the OJC/LSC.

Concentrations of antimony, arsenic, selenium, and thallium also exceeded the screening criteria. However, reported concentrations of these metals were within site-specific background concentrations. Therefore, these inorganics were not retained as COPCs for the soil-to-ground water migration pathway.

### 4.2.3 Subsurface Soil (Depths Greater than 2 Feet)

Five dioxin/furans, seven VOCs, 23 SVOCs, six energetics, and 24 metals were detected in subsurface soil samples collected at OJT/LSC. The maximum detected subsurface soil concentrations are compared to U.S. EPA Region 9 PRGs for residential exposures and IDEM residential default closure levels for direct contact in Table 4-12. The following chemicals were detected in subsurface soil at maximum concentrations that exceeded the direct contact risk-based COPC screening levels. These chemicals were retained as COPCs for subsurface soil at the OJT/LSC.

- SVOCs - Acetophenone and benzo(a)pyrene
- Energetics - 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and RDX
- Inorganics - Barium, cadmium, cobalt, copper, iron, lead, manganese, and nickel

Concentrations of aluminum, antimony, arsenic, and chromium also exceeded the screening criteria. However, reported concentrations of these metals were within site-specific background concentrations. Therefore, these metals were not retained as COPCs for direct contact exposures to subsurface soil at the OJT/LSC.

The maximum detected subsurface soil concentrations are compared to U.S. EPA SSLs for chemical migration from soil to air in Table 4-13. Concentrations reported for all chemicals were less than the U.S.

EPA SSLs for soil to air; therefore, exposures through inhalation of fugitive dust emissions from subsurface soil at the OJT/LSC were not evaluated quantitatively in the HHRA.

The maximum detected subsurface soil concentrations are compared to U.S. EPA SSLs for chemical migration from soil to ground water and IDEM residential default closure levels for migration to ground water in Table 4-13. The following chemicals were detected in surface soil at maximum concentrations that exceeded the COPC screening levels for migration from soil to ground water. These chemicals were retained as COPCs for subsurface soil at the OJT/LSC:

- Dioxins/furans - 1,2,3,4,6,7,8,9-OCDD, 1,2,3,4,6,7,8-HPCDD, 2,3,7,8-TCDD equivalents
- VOCs - 1,1,2,2-Tetrachloroethane and trichloroethene
- SVOCs - Benzo(b)fluoranthene
- Energetics - 2,4-Dinitrotoluene
- Inorganics - Barium, cadmium, copper, lead, nickel, silver, and zinc

Benzo(b)fluoranthene and 2,4-dinitrotoluene were not detected in ground water at the OJC/LSC.

Concentrations of antimony, arsenic, chromium, mercury, selenium, and thallium also exceeded the screening criteria. However, reported concentrations of these metals were within site-specific background concentrations. Therefore, these inorganics were not retained as COPCs for the soil-to-ground water migration pathway.

### 4.2.4 Ground Water

Ten VOCs, one SVOC, six energetics, 20 total inorganics, and 12 dissolved inorganics were detected in ground water samples collected from the surficial aquifer. A comparison of the maximum detected ground water concentrations to U.S. EPA Region 9 PRGs for ingestion of tap water, EPA MCLs, and IDEM ground water closure levels is presented in Table 4-14. The following chemicals were detected in ground water at maximum concentrations that exceeded the COPC screening levels. These chemicals were retained as COPCs for ground water at the OJT/LSC:

- VOCs - 1,1,2,2-Tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride.
- Energetics - 2,4,6-Trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and RDX.
- Inorganics - Aluminum, barium, cadmium, chromium, iron, manganese, nickel, and thallium.
- Miscellaneous - Nitrate.

Concentrations of arsenic also exceeded the screening criteria. However, reported concentrations of arsenic were within site-specific background concentrations. Therefore, arsenic was not retained as COPCs for ground water.

### 4.2.5 Sediment

**Shallow Sediment (0 to 6 inches)**

Five VOCs, six SVOCs, four energetics, one pesticide/PCB, five herbicides, and 24 inorganics were detected in shallow sediment samples collected at OJT/LSC. The maximum detected sediment concentrations are compared to U.S. EPA Region 9 PRGs for residential exposures and IDEM residential default closure levels for direct contact in Table 4-15. The following chemicals were detected in shallow sediment at maximum concentrations that exceeded the direct contact risk-based COPC screening levels. These chemicals were retained as COPCs for sediment at the OJT/LSC:

- Inorganics - Aluminum, antimony, barium, and lead

Concentrations of arsenic, chromium, iron, and manganese also exceeded the screening criteria. However, reported concentrations of these metals were within site-specific background concentrations. Therefore, these metals were not retained as COPCs for direct contact exposures to shallow sediment at the OJT/LSC.

It should be noted that, although the maximum detected lead concentration of 653 mg/kg in shallow sediment exceeded the OSWER screening level of 400 mg/kg for residential settings, it was less than the recommended screening level of 750 mg/kg for commercial/industrial sites.

**Deep Sediment (6 to 12 inches)**

Six VOCs, seven SVOCs, five energetics, six herbicides, and 24 inorganics were detected in deep sediment samples collected at OJT/LSC. The maximum detected sediment concentrations are compared to U.S. EPA Region 9 PRGs for residential exposures and IDEM residential default closure levels for direct contact in Table 4-16. The following chemicals were detected in deep sediment at maximum concentrations that exceeded the direct contact risk-based COPC screening levels. These chemicals were retained as COPCs for sediment at the OJT/LSC:

- Energetics - 2-amino-4,6-dinitrotoluene

- Inorganics - Aluminum, antimony, barium, cadmium, and lead

Concentrations of arsenic, chromium, iron, and manganese also exceeded the screening criteria. However, reported concentrations of these metals were within site-specific background concentrations. Therefore, these metals were not retained as COPCs for direct contact exposures to deep sediment at the OJT/LSC.

Although the maximum detected lead concentration of 445 mg/kg in deep sediment exceeded the OSWER screening level of 400 mg/kg for residential settings, it was less than the recommended screening level of 750 mg/kg for commercial/industrial sites.

### 4.2.6 Surface Water

**Low-Flow Conditions**

Three VOCs, five energetics, one herbicide, 17 total inorganics, and 19 dissolved inorganics were detected in surface water samples collected during low-flow conditions. The maximum detected surface water concentrations are compared to U.S. EPA Region 9 PRGs for ingestion of tap water, EPA MCLs, and IDEM ground water closure levels in Table 4-17. The following chemicals were detected in the low-flow surface water samples at maximum concentrations that exceeded the COPC screening levels. These chemicals were retained as COPCs for surface water at the OJT/LSC:

- VOCs - Bromomethane
- Energetics - 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and RDX
- Inorganics - Lead

Concentrations of total aluminum, total arsenic, and total iron also exceeded the screening criteria. However, reported concentrations of these metals were within site-specific background concentrations. Therefore, these metals were not retained as COPCs for direct contact exposures to surface water at the OJT/LSC.

Concentrations of dissolved arsenic in filtered samples exceeded arsenic's EPA Region 9 PRG and were above site-specific background concentrations. Dissolved arsenic was not retained as a COPC in surface water under low-flow conditions because dissolved arsenic concentrations were less than total arsenic concentrations in all samples and concentrations of total arsenic were within site-specific background

levels. In addition, dissolved arsenic concentrations were also less than the EPA MCL and IDEM residential closure level.

**High Flow Conditions**

Two VOCs, two SVOCs, five energetics, three herbicides, 21 total inorganics, and 20 dissolved inorganics were detected in surface water samples collected during high-flow conditions. The maximum detected surface water concentrations are compared to U.S. EPA Region 9 PRGs for ingestion of tap water, EPA MCLs, and IDEM ground water closure levels in Table 4-18. The following chemicals were detected in the high-flow surface water samples at maximum concentrations that exceeded the COPC screening levels. These chemicals were retained as COPCs for surface water at the OJT/LSC:

- VOCs - Acetone and methylene chloride
- SVOCs - bis(2-ethylhexyl) phthalate
- Energetics - 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and RDX
- Herbicides - Pentachlorophenol
- Inorganics - Antimony and lead

Concentrations of total aluminum, total arsenic, total iron, total manganese, and nitrate also exceeded the screening criteria. However, reported concentrations of these metals were within site-specific background concentrations. Therefore, these metals were not retained as COPCs for direct contact exposures to surface water at the OJT/LSC.

Concentrations of dissolved arsenic in filtered samples exceeded arsenic's EPA Region 9 PRG and were greater than site-specific background samples. Dissolved arsenic was not retained as a COPC in surface water under high-flow conditions because dissolved arsenic concentrations were less than total arsenic concentrations in all samples and concentrations of total arsenic were within site-specific background levels. In addition, dissolved arsenic concentrations were also less than the EPA MCL and IDEM residential closure level.

### 4.2.7 Summary

Table 4-19 summarizes the chemicals retained as COPCs for soil, ground water, sediment, and surface water at the OJT/LSC. RAGS Part D tables for COPC selection are included in Appendix G.3.

## 4.3 SELECTION OF ECOLOGICAL RISK CHEMICALS OF POTENTIAL CONCERN

The selection of COPCs is a qualitative screening process used to limit the number of chemicals and exposure routes quantitatively evaluated in the ecological risk assessment (ERA) to those site-related constituents that dominate overall potential risks. Site data are screened against risk-based concentrations and background levels to focus the risk assessment on meaningful chemicals and exposure routes.

Screening concentrations based on U.S. EPA Region 5 Ecological Data Quality Levels (EDQLs) (U.S. EPA, 1999d) were used for surface water (high and low flow), sediment (shallow and deep), and surface soil. The ecological screening levels provide an initial screening level that is protective of ecological receptors (e.g. plants, invertebrates, mammals) (U.S. EPA, Working Draft, 1999)

In general, a chemical is selected as a COPC and retained for further quantitative risk evaluation in the ERA if the maximum detection level in a sampled medium exceeds the EDQL and the chemical is determined to be present at concentrations exceeding background. This second condition applies only to those chemicals for which background comparison is appropriate (e.g., inorganics). A chemical is also retained as a COPC if the detection level exceeds background levels and no screening level is currently available for that chemical. Chemicals eliminated from further evaluation at this time are assumed to present minimal risks to potential ecological receptors.

As discussed in more detail in Section 8.0 of this report, the only media being evaluated in the ERA are surface water, sediment, and surface soil. Ground water is not evaluated in the ERA because ecological receptors are not exposed directly to the ground water before it is mixed with the surface water. Also, subsurface soil is not evaluated because most ecological receptors are not exposed to the subsurface soil. The surface soil is defined as the samples that were collected from 0 to 2 feet in depth.

Surface water samples were collected during low-flow and high-flow sampling events. The objectives of the two sampling events are presented in more detail in Section 2.0 of this report. In summary, the low-flow samples represent surface water concentrations in the creek related to ground water flow, and the high-flow samples represent surface water concentrations in the creek related to ground water flow and surface water runoff. Although aquatic organisms are exposed to the surface water under both scenarios, the surface water data from both data sets were evaluated separately to select COPCs to determine whether one scenario presented greater risks than the other. A combined data set, including surface water at both high-flow and low-flow was used to refine the list of COPCs in Step 3a of the ERA process

since aquatic receptors can be exposed to sediment from both sets. This is further discussed in Section 8.0 because aquatic receptors will be exposed to surface water under both scenarios.

Sediment samples were collected from depths of 0 to 6 inches (shallow) and 6 to 12 inches (deep). For the selection of COPCs and risk calculations, the samples from these two depth intervals were evaluated separately. Although ecological receptors in the sediment are typically only exposed to the surficial sediment layer (i.e., 0 to 6 inches or less), the sediment dynamics in Little Sulphur Creek warrant the inclusion of both depth intervals in the ERA. During periods of rain, it has been reported by base personnel that the creek flows very rapidly and the sediment is scoured along the creek bottom. Therefore, it is likely that there is considerable mixing of the sediment during these events and aquatic receptors may be exposed to the deeper sediment in the future. For these reasons, it is appropriate to evaluate the data from both depth intervals for the ERA. A combined data set including both depth intervals was used to refine the list of COPCs in Step 3a of the ERA process because aquatic receptors can be exposed to sediment from both sets. This is further discussed in Section 8.0 of the report.

**Dioxins/Furans as COPCs**

EPA Region 5 recommends that a TEF approach be used to evaluate chlorinated dioxin and furan congeners. The total amount of toxic dioxin and furan congeners present at a site is usually expressed as TEQ of 2,3,7,8-TCDD present. Section 4.2 presented the TEFs used to convert concentrations of dioxin and furan congeners to TEQ of TCDD for humans, which are the same TEFs for other mammals. The following TEFs were used to convert concentrations of dioxin and furan congeners to TEQ of TCDD for the bird:

- 1,2,3,4,6,7,8-HPCDD – <0.001
- 1,2,3,4,6,7,8-HPCDF – 0.01
- 1,2,3,4,7,8,9-HPCDF – 0.01
- 1,2,3,4,7,8-HXCDD – 0.05
- 1,2,3,4,7,8-HXCDF – 0.1
- 1,2,3,6,7,8-HXCDD – 0.01
- 1,2,3,6,7,8-HXCDF – 0.1
- 1,2,3,7,8,9-HXCDD – 0.1
- 1,2,3,7,8,9-HXCDF – 0.1
- 1,2,3,7,8-PECDD – 1.0
- 1,2,3,7,8-PECDF – 0.1
- 2,3,4,6,7,8-HXCDF – 0.1

- 2,3,4,7,8-PECDF – 1.0
- 2,3,7,8-TCDF – 1.0
- OCDD – 0.0001
- OCDF – 0.0001

COPCs were identified for both the individual dioxin and furan congeners and 2,3,7,8-TCDD equivalent concentration, although only the 2,3,7,8-TCDD equivalent concentration was evaluated in the ecological risk assessment.

**Essential Nutrients and Chemicals without Toxicity Criteria**

The essential nutrients of calcium, magnesium, potassium, and sodium were not included as COPCs for OJT/LSC. These inorganic chemicals are naturally abundant in environmental matrices and are only toxic at high doses. In addition, because of the lack or toxicity criteria, risk-based COPC screening levels are not available for some compounds. Chemicals without EDQLs were retained as COPCs for further evaluation in Step 3a of the ERA process.

**Determination of Site-Related Chemicals**

Inorganic chemicals found at concentrations indicative of background levels are not considered to be site-related contaminants and were not retained as COPCs for the quantitative risk assessment. The methodology for determining whether concentrations of inorganics detected in site media were within background levels was presented in Section 3.4.

### 4.3.1 Surface Soil (0 to 2 feet)

Twenty-three dioxins/furans (including six dioxin/furan totals), six VOCs, 20 SVOCs, eight energetics, three herbicides, and 23 metals were detected in surface soil samples collected at OJT/LSC. The maximum detected surface soil metals concentrations are compared to U.S. EPA Region 5 surface soil screening levels in Table 4-20. The following individual chemicals were detected in surface soil at maximum concentrations exceeding the direct contact risk-based COPC screening levels. These chemicals were retained as COPCs for surface soil at OJT/LSC:

- Dioxins/Furans - 1,2,3,4,6,7,8,9-OCDD, 1,2,3,4,6,7,8,9-OCDF, 1,2,3,4,6,7,8-HPCDD, 1,2,3,4,7,8-HXCDD, 1,2,3,6,7,8-HXCDD, 1,2,3,7,8,9-HXCDD, 1,2,3,7,8-PECDD, and 2,3,7,8-TCDD.
- Semivolatile Organics - di-n-butyl phthalate and naphthalene.

- Energetics - 1,3,5-Trinitrobenzene.
- Inorganics - Barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, and zinc.

Concentrations of antimony, arsenic, cobalt, selenium, thallium, and vanadium also exceeded their screening criteria. However, reported concentrations of these metals were within site-specific background concentrations and therefore were not retained as COPCs for direct contact exposures to surface soil at the OJT/LSC.

The following chemicals (or totals for the dioxins) were retained as COPCs for surface soil at OJT/LSC because there are no current available surface soil EDQLs. They will be further evaluated in Step 3a of the ERA process.

- Dioxins/Furans - Bird and human TEQ; total HPCDD, HPCDF, HXCDD, HXCDF, PECDD, and TCDD.
- Energetics - 2,4,6-Trinitrotoluene, 2-amino-4,6-dinitrotoluene, 2-nitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX.
- Metals - Iron.

### 4.3.2 Sediment

**Shallow Sediment (0 to 6 inches)**

Five VOCs, six SVOCs, four energetics, one pesticide, five herbicides, and 24 inorganics were detected in shallow sediment samples collected at OJT/LSC. The maximum detected sediment concentrations are compared to U.S. EPA Region 5 sediment screening levels in Table 4-21. The following chemicals were detected in shallow sediment at maximum concentrations that exceeded the direct contact risk-based COPC screening levels. These chemicals were retained as COPCs for sediment at OJT/LSC:

- SVOCs - Acenaphthene, di-n-butyl phthalate, and diphenylamine.
- Energetics - 2,4-Dinitrotoluene.
- Pesticides - Methoxychlor.
- Herbicides - 2,4-D.
- Inorganics - Cadmium, copper, lead, and zinc.

Concentrations of arsenic, chromium, mercury, nickel, and silver also exceeded the screening criteria. However, reported concentrations of these metals were within site-specific background concentrations.

Therefore, these metals were not retained as COPCs for direct contact exposures to shallow sediment at the OJT/LSC.

The following chemicals were retained as COPCs for shallow sediment at OJT/LSC because there are no current available sediment EDQLS. These chemicals will be further evaluated in Step 3a of the ERA process.

- Energetics - 2,4,6-Trinitrotoluene, 2-amino-4,6-dinitrotoluene, and HMX.
- Inorganics – Aluminum, antimony, barium, and tin.

**Deep Sediment (6 to 12 inches)**

Six VOCs, seven SVOCs, five energetics, six herbicides, and 24 inorganics were detected in deep sediment samples collected at OJT/LSC. The maximum detected sediment concentrations are compared to U.S. EPA Region 5 sediment screening levels in Table 4-22. The following chemicals were detected in deep sediment at maximum concentrations that exceeded the direct contact risk-based COPC screening levels. These chemicals were retained as COPCs for sediment at OJT/LSC:

- SVOCs - Di-n-butyl phthalate.
- Herbicides - 2,4-D.
- Inorganics - Cadmium, copper, lead, and zinc.

Concentrations of arsenic, chromium, and nickel also exceeded the screening criteria. However, reported concentrations were within site-specific background concentrations. Therefore, they were not retained as COPCs for direct contact exposures to deep sediment at the OJT/LSC.

The following chemicals were retained as COPCs for deep sediment at OJT/LSC because there are no current available sediment EDQLs. They will be further evaluated in Step 3a of the ERA process.

- Energetics - 2,4,6-Trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX
- Inorganics – Aluminum, antimony, barium, and tin.

### 4.3.3 Surface Water

**Low-Flow Conditions**

Three VOCs, five energetics, one herbicide, 17 total inorganics, and 19 dissolved inorganics were detected in surface water samples collected during low-flow conditions. The maximum detected surface water concentrations are compared to U.S. EPA Region 5 surface water screening levels in Table 4-23. The total metals—lead was detected in the low-flow surface water samples at maximum concentrations exceeding the COPC screening levels at OJT/LSC.

The following chemicals were retained as COPCs for low-flow surface water at OJT/LSC because there are no current available surface water EDQLs. They will be further evaluated in Step 3a of the ERA process.

- VOCs - Bromomethane.
- Energetics - 2,4,6-Trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX.
- Dissolved metals—Iron.

**High-Flow Conditions**

Two VOCs, two SVOCs, five energetics, three herbicides, 21 total inorganics, and 20 dissolved inorganics were detected in surface water samples collected during high-flow conditions. The maximum detected surface water concentrations are compared to U.S. EPA Region 5 surface water screening levels presented in Table 4-24. The following chemicals were detected in the high-flow surface water samples at maximum concentrations exceeding the COPC screening levels. These chemicals were retained as COPCs for surface water at OJT/LSC:

- SVOCs - bis(2-ethylhexyl) phthalate.
- Total Metals – Cadmium, copper, lead, and zinc.
- Dissolved Metals - Copper and lead

The following chemicals were retained as COPCs for high-flow surface water at OJT/LSC due to no current available surface water EDQLs. These chemicals will be further evaluated in Step 3a of the ERA process:

- Energetics - 2-Amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, nitrocellulose, and RDX.
- Herbicides - 2,4-D.

### 4.3.4 Summary

Table 4-25 summarizes the chemicals retained as ecological COPCs for soils, sediments, and surface water at the OJT/LSC.

## 4.4 OVERALL SUMMARY OF HUMAN HEALTH AND ECOLOGICAL COPCs

Table 4-26 summarizes the overall list of chemicals that were retained as COPCs for either the human health or ecological risk assessment. Chemicals retained as human health COPCs are designated with an "H," and chemicals retained as ecological COPCs are designated with an "E".

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB01 | 03SB02 | 03SB03 | 03SB04 | 03SB05 | 03SB06 | 03SB07 | 03SB08 | 03SB09 | 03SB10 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS010002 | 03SS020002 | 03SS030002 | 03SS040002 | 03SS050002 | 03SS060002 | 03SS070002 | 03SS080002 | 03SS090002 | 03SS100002 |
| SAMPLE | 03SS010002 | 03SS020002 | 03SS030002 | 03SS040002 | 03SS050002 | 03SS060002 | 03SS070002 | 03SS080002 | 03SS090002 | 03SS100002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | ORIG | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDF | | | | | | | | | | |
| 1,2,3,4,6,7,8-HPCDD | | | | | | | | | | |
| 1,2,3,4,6,7,8-HPCDF | | | | | | | | | | |
| 1,2,3,4,7,8,9-HPCDF | | | | | | | | | | |
| 1,2,3,4,7,8-HXCDD | | | | | | | | | | |
| 1,2,3,4,7,8-HXCDF | | | | | | | | | | |
| 1,2,3,6,7,8-HXCDD | | | | | | | | | | |
| 1,2,3,6,7,8-HXCDF | | | | | | | | | | |
| 1,2,3,7,8,9-HXCDD | | | | | | | | | | |
| 1,2,3,7,8,9-HXCDF | | | | | | | | | | |
| 1,2,3,7,8-PECDD | | | | | | | | | | |
| 1,2,3,7,8-PECDF | | | | | | | | | | |
| 2,3,4,6,7,8-HXCDF | | | | | | | | | | |
| 2,3,4,7,8-PECDF | | | | | | | | | | |
| 2,3,7,8-TCDD | | | | | | | | | | |
| 2,3,7,8-TCDF | | | | | | | | | | |
| TEQ BIRD | | | | | | | | | | |
| TEQ FISH | | | | | | | | | | |
| TEQ HUMAN | | | | | | | | | | |
| TOTAL HPCDD | | | | | | | | | | |
| TOTAL HPCDF | | | | | | | | | | |
| TOTAL HXCDD | | | | | | | | | | |
| TOTAL HXCDF | | | | | | | | | | |
| TOTAL PECDD | | | | | | | | | | |
| TOTAL TCDD | | | | | | | | | | |
| **Volatile Organics (µg/kg)** | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | | | | | | | | | | |
| 2-HEXANONE | | | | | | | | | | |
| 4-METHYL-2-PENTANONE | | | | | | | | | | |
| TETRACHLOROETHENE | | | | | | | | | | |
| TOTAL XYLENES | | | | | | | | | | |
| TRICHLOROETHENE | | | | | | | | | | |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | |
| 1,4-PHENYLENEDIAMINE | | 76 U | | 72 U | 83 UJ | 74 U | 74 U | 73 UJ | 67 UJ | 78 UJ |
| 2-METHYLNAPHTHALENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| ACENAPHTHENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| ACENAPHTHYLENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| ANTHRACENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| BENZO(A)ANTHRACENE | | 1 48 U | | 1 4 U | 1 6 U | 5 7 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| BENZO(A)PYRENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| BENZO(B)FLUORANTHENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 9 |
| BENZO(G,H,I)PERYLENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | | 76 U | | 72 U | 83 U | 74 U | 74 U | 73 U | 67 U | 78 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB01 | 03SB02 | 03SB03 | 03SB04 | 03SB05 | 03SB06 | 03SB07 | 03SB08 | 03SB09 | 03SB10 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS010002 | 03SS020002 | 03SS030002 | 03SS040002 | 03SS050002 | 03SS060002 | 03SS070002 | 03SS080002 | 03SS090002 | 03SS100002 |
| SAMPLE | 03SS010002 | 03SS020002 | 03SS030002 | 03SS040002 | 03SS050002 | 03SS060002 | 03SS070002 | 03SS080002 | 03SS090002 | 03SS100002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | ORIG | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| CHRYSENE | | 1 48 U | | 1 4 U | 1 6 U | 5 7 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB01 | 03SB02 | 03SB03 | 03SB04 | 03SB05 | 03SB06 | 03SB07 | 03SB08 | 03SB09 | 03SB10 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS010002 | 03SS020002 | 03SS030002 | 03SS040002 | 03SS050002 | 03SS060002 | 03SS070002 | 03SS080002 | 03SS090002 | 03SS100002 |
| SAMPLE | 03SS010002 | 03SS020002 | 03SS030002 | 03SS040002 | 03SS050002 | 03SS060002 | 03SS070002 | 03SS080002 | 03SS090002 | 03SS100002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | ORIG | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Semivolatile Organics (µg/kg) (Continued)** | | | | | | | | | | |
| DI-N-BUTYL PHTHALATE | | 76 U | | 72 U | 83 U | 74 U | 74 U | 73 U | 67 U | 120 J |
| DI-N-OCTYL PHTHALATE | | 76 U | | 72 U | 83 U | 74 U | 74 U | 73 U | 67 U | 78 UJ |
| DIBENZO(A,H)ANTHRACENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| FLUORANTHENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| FLUORENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| INDENO(1,2,3-CD)PYRENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| NAPHTHALENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| PHENANTHRENE | | 1 48 U | | 1 4 U | 1 6 U | 1 44 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| PYRENE | | 1 48 U | | 1 4 U | 1 6 U | 5 7 U | 1 43 U | 1 41 U | 1 3 U | 1 51 U |
| **Energetics (mg/kg)** | | | | | | | | | | |
| 1,3,5-TRINITROBENZENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-NITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 34 | 0 28 U | 0 44 | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| RDX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Herbicides (µg/kg)** | | | | | | | | | | |
| 2,4,5-T | | | | | | | | | | |
| 2,4-D | | | | | | | | | | |
| DINOSEB | | | | | | | | | | |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB01 | 03SB02 | 03SB03 | 03SB04 | 03SB05 | 03SB06 | 03SB07 | 03SB08 | 03SB09 | 03SB10 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS010002 | 03SS020002 | 03SS030002 | 03SS040002 | 03SS050002 | 03SS060002 | 03SS070002 | 03SS080002 | 03SS090002 | 03SS100002 |
| SAMPLE | 03SS010002 | 03SS020002 | 03SS030002 | 03SS040002 | 03SS050002 | 03SS060002 | 03SS070002 | 03SS080002 | 03SS090002 | 03SS100002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | ORIG | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Inorganics (mg/kg)** | | | | | | | | | | |
| ALUMINUM | | | | | | | | | | |
| ANTIMONY | | | | | | | | | | |
| ARSENIC | | | | | | | | | | |
| BARIUM | | | | | | | | | | |
| BERYLLIUM | | | | | | | | | | |
| CADMIUM | | | | | | | | | | |
| CALCIUM | | | | | | | | | | |
| CHROMIUM | | | | | | | | | | |
| COBALT | | | | | | | | | | |
| COPPER | | | | | | | | | | |
| IRON | | | | | | | | | | |
| LEAD | | | | | | | | | | |
| MAGNESIUM | | | | | | | | | | |
| MANGANESE | | | | | | | | | | |
| MERCURY | | | | | | | | | | |
| NICKEL | | | | | | | | | | |
| POTASSIUM | | | | | | | | | | |
| SELENIUM | | | | | | | | | | |
| SILVER | | | | | | | | | | |
| SODIUM | | | | | | | | | | |
| THALLIUM | | | | | | | | | | |
| VANADIUM | | | | | | | | | | |
| ZINC | | | | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | | | | |
| NITRATE mg/kg | 0 6 U | 1 7 | 1 2 | 1 9 | 2 4 | 3 | 3 6 | 2 8 | 2 2 | 3 7 |
| NITRITE mg/kg | 5 6 J | 14 UJ | 2 4 UJ | 2 UJ | 20 UR | 11 UJ | 5 3 UJ | 2 UJ | 12 UJ | 2 2 UR |
| NITRITE/NITRATE mg/kg | 0 6 U | 1 7 J | 1 2 | 1 9 J | 2 4 J | 3 J | 3 6 J | 2 8 J | 2 2 J | 3 7 J |
| PERCENT MOISTURE % | 19 4 | 10 6 | 19 9 | 7 7 | 19 | 9 7 | 7 6 | 6 4 | 25 | 13 8 |
| PERCHLORATE µg/kg | 25 UJ | 22 UJ | 25 UJ | 22 UJ | 25 UJ | 22 UJ | 22 UJ | 24 J | 27 UJ | 23 UJ |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB11 | 03SB12 | 03SB13 | 03SB14 | 03SB15 | 03SB16 | 03SB17 | 03SB18 | 03SB19 | 03SB20 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS110002 | 03SS120002 | 03SS130002 | 03SS140002 | 03SS150002 | 03SS160002 | 03SS170002 | 03SS180002 | 03SS190002 | 03SS200002 |
| SAMPLE | 03SS110002 | 03SS120002 | 03SS130002 | 03SS140002 | 03SS150002 | 03SS160002 | 03SS170002 | 03SS180002 | 03SS190002 | 03SS200002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | | | | | | | 2350 J | | | 771 J |
| 1,2,3,4,6,7,8,9-OCDF | | | | | | | 62 2 J | | | 0 3 UJ |
| 1,2,3,4,6,7,8-HPCDD | | | | | | | 233 | | | 12 6 |
| 1,2,3,4,6,7,8-HPCDF | | | | | | | 32 1 | | | 0 19 J |
| 1,2,3,4,7,8,9-HPCDF | | | | | | | 2 1 J | | | 0 2 U |
| 1,2,3,4,7,8-HXCDD | | | | | | | 2 1 J | | | 0 2 U |
| 1,2,3,4,7,8-HXCDF | | | | | | | 2 1 BU | | | 0 08 U |
| 1,2,3,6,7,8-HXCDD | | | | | | | 10 1 | | | 0 1 U |
| 1,2,3,6,7,8-HXCDF | | | | | | | 2 4 J | | | 0 08 U |
| 1,2,3,7,8,9-HXCDD | | | | | | | 6 5 | | | 0 35 J |
| 1,2,3,7,8,9-HXCDF | | | | | | | 0 35 U | | | 0 1 U |
| 1,2,3,7,8-PECDD | | | | | | | 1 3 J | | | 0 1 U |
| 1,2,3,7,8-PECDF | | | | | | | 0 38 U | | | 0 08 U |
| 2,3,4,6,7,8-HXCDF | | | | | | | 2 7 J | | | 0 08 U |
| 2,3,4,7,8-PECDF | | | | | | | 0 56 J | | | 0 08 U |
| 2,3,7,8-TCDD | | | | | | | 0 43 J | | | 0 19 J |
| 2,3,7,8-TCDF | | | | | | | 0 5 J | | | 0 08 U |
| TEQ BIRD | | | | | | | 5 | | | 0 32 |
| TEQ FISH | | | | | | | 4 6 | | | 0 29 |
| TEQ HUMAN | | | | | | | 7 4 | | | 0 43 |
| TOTAL HPCDD | | | | | | | 419 | | | 31 6 |
| TOTAL HPCDF | | | | | | | 93 9 U | | | 0 19 |
| TOTAL HXCDD | | | | | | | 59 1 U | | | 2 7 U |
| TOTAL HXCDF | | | | | | | 61 2 U | | | 0 09 U |
| TOTAL PECDD | | | | | | | 10 4 U | | | 0 1 U |
| TOTAL TCDD | | | | | | | 1 | | | 0 37 U |
| **Volatile Organics (µg/kg)** | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | | | | | | | 4 7 U | 8 7 U | 0 96 U | 5 U |
| 2-HEXANONE | | | | | | | 4 7 U | 8 7 U | 0 96 UJ | 5 U |
| 4-METHYL-2-PENTANONE | | | | | | | 4 7 U | 8 7 U | 0 96 UJ | 5 U |
| TETRACHLOROETHENE | | | | | | | 4 7 U | 8 7 U | 0 96 U | 5 U |
| TOTAL XYLENES | | | | | | | 4 7 U | 8 7 U | 0 96 U | 5 U |
| TRICHLOROETHENE | | | | | | | 4 7 U | 8 7 U | 0 96 U | 5 U |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | |
| 1,4-PHENYLENEDIAMINE | 76 UJ | | 76 UJ | 78 UJ | 76 UJ | 78 UJ | 76 UR | 82 U | 80 UJ | 81 UR |
| 2-METHYLNAPHTHALENE | 1 49 U | | 55 U | 1 5 U | 1 51 U | 1 51 U | 1 5 U | 6 4 U | 1 5 U | 1 5 U |
| ACENAPHTHENE | 1 49 U | | 55 U | 1 5 U | 1 51 U | 1 51 U | 1 5 U | 6 4 U | 1 5 U | 1 5 U |
| ACENAPHTHYLENE | 14 | | 55 U | 1 5 U | 1 51 U | 1 51 U | 1 5 U | 6 4 U | 1 5 U | 1 5 U |
| ANTHRACENE | 12 | | 55 U | 1 5 U | 1 51 U | 1 51 U | 1 5 U | 6 4 U | 1 5 U | 1 5 U |
| BENZO(A)ANTHRACENE | 18 | | 55 UJ | 1 5 U | 1 51 U | 1 51 U | 1 5 U | 37 | 1 5 U | 1 5 U |
| BENZO(A)PYRENE | 28 | | 55 UJ | 1 5 U | 1 51 U | 1 51 U | 1 5 | 52 | 10 | 1 5 U |
| BENZO(B)FLUORANTHENE | 49 | | 55 UJ | 14 | 12 | 1 51 U | 11 | 160 | 24 | 1 5 U |
| BENZO(G,H,I)PERYLENE | 22 | | 55 UJ | 8 | 1 51 U | 1 51 U | 15 | 67 | 13 | 1 5 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | 76 U | | 170 U | 84 J | 76 U | 78 U | 76 U | 870 | 80 U | 81 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB11 | 03SB12 | 03SB13 | 03SB14 | 03SB15 | 03SB16 | 03SB17 | 03SB18 | 03SB19 | 03SB20 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS110002 | 03SS120002 | 03SS130002 | 03SS140002 | 03SS150002 | 03SS160002 | 03SS170002 | 03SS180002 | 03SS190002 | 03SS200002 |
| SAMPLE | 03SS110002 | 03SS120002 | 03SS130002 | 03SS140002 | 03SS150002 | 03SS160002 | 03SS170002 | 03SS180002 | 03SS190002 | 03SS200002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| CHRYSENE | 18 | | 55 UJ | 10 | 1.51 U | 8 | 1.5 U | 68 | 11 | 1.5 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB11 | 03SB12 | 03SB13 | 03SB14 | 03SB15 | 03SB16 | 03SB17 | 03SB18 | 03SB19 | 03SB20 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS110002 | 03SS120002 | 03SS130002 | 03SS140002 | 03SS150002 | 03SS160002 | 03SS170002 | 03SS180002 | 03SS190002 | 03SS200002 |
| SAMPLE | 03SS110002 | 03SS120002 | 03SS130002 | 03SS140002 | 03SS150002 | 03SS160002 | 03SS170002 | 03SS180002 | 03SS190002 | 03SS200002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Semivolatile Organics (µg/kg) (Co** | | | | | | | | | | |
| DI-N-BUTYL PHTHALATE | 76 U | | 1200 | 78 U | 76 U | 150 J | 760 | 4500 | 140 J | 81 U |
| DI-N-OCTYL PHTHALATE | 76 U | | 76 UJ | 78 UR | 76 U | 78 U | 76 U | 82 U | 80 U | 81 U |
| DIBENZO(A,H)ANTHRACENE | 1 49 U | | 55 UJ | 1 5 U | 1 51 U | 1 51 U | 1 5 U | 6 4 U | 1 5 U | 1 5 U |
| FLUORANTHENE | 14 | | 55 U | 1 5 U | 10 | 1 51 U | 1 5 U | 59 | 12 | 1 5 U |
| FLUORENE | 1 49 U | | 55 U | 1 5 U | 1 51 U | 1 51 U | 1 5 U | 6 4 U | 1 5 U | 1 5 U |
| INDENO(1,2,3-CD)PYRENE | 20 | | 55 UJ | 1 5 U | 1 51 U | 1 51 U | 8 | 49 J | 10 | 1 5 U |
| NAPHTHALENE | 1 49 U | | 55 U | 1 5 U | 11 | 1 51 U | 1 5 U | 33 | 1 5 U | 1 5 U |
| PHENANTHRENE | 8 | | 55 U | 1 5 U | 14 | 1 51 U | 1 5 U | 42 | 1 5 U | 1 5 U |
| PYRENE | 19 | | 55 U | 8 | 14 | 1 51 U | 1 5 UJ | 62 | 12 | 1 5 U |
| **Energetics (mg/kg)** | | | | | | | | | | |
| 1,3,5-TRINITROBENZENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 1 2 | 0 25 U |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 39 J | 0 25 U | 0 25 U | 2 | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 82 | 0 25 U | 0 25 U | 0 56 | 0 25 U | 0 72 | 2 3 | 0 25 U |
| 2-NITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 63 | 0 25 U | 0 25 U | 0 35 J | 0 25 U | 0 43 J | 1 4 | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 34 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 72 | 14 | 0 25 U |
| RDX | 0 25 U | 0 25 U | 0 93 | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 1 2 | 6 2 | 0 25 U |
| **Herbicides (µg/kg)** | | | | | | | | | | |
| 2,4,5-T | | | | | | | | | | |
| 2,4-D | | | | | | | | | | |
| DINOSEB | | | | | | | | | | |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB11 | 03SB12 | 03SB13 | 03SB14 | 03SB15 | 03SB16 | 03SB17 | 03SB18 | 03SB19 | 03SB20 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS110002 | 03SS120002 | 03SS130002 | 03SS140002 | 03SS150002 | 03SS160002 | 03SS170002 | 03SS180002 | 03SS190002 | 03SS200002 |
| SAMPLE | 03SS110002 | 03SS120002 | 03SS130002 | 03SS140002 | 03SS150002 | 03SS160002 | 03SS170002 | 03SS180002 | 03SS190002 | 03SS200002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Inorganics (mg/kg)** | | | | | | | | | | |
| ALUMINUM | | | | | | | 5970 J | 9770 J | 11900 J | 7020 J |
| ANTIMONY | | | | | | | 0 19 U | 0 42 U | 0 69 J | 0 23 U |
| ARSENIC | | | | | | | 9 9 J | 2 8 U | 3 J | 3 3 J |
| BARIUM | | | | | | | 93 1 J | 156 J | 103 J | 120 J |
| BERYLLIUM | | | | | | | 0 57 J | 1 4 | 0 78 J | 0 75 J |
| CADMIUM | | | | | | | 0 55 | 1 7 | 0 84 | 0 32 U |
| CALCIUM | | | | | | | 111000 J | 73400 J | 5150 J | 3300 J |
| CHROMIUM | | | | | | | 16 4 J | 11 8 J | 15 5 J | 7 7 J |
| COBALT | | | | | | | 12 3 J | 10 6 | 11 7 J | 9 6 J |
| COPPER | | | | | | | 7 3 J | 12 8 J | 15 1 J | 5 4 J |
| IRON | | | | | | | 28600 J | 13700 J | 20900 J | 8280 J |
| LEAD | | | | | | | 21 2 J | 244 J | 14 7 J | 11 3 J |
| MAGNESIUM | | | | | | | 5820 J | 4960 J | 2860 J | 644 J |
| MANGANESE | | | | | | | 796 J | 322 J | 260 J | 1090 J |
| MERCURY | | | | | | | 0 023 J | 0 019 J | 0 038 | 0 025 J |
| NICKEL | | | | | | | 17 9 J | 32 6 J | 20 2 J | 8 9 J |
| POTASSIUM | | | | | | | 333 J | 2180 J | 632 J | 330 J |
| SELENIUM | | | | | | | 0 18 J | 0 3 | 0 17 U | 0 28 J |
| SILVER | | | | | | | 0 04 U | 0 05 U | 0 04 U | 0 05 U |
| SODIUM | | | | | | | 598 J | 89 7 U | 48 8 U | 430 J |
| THALLIUM | | | | | | | 0 09 | 0 08 | 0 09 | 0 11 |
| VANADIUM | | | | | | | 20 5 J | 13 9 | 21 1 J | 12 3 J |
| ZINC | | | | | | | 44 6 J | 68 9 J | 56 7 J | 19 5 J |
| **Miscellaneous Parameters** | | | | | | | | | | |
| NITRATE mg/kg | 1 1 UJ | 0 8 | 3 3 | 1 3 | 2 3 | 1 4 | 3 7 J | 4 2 | 2 1 | 2 3 J |
| NITRITE mg/kg | 31 UJ | 2 4 J | 6 UR | 12 UJ | 11 UR | 11 UR | 11 UJ | 12 UJ | 11 U | 4 7 UJ |
| NITRITE/NITRATE mg/kg | 1 1 UJ | 0 8 | 3 3 J | 1 3 J | 2 3 J | 1 4 J | 3 7 J | 4 2 J | 2 1 J | 2 3 J |
| PERCENT MOISTURE % | 16 5 | 13 9 | 9 5 | 12 | 10 6 | 12 6 | 10 2 | 23 4 | 16 5 | 19 2 |
| PERCHLORATE µg/kg | 24 UJ | 23 UJ | 22 UJ | 23 UJ | 22 UJ | 23 UJ | 22 U | 20 U | 24 U | 25 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
- SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB21 | 03SB22 | 03SB23 | 03SB24 | 03SB25 | 03SB26 | 03SB27 | 03SB28 | 03SB29 | 03SB30 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS210002 | 03SS220002 | 03SS230002 | 03SS240002 | 03SS250002 | 03SS260002 | 03SS270002 | 03SS280002 | 03SS290002 | 03SS300002 |
| SAMPLE | 03SS210002 | 03SS220002 | 03SS230002 | 03SS240002 | 03SS250002 | 03SS260002 | 03SS270002 | 03SS280002 | 03SS290002 | 03SS300002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 1 1 | 0 - 1 65 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | | | 3400 J | | 1120 J | 1590 J | | | 705 J | 623 J |
| 1,2,3,4,6,7,8,9-OCDF | | | 10 3 J | | 0 3 UJ | 7 6 J | | | 0 88 BU | 0 95 BU |
| 1,2,3,4,6,7,8-HPCDD | | | 36 2 | | 16 1 | 33 8 | | | 13 5 J | 10 J |
| 1,2,3,4,6,7,8-HPCDF | | | 11 8 | | 0 17 U | 7 5 | | | 0 45 U | 0 53 BU |
| 1,2,3,4,7,8,9-HPCDF | | | 1 3 J | | 0 2 U | 0 7 J | | | 0 2 U | 0 2 U |
| 1,2,3,4,7,8-HXCDD | | | 0 9 J | | 0 18 U | 0 87 J | | | 0 24 BU | 0 25 U |
| 1,2,3,4,7,8-HXCDF | | | 3 9 BJ | | 0 09 U | 3 1 BJ | | | 0 2 BU | 0 25 BU |
| 1,2,3,6,7,8-HXCDD | | | 1 2 J | | 0 23 U | 1 5 J | | | 0 33 J | 0 29 U |
| 1,2,3,6,7,8-HXCDF | | | 1 7 J | | 0 09 U | 1 4 J | | | 0 1 U | 0 19 J |
| 1,2,3,7,8,9-HXCDD | | | 2 6 J | | 0 44 U | 2 5 J | | | 0 41 BU | 0 55 BU |
| 1,2,3,7,8,9-HXCDF | | | 0 22 J | | 0 1 U | 0 22 U | | | 0 1 U | 0 27 U |
| 1,2,3,7,8-PECDD | | | 0 67 J | | 0 1 U | 0 67 J | | | 0 1 UJ | 0 2 UJ |
| 1,2,3,7,8-PECDF | | | 0 99 J | | 0 07 U | 1 1 J | | | 0 09 U | 0 1 U |
| 2,3,4,6,7,8-HXCDF | | | 2 J | | 0 09 U | 1 3 J | | | 0 1 U | 0 13 U |
| 2,3,4,7,8-PECDF | | | 1 4 J | | 0 07 U | 1 1 J | | | 0 09 U | 0 15 U |
| 2,3,7,8-TCDD | | | 0 31 J | | 0 08 U | 3 9 | | | 0 1 U | 0 1 U |
| 2,3,7,8-TCDF | | | 0 85 U | | 0 07 U | 0 55 J | | | 0 09 U | 0 1 U |
| TEQ BIRD | | | 4 1 | | 0 13 | 7 5 | | | 0 087 | 0 091 |
| TEQ FISH | | | 3 5 | | 0 13 | 6 5 | | | 0 087 | 0 091 |
| TEQ HUMAN | | | 3 8 | | 0 27 | 6 9 | | | 0 24 | 0 18 |
| TOTAL HPCDD | | | 80 2 | | 40 2 | 68 3 | | | 28 5 J | 20 8 J |
| TOTAL HPCDF | | | 19 | | 0 17 U | 13 1 | | | 0 83 U | 1 1 J |
| TOTAL HXCDD | | | 16 1 U | | 3 9 U | 17 U | | | 4 | 3 2 U |
| TOTAL HXCDF | | | 17 8 | | 0 07 U | 15 2 U | | | 0 6 U | 1 2 U |
| TOTAL PECDD | | | 7 6 U | | 0 27 U | 6 5 U | | | 0 1 UJ | 0 2 UJ |
| TOTAL TCDD | | | 4 2 U | | 0 18 U | 7 5 U | | | 0 1 U | 0 1 U |
| **Volatile Organics (µg/kg)** | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 13 J | 5 1 U | 2 J | 4 8 U | 0 93 U | 2 J | 1 5 U | 19 J | | |
| 2-HEXANONE | 12 U | 5 1 U | 1 2 U | 4 8 U | 0 93 U | 1 1 U | 1 5 U | 10 U | | |
| 4-METHYL-2-PENTANONE | 12 U | 5 1 U | 1 2 U | 4 8 U | 0 93 U | 1 1 U | 1 5 U | 10 U | | |
| TETRACHLOROETHENE | 12 U | 5 1 U | 3 J | 4 8 U | 0 93 U | 1 J | 1 5 U | 10 U | | |
| TOTAL XYLENES | 12 U | 5 1 U | 1 2 UJ | 4 8 U | 0 93 U | 1 1 U | 1 5 U | 10 U | | |
| TRICHLOROETHENE | 12 U | 5 1 U | 14 J | 4 8 U | 0 93 U | 4 | 1 5 U | 10 U | | |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | |
| 1,4-PHENYLENEDIAMINE | 80 UR | 82 UJ | 87 U | 77 UR | 76 UJ | 83 UR | 91 UR | 95 UR | 80 UR | 78 UR |
| 2-METHYLNAPHTHALENE | 1 5 U | 1 6 U | 1 7 U | 290 | 1 5 U | 24 | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| ACENAPHTHENE | 1 5 U | 1 6 U | 1 7 U | 18 | 1 5 U | 1 6 U | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| ACENAPHTHYLENE | 1 5 U | 1 6 U | 1 7 U | 11 | 1 5 U | 1 6 U | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| ANTHRACENE | 1 5 U | 1 6 U | 1 7 U | 380 U | 1 5 U | 1 6 U | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| BENZO(A)ANTHRACENE | 1 5 U | 1 6 U | 1 7 U | 380 U | 1 5 U | 1 6 U | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| BENZO(A)PYRENE | 1 5 U | 1 6 U | 1 7 U | 54 | 1 5 U | 1 6 U | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| BENZO(B)FLUORANTHENE | 1 5 U | 1 6 U | 1 7 U | 160 | 1 5 U | 20 | 1 8 U | 1 8 U | 12 | 14 |
| BENZO(G,H,I)PERYLENE | 1 5 U | 1 6 U | 1 7 U | 30 | 1 5 U | 10 | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | 80 U | 100 J | 230 J | 210 J | 76 UJ | 83 U | 91 U | 95 U | 80 U | 78 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB21 | 03SB22 | 03SB23 | 03SB24 | 03SB25 | 03SB26 | 03SB27 | 03SB28 | 03SB29 | 03SB30 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS210002 | 03SS220002 | 03SS230002 | 03SS240002 | 03SS250002 | 03SS260002 | 03SS270002 | 03SS280002 | 03SS290002 | 03SS300002 |
| SAMPLE | 03SS210002 | 03SS220002 | 03SS230002 | 03SS240002 | 03SS250002 | 03SS260002 | 03SS270002 | 03SS280002 | 03SS290002 | 03SS300002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 1 1 | 0 - 1 65 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| CHRYSENE | 1 5 U | 1 6 U | 1 7 U | 380 U | 1 5 U | 12 | 1 8 U | 1 8 U | 1 6 U | 1 5 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB21 | 03SB22 | 03SB23 | 03SB24 | 03SB25 | 03SB26 | 03SB27 | 03SB28 | 03SB29 | 03SB30 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS210002 | 03SS220002 | 03SS230002 | 03SS240002 | 03SS250002 | 03SS260002 | 03SS270002 | 03SS280002 | 03SS290002 | 03SS300002 |
| SAMPLE | 03SS210002 | 03SS220002 | 03SS230002 | 03SS240002 | 03SS250002 | 03SS260002 | 03SS270002 | 03SS280002 | 03SS290002 | 03SS300002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 1 1 | 0 - 1 65 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Semivolatile Organics (µg/kg) (Co** | | | | | | | | | | |
| DI-N-BUTYL PHTHALATE | 80 U | 82 U | 87 U | 77 UJ | 76 UJ | 980 | 91 U | 110 J | 80 U | 78 U |
| DI-N-OCTYL PHTHALATE | 80 U | 82 U | 87 U | 77 UJ | 270 J | 83 U | 91 U | 95 U | 80 U | 78 U |
| DIBENZO(A,H)ANTHRACENE | 1 5 U | 1 6 U | 1 7 U | 8 | 1 5 U | 1 6 U | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| FLUORANTHENE | 1 5 U | 1 6 U | 1 7 U | 250 | 1 5 U | 15 | 1 8 U | 1 8 U | 8 | 1 5 U |
| FLUORENE | 1 5 U | 1 6 U | 1 7 U | 15 | 1 5 U | 1 6 U | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| INDENO(1,2,3-CD)PYRENE | 1 5 U | 1 6 U | 1 7 U | 28 | 1 5 U | 1 6 U | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| NAPHTHALENE | 1 5 U | 1 6 U | 1 7 U | 130 | 1 5 U | 19 | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| PHENANTHRENE | 1 5 U | 1 6 U | 1 7 U | 320 | 1 5 U | 15 | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| PYRENE | 1 5 U | 1 6 UJ | 1 7 U | 250 | 1 5 UJ | 11 | 1 8 U | 1 8 U | 1 6 U | 1 5 U |
| **Energetics (mg/kg)** | | | | | | | | | | |
| 1,3,5-TRINITROBENZENE | 0 25 U | 0 72 | 0 25 U | 11 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 510 | 0 25 U | 1700 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 1 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 1 2 | 0 25 U | 30 J | 0 25 U | 0 77 | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-NITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 2 | 0 25 U | 15 J | 0 25 U | 1 | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 36 J | 77 | 0 25 U | 1600 J | 0 25 U | 58 | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| RDX | 0 25 U | 140 | 0 25 U | 2400 J | 0 25 U | 4 3 | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Herbicides (µg/kg)** | | | | | | | | | | |
| 2,4,5-T | | | | | | | | | 1 7 U | 1 6 U |
| 2,4-D | | | | | | | | | 7 5 J | 6 7 |
| DINOSEB | | | | | | | | | 11 | 8 R |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB21 | 03SB22 | 03SB23 | 03SB24 | 03SB25 | 03SB26 | 03SB27 | 03SB28 | 03SB29 | 03SB30 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS210002 | 03SS220002 | 03SS230002 | 03SS240002 | 03SS250002 | 03SS260002 | 03SS270002 | 03SS280002 | 03SS290002 | 03SS300002 |
| SAMPLE | 03SS210002 | 03SS220002 | 03SS230002 | 03SS240002 | 03SS250002 | 03SS260002 | 03SS270002 | 03SS280002 | 03SS290002 | 03SS300002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 1 1 | 0 - 1 65 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Inorganics (mg/kg)** | | | | | | | | | | |
| ALUMINUM | 6440 J | 12800 J | 7890 J | 14000 J | 6570 J | 7060 J | 14900 J | 10000 J | 6300 J | 6060 J |
| ANTIMONY | 0 48 U | 0 74 J | 1 5 U | 4 4 J | 0 48 U | 1 8 J | 1 1 U | 0 69 U | 0 49 J | 0 84 J |
| ARSENIC | 5 9 J | 4 5 J | 5 3 J | 8 5 J | 6 5 J | 6 8 J | 7 4 J | 7 3 J | 7 4 J | 8 J |
| BARIUM | 149 J | 118 J | 420 J | 150 J | 107 J | 565 J | 167 J | 313 J | 114 J | 105 J |
| BERYLLIUM | 0 82 J | 0 77 J | 0 48 | 0 33 J | 1 | 0 55 | 0 91 | 0 75 | 1 | 1 1 |
| CADMIUM | 0 42 | 0 83 | 1 1 | 4 4 | 0 48 | 1 2 | 2 4 | 0 82 | 1 2 | 0 46 |
| CALCIUM | 1680 J | 15400 J | 1700 J | 54500 J | 4240 J | 3860 J | 3050 J | 1750 J | 15700 J | 26100 J |
| CHROMIUM | 10 8 J | 15 6 J | 11 2 J | 12 2 J | 19 J | 12 4 J | 288 J | 52 4 J | 18 4 J | 22 J |
| COBALT | 14 6 J | 11 6 J | 10 6 | 7 4 J | 18 1 J | 13 8 | 13 6 | 13 7 | 17 3 J | 17 1 J |
| COPPER | 8 7 J | 23 1 J | 53 7 J | 34 5 J | 9 1 J | 46 6 J | 63 9 J | 41 7 J | 10 J | 9 3 J |
| IRON | 18600 J | 19700 J | 15500 J | 13500 J | 26900 J | 17100 J | 23800 J | 28400 J | 27800 J | 34300 J |
| LEAD | 16 2 J | 27 6 J | 54 7 J | 10200 J | 16 J | 66 J | 36 J | 22 6 J | 26 8 J | 20 9 J |
| MAGNESIUM | 556 J | 2890 J | 1160 J | 1740 J | 851 J | 948 J | 2620 J | 1330 J | 1790 J | 2860 J |
| MANGANESE | 1390 J | 788 J | 741 J | 292 J | 1530 J | 1150 J | 837 J | 1470 J | 1170 J | 1210 J |
| MERCURY | 0 031 J | 0 046 | 0 18 J | 0 066 | 0 021 J | 0 093 J | 0 17 J | 0 26 J | 0 04 | 0 03 |
| NICKEL | 14 8 J | 17 7 J | 12 9 J | 14 J | 19 2 J | 13 6 J | 24 1 J | 21 5 J | 23 2 J | 19 4 J |
| POTASSIUM | 434 J | 700 J | 696 J | 539 J | 409 J | 686 J | 1890 J | 908 J | 459 J | 414 J |
| SELENIUM | 0 3 J | 0 25 J | 0 32 | 0 17 J | 0 37 J | 0 33 | 0 42 | 0 3 | 0 42 | 0 25 |
| SILVER | 0 04 U | 0 15 U | 0 11 U | 0 62 J | 0 5 J | 0 05 U | 0 12 U | 0 07 U | 0 04 U | 0 08 U |
| SODIUM | 394 J | 88 9 U | 56 2 U | 89 6 U | 126 J | 49 U | 73 U | 69 7 U | 23 7 U | 21 U |
| THALLIUM | 0 11 | 0 12 | 0 11 | 0 07 | 0 11 | 0 11 | 0 21 | 0 17 | 0 11 | 0 11 |
| VANADIUM | 16 3 J | 22 4 J | 17 6 | 13 7 J | 22 2 J | 18 | 29 1 | 24 4 | 23 | 24 2 |
| ZINC | 37 4 J | 79 2 J | 189 J | 211 J | 36 7 J | 191 J | 145 J | 739 J | 55 7 J | 48 9 J |
| **Miscellaneous Parameters** | | | | | | | | | | |
| NITRATE mg/kg | 3 3 J | 6 4 | 2 6 | 49 | 20 | 3 6 | 2 9 | 3 2 | 2 4 | 1 7 |
| NITRITE mg/kg | 18 U | 11 U | 44 UJ | 11 U | 11 UJ | 24 UJ | 2 7 UJ | 14 UJ | 2 3 UJ | 2 3 UJ |
| NITRITE/NITRATE mg/kg | 3 3 J | 6 4 J | 2 6 J | 49 J | 20 J | 3 6 J | 2 9 J | 3 2 J | 2 4 | 1 7 |
| PERCENT MOISTURE % | 13 7 | 21 | 21 4 | 15 1 | 12 7 | 20 9 | 25 6 | 23 7 | 16 7 | 12 |
| PERCHLORATE µg/kg | 23 U | 470 J | 20 U | 210 J | 23 U | 20 U | 20 U | 20 U | 24 UJ | 23 UJ |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB31 | 03SB32 | 03SB33 | 03SB34 | 03SB35 | 03SB36 | 03SB37 | 03SB38 | 03SB39 | 03SB40 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS310002 | 03SS320002 | 03SS330002 | 03SS340002 | 03SS350002 | 03SS360002 | 03SS370002 | 03SS380002 | 03SS390002 | 03SS400002 |
| SAMPLE | 03SS310002 | 03SS320002 | 03SS330002 | 03SS340002 | 03SS350002 | 03SS360002 | 03SS370002 | 03SS380002 | 03SS390002 | 03SS400002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 1 1 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | 622 J | 209 J | 176 J | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDF | 0 67 BU | 1 8 BU | 0 57 BU | | | | | | | |
| 1,2,3,4,6,7,8-HPCDD | 8 2 J | 3 8 BJ | 3 2 BJ | | | | | | | |
| 1,2,3,4,6,7,8-HPCDF | 0 26 U | 0 71 BU | 0 4 BU | | | | | | | |
| 1,2,3,4,7,8,9-HPCDF | 0 1 U | 0 87 J | 0 4 U | | | | | | | |
| 1,2,3,4,7,8-HXCDD | 0 17 BU | 0 74 BU | 0 3 U | | | | | | | |
| 1,2,3,4,7,8-HXCDF | 0 14 BU | 0 55 U | 0 23 U | | | | | | | |
| 1,2,3,6,7,8-HXCDD | 0 1 U | 0 54 J | 0 3 U | | | | | | | |
| 1,2,3,6,7,8-HXCDF | 0 06 U | 0 48 J | 0 2 U | | | | | | | |
| 1,2,3,7,8,9-HXCDD | 0 32 BU | 0 76 BU | 0 35 U | | | | | | | |
| 1,2,3,7,8,9-HXCDF | 0 08 U | 0 65 U | 0 2 U | | | | | | | |
| 1,2,3,7,8-PECDD | 0 08 UJ | 0 45 J | 0 2 UJ | | | | | | | |
| 1,2,3,7,8-PECDF | 0 06 U | 0 2 U | 0 2 U | | | | | | | |
| 2,3,4,6,7,8-HXCDF | 0 07 U | 0 6 J | 0 13 U | | | | | | | |
| 2,3,4,7,8-PECDF | 0 06 U | 0 67 U | 0 2 U | | | | | | | |
| 2,3,7,8-TCDD | 0 08 U | 0 2 U | 0 2 U | | | | | | | |
| 2,3,7,8-TCDF | 0 06 U | 0 2 U | 0 73 J | | | | | | | |
| TEQ BIRD | 0 07 | 0 6 | 0 75 | | | | | | | |
| TEQ FISH | 0 07 | 0 6 | 0 057 | | | | | | | |
| TEQ HUMAN | 0 14 | 0 68 | 0 12 | | | | | | | |
| TOTAL HPCDD | 15 J | 6 9 U | 6 7 J | | | | | | | |
| TOTAL HPCDF | 0 68 U | 1 6 J | 0 64 U | | | | | | | |
| TOTAL HXCDD | 1 4 U | 2 | 1 7 U | | | | | | | |
| TOTAL HXCDF | 0 47 U | 2 3 U | 0 96 U | | | | | | | |
| TOTAL PECDD | 0 08 UJ | 0 45 J | 0 2 UJ | | | | | | | |
| TOTAL TCDD | 0 08 U | 0 2 U | 0 2 U | | | | | | | |
| **Volatile Organics (µg/kg)** | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | | | | | | | | | | |
| 2-HEXANONE | | | | | | | | | | |
| 4-METHYL-2-PENTANONE | | | | | | | | | | |
| TETRACHLOROETHENE | | | | | | | | | | |
| TOTAL XYLENES | | | | | | | | | | |
| TRICHLOROETHENE | | | | | | | | | | |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | |
| 1,4-PHENYLENEDIAMINE | 79 UR | 80 UR | 74 UR | 210 J | 80 U | 77 UR | 79 UJ | 82 UJ | 76 UR | 77 UR |
| 2-METHYLNAPHTHALENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| ACENAPHTHENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| ACENAPHTHYLENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| ANTHRACENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| BENZO(A)ANTHRACENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| BENZO(A)PYRENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| BENZO(B)FLUORANTHENE | 11 | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| BENZO(G,H,I)PERYLENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | 79 U | 80 U | 74 U | 76 U | 80 U | 77 U | 79 U | 82 U | 88 J | 77 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB31 | 03SB32 | 03SB33 | 03SB34 | 03SB35 | 03SB36 | 03SB37 | 03SB38 | 03SB39 | 03SB40 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS310002 | 03SS320002 | 03SS330002 | 03SS340002 | 03SS350002 | 03SS360002 | 03SS370002 | 03SS380002 | 03SS390002 | 03SS400002 |
| SAMPLE | 03SS310002 | 03SS320002 | 03SS330002 | 03SS340002 | 03SS350002 | 03SS360002 | 03SS370002 | 03SS380002 | 03SS390002 | 03SS400002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 1 1 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| CHRYSENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB31 | 03SB32 | 03SB33 | 03SB34 | 03SB35 | 03SB36 | 03SB37 | 03SB38 | 03SB39 | 03SB40 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS310002 | 03SS320002 | 03SS330002 | 03SS340002 | 03SS350002 | 03SS360002 | 03SS370002 | 03SS380002 | 03SS390002 | 03SS400002 |
| SAMPLE | 03SS310002 | 03SS320002 | 03SS330002 | 03SS340002 | 03SS350002 | 03SS360002 | 03SS370002 | 03SS380002 | 03SS390002 | 03SS400002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 1 1 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Semivolatile Organics (µg/kg) (Co** | | | | | | | | | | |
| DI-N-BUTYL PHTHALATE | 79 U | 80 U | 74 U | 76 U | 80 U | 77 U | 79 U | 82 U | 76 U | 77 U |
| DI-N-OCTYL PHTHALATE | 79 U | 80 U | 74 U | 76 UR | 80 U | 77 U | 79 U | 82 U | 76 U | 77 U |
| DIBENZO(A,H)ANTHRACENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| FLUORANTHENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| FLUORENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| INDENO(1,2,3-CD)PYRENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| NAPHTHALENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| PHENANTHRENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| PYRENE | 1 5 U | 1 5 U | 1 4 U | 1 3 UJ | 1 5 U | 1 5 U | 1 5 U | 1 6 U | 1 5 U | 1 5 U |
| **Energetics (mg/kg)** | | | | | | | | | | |
| 1,3,5-TRINITROBENZENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-NITROTOLUENE | 0 25 U | 0 25 U | 0 28 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 2 1 R | 0 25 U | 0 25 U |
| RDX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Herbicides (µg/kg)** | | | | | | | | | | |
| 2,4,5-T | 1 7 U | 6 4 | 1 6 U | | | | | | | |
| 2,4-D | 1 7 U | 8 3 J | 1 6 U | | | | | | | |
| DINOSEB | 1 7 U | 2 3 R | 1 6 U | | | | | | | |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB31 | 03SB32 | 03SB33 | 03SB34 | 03SB35 | 03SB36 | 03SB37 | 03SB38 | 03SB39 | 03SB40 |
|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS310002 | 03SS320002 | 03SS330002 | 03SS340002 | 03SS350002 | 03SS360002 | 03SS370002 | 03SS380002 | 03SS390002 | 03SS400002 |
| SAMPLE | 03SS310002 | 03SS320002 | 03SS330002 | 03SS340002 | 03SS350002 | 03SS360002 | 03SS370002 | 03SS380002 | 03SS390002 | 03SS400002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 1 1 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Inorganics (mg/kg)** | | | | | | | | | | |
| ALUMINUM | 8380 J | 5970 J | 2350 J | 7130 J | 7670 J | 7800 J | 9330 J | 8160 J | 6530 J | 6650 J |
| ANTIMONY | 0 35 U | 0 49 U | 0 35 U | 0 41 U | 2 3 J | 0 32 U | 0 58 U | 2 8 U | 0 29 U | 0 37 U |
| ARSENIC | 6 8 J | 5 5 J | 28 4 J | 5 8 J | 6 3 J | 5 1 | 5 8 | 4 4 | 6 | 5 3 |
| BARIUM | 66 2 J | 80 J | 81 3 J | 103 J | 178 J | 77 J | 95 6 J | 177 J | 132 J | 113 J |
| BERYLLIUM | 0 62 | 0 67 | 0 2 U | 1 2 | 1 | 0 45 | 0 77 | 0 58 | 0 79 | 0 73 |
| CADMIUM | 0 31 U | 0 4 | 0 56 | 0 5 | 1 2 | 0 35 | 0 32 U | 1 6 | 0 37 | 0 48 |
| CALCIUM | 22600 J | 3540 J | 244000 J | 14400 J | 2620 J | 18900 J | 1280 J | 2230 J | 10100 J | 16800 J |
| CHROMIUM | 21 2 J | 15 3 J | 11 9 J | 22 6 J | 33 5 J | 13 2 J | 10 4 J | 8 8 J | 11 2 J | 13 8 J |
| COBALT | 12 9 J | 12 J | 3 J | 19 9 J | 16 4 | 14 J | 15 J | 12 1 J | 18 9 J | 17 1 J |
| COPPER | 8 2 J | 7 9 J | 6 7 J | 10 2 J | 39 8 J | 8 J | 10 8 J | 54 6 J | 8 1 J | 9 8 J |
| IRON | 22800 J | 21100 J | 15300 J | 51600 J | 39600 J | 20600 J | 18100 J | 14500 J | 26900 J | 24200 J |
| LEAD | 20 8 J | 14 4 J | 9 2 J | 19 6 J | 60 3 J | 12 8 J | 15 5 J | 85 5 J | 16 3 J | 15 7 J |
| MAGNESIUM | 2260 J | 827 J | 15000 J | 858 J | 789 J | 2660 J | 1460 J | 1080 J | 1000 J | 1110 J |
| MANGANESE | 853 J | 1020 J | 321 J | 1490 J | 1290 J | 917 J | 379 J | 1210 J | 1760 J | 1490 J |
| MERCURY | 0 2 | 0 02 | 0 02 U | 0 023 J | 0 12 J | 0 027 J | 0 019 J | 0 14 J | 0 028 J | 0 028 J |
| NICKEL | 9 J | 12 5 J | 14 4 J | 27 3 J | 22 J | 10 J | 13 6 J | 13 7 J | 17 J | 16 J |
| POTASSIUM | 437 J | 411 J | 395 J | 502 J | 535 J | 626 J | 797 J | 514 J | 460 J | 487 J |
| SELENIUM | 0 18 U | 0 29 | 0 16 U | 0 22 J | 0 23 | 0 23 | 0 29 | 0 27 | 0 33 | 0 26 |
| SILVER | 0 4 U | 0 6 U | 0 04 U | 0 04 U | 0 8 U | 0 04 U | 0 05 U | 0 72 | 0 04 U | 0 04 U |
| SODIUM | 40 7 U | 61 6 U | 176 U | 146 J | 25 7 U | 183 U | 108 U | 139 U | 111 U | 237 U |
| THALLIUM | 0 12 | 0 1 | 0 05 | 0 1 | 0 19 | 0 1 | 0 1 | 0 09 | 0 11 | 0 11 |
| VANADIUM | 24 | 17 8 | 10 8 | 21 8 J | 28 9 | 14 3 J | 14 5 J | 12 7 J | 16 3 J | 16 3 J |
| ZINC | 27 1 J | 29 5 J | 48 2 J | 49 J | 120 J | 30 2 J | 33 7 J | 142 J | 34 4 J | 42 J |
| **Miscellaneous Parameters** | | | | | | | | | | |
| NITRATE mg/kg | 1 3 | 1 8 | 13 | 1 2 | 4 8 | 2 4 | 1 7 | 3 | 1 5 | 2 1 |
| NITRITE mg/kg | 2 3 UJ | 2 2 UJ | 2 2 UJ | 11 UJ | 12 UJ | 11 UR | 22 UJ | 28 UJ | 2 2 UR | 21 UR |
| NITRITE/NITRATE mg/kg | 1 3 | 1 8 | 13 | 1 2 J | 4 8 J | 2 4 J | 1 7 J | 3 J | 1 5 J | 2 1 J |
| PERCENT MOISTURE % | 12 | 15 6 | 6 9 | 10 7 | 15 6 | 13 3 | 15 2 | 19 3 | 11 | 13 |
| PERCHLORATE µg/kg | 23 UJ | 24 UJ | 21 UJ | 22 UJ | 24 UJ | 23 UJ | 24 UJ | 25 UJ | 22 UJ | 23 UJ |

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SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB41 | 03SB42 | 03SB43 | 03SB44 | 03SB45 | 03SB46 | 03SB47 | 03SB48 |
|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS410002 | 03SS420002 | 03SS430002 | 03SS440002 | 03SS450002 | 03SS460002 | 03SS470002 | 03SS480002 |
| SAMPLE | 03SS410002 | 03SS420002 | 03SS430002 | 03SS440002 | 03SS450002 | 03SS460002 | 03SS470002 | 03SS480002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | | | | | | | 3440 J | |
| 1,2,3,4,6,7,8,9-OCDF | | | | | | | 2 1 UJ | |
| 1,2,3,4,6,7,8-HPCDD | | | | | | | 26 9 | |
| 1,2,3,4,6,7,8-HPCDF | | | | | | | 2 1 J | |
| 1,2,3,4,7,8,9-HPCDF | | | | | | | 0 2 U | |
| 1,2,3,4,7,8-HXCDD | | | | | | | 0 58 J | |
| 1,2,3,4,7,8-HXCDF | | | | | | | 0 74 BU | |
| 1,2,3,6,7,8-HXCDD | | | | | | | 0 76 U | |
| 1,2,3,6,7,8-HXCDF | | | | | | | 0 37 J | |
| 1,2,3,7,8,9-HXCDD | | | | | | | 1 8 J | |
| 1,2,3,7,8,9-HXCDF | | | | | | | 0 1 U | |
| 1,2,3,7,8-PECDD | | | | | | | 0 4 J | |
| 1,2,3,7,8-PECDF | | | | | | | 0 37 J | |
| 2,3,4,6,7,8-HXCDF | | | | | | | 0 43 J | |
| 2,3,4,7,8-PECDF | | | | | | | 0 39 J | |
| 2,3,7,8-TCDD | | | | | | | 0 24 J | |
| 2,3,7,8-TCDF | | | | | | | 0 78 J | |
| TEQ BIRD | | | | | | | 2 5 | |
| TEQ FISH | | | | | | | 1 7 | |
| TEQ HUMAN | | | | | | | 1 9 | |
| TOTAL HPCDD | | | | | | | 58 3 | |
| TOTAL HPCDF | | | | | | | 3 1 U | |
| TOTAL HXCDD | | | | | | | 10 4 U | |
| TOTAL HXCDF | | | | | | | 3 2 | |
| TOTAL PECDD | | | | | | | 3 4 U | |
| TOTAL TCDD | | | | | | | 0 84 U | |
| **Volatile Organics (µg/kg)** | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | | | | | | 2 1 U | 11 U | 0 94 U |
| 2-HEXANONE | | | | | | 5 J | 11 U | 0 94 U |
| 4-METHYL-2-PENTANONE | | | | | | 4 J | 11 U | 0 94 U |
| TETRACHLOROETHENE | | | | | | 2 1 U | 11 U | 0 94 UJ |
| TOTAL XYLENES | | | | | | 2 1 U | 82 | 0 94 UJ |
| TRICHLOROETHENE | | | | | | 2 1 U | 11 U | 3 J |
| **Semivolatile Organics (µg/kg)** | | | | | | | | |
| 1,4-PHENYLENEDIAMINE | 86 U | 76 UR | 98 U | 76 UJ | 94 U | 74 UJ | 76 UJ | 78 UJ |
| 2-METHYLNAPHTHALENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| ACENAPHTHENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| ACENAPHTHYLENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| ANTHRACENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| BENZO(A)ANTHRACENE | 1 7 U | 1 5 U | 1 9 U | 8 | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| BENZO(A)PYRENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| BENZO(B)FLUORANTHENE | 1 7 U | 1 5 U | 1 9 U | 30 | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| BENZO(G,H,I)PERYLENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | 390 J | 76 U | 98 U | 76 U | 94 U | 74 U | 76 U | 78 U |

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SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB41 | 03SB42 | 03SB43 | 03SB44 | 03SB45 | 03SB46 | 03SB47 | 03SB48 |
|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS410002 | 03SS420002 | 03SS430002 | 03SS440002 | 03SS450002 | 03SS460002 | 03SS470002 | 03SS480002 |
| SAMPLE | 03SS410002 | 03SS420002 | 03SS430002 | 03SS440002 | 03SS450002 | 03SS460002 | 03SS470002 | 03SS480002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y |
| CHRYSENE | 17 U | 15 U | 19 U | 12 | 18 U | 14 U | 15 U | 15 U |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB41 | 03SB42 | 03SB43 | 03SB44 | 03SB45 | 03SB46 | 03SB47 | 03SB48 |
|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS410002 | 03SS420002 | 03SS430002 | 03SS440002 | 03SS450002 | 03SS460002 | 03SS470002 | 03SS480002 |
| SAMPLE | 03SS410002 | 03SS420002 | 03SS430002 | 03SS440002 | 03SS450002 | 03SS460002 | 03SS470002 | 03SS480002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y |
| **Semivolatile Organics (µg/kg) (Cc** | | | | | | | | |
| DI-N-BUTYL PHTHALATE | 86 U | 76 U | 98 U | 76 U | 510 | 74 U | 76 U | 78 U |
| DI-N-OCTYL PHTHALATE | 86 U | 76 U | 98 U | 76 UR | 94 U | 74 UR | 76 UR | 78 UR |
| DIBENZO(A,H)ANTHRACENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| FLUORANTHENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 13 | 1 4 U | 1 5 U | 1 5 U |
| FLUORENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| INDENO(1,2,3-CD)PYRENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| NAPHTHALENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| PHENANTHRENE | 1 7 U | 1 5 U | 1 9 U | 1 5 U | 1 8 U | 1 4 U | 1 5 U | 1 5 U |
| PYRENE | 1 7 U | 1 5 U | 1 9 U | 8 | 13 | 1 4 U | 1 5 U | 1 5 UJ |
| **Energetics (mg/kg)** | | | | | | | | |
| 1,3,5-TRINITROBENZENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-NITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 51 | 0 25 U | 0 25 U | 0 25 U |
| RDX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Herbicides (µg/kg)** | | | | | | | | |
| 2,4,5-T | | | | | | | | |
| 2,4-D | | | | | | | | |
| DINOSEB | | | | | | | | |

TABLE 4-1

SUMMARY OF CHEMICALS DETECTED IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB41 | 03SB42 | 03SB43 | 03SB44 | 03SB45 | 03SB46 | 03SB47 | 03SB48 |
|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SS410002 | 03SS420002 | 03SS430002 | 03SS440002 | 03SS450002 | 03SS460002 | 03SS470002 | 03SS480002 |
| SAMPLE | 03SS410002 | 03SS420002 | 03SS430002 | 03SS440002 | 03SS450002 | 03SS460002 | 03SS470002 | 03SS480002 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SS | SS | SS | SS | SS | SS | SS | SS |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH_RANGE | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y |
| **Inorganics (mg/kg)** | | | | | | | | |
| ALUMINUM | 7270 J | 6870 J | 8410 J | 6260 J | 7940 J | 5380 J | 5700 J | 5740 J |
| ANTIMONY | 1 3 U | 0 44 U | 0 58 U | 0 34 U | 2 J | 0 45 U | 0 53 U | 0 46 U |
| ARSENIC | 5 6 J | 4 6 | 4 4 U | 4 5 J | 5 7 J | 6 4 J | 8 4 J | 4 4 J |
| BARIUM | 429 J | 118 J | 75 7 J | 108 J | 311 J | 72 2 J | 112 J | 2040 J |
| BERYLLIUM | 0 52 | 0 8 | 0 54 | 0 62 | 0 55 | 1 1 | 0 91 | 0 55 |
| CADMIUM | 1 3 | 0 38 | 0 56 | 0 59 | 1 5 | 0 4 | 0 78 | 0 58 |
| CALCIUM | 2420 J | 8790 J | 7710 J | 76500 J | 2860 J | 3870 J | 1180 J | 15400 J |
| CHROMIUM | 10 8 J | 11 8 J | 12 6 J | 11 8 J | 10 2 J | 28 8 J | 19 9 J | 23 J |
| COBALT | 12 6 | 17 5 J | 6 9 | 13 5 J | 11 8 | 17 2 J | 15 2 J | 6 7 J |
| COPPER | 62 J | 8 9 J | 13 7 J | 12 J | 54 9 J | 18 J | 23 5 J | 14 4 J |
| IRON | 15200 J | 26800 J | 12800 J | 20200 J | 14300 J | 49700 J | 30400 J | 28800 J |
| LEAD | 83 5 J | 14 8 J | 20 6 J | 61 1 J | 63 3 J | 17 3 J | 16 J | 124 J |
| MAGNESIUM | 1030 J | 1240 J | 1850 J | 4120 J | 935 J | 567 J | 634 J | 1420 J |
| MANGANESE | 1160 J | 1500 J | 451 J | 1270 J | 1020 J | 1120 J | 1210 J | 423 J |
| MERCURY | 0 13 J | 0 026 J | 0 03 J | 0 028 J | 0 16 J | 0 017 J | 0 022 J | 0 075 J |
| NICKEL | 13 5 J | 14 1 J | 12 8 J | 15 3 J | 14 5 J | 22 4 J | 19 J | 25 5 J |
| POTASSIUM | 626 J | 475 J | 923 J | 640 J | 671 J | 409 J | 398 J | 784 J |
| SELENIUM | 0 35 | 0 3 | 0 28 | 0 26 J | 0 34 | 0 17 J | 0 24 J | 0 17 J |
| SILVER | 0 13 U | 0 33 | 0 38 U | 0 04 U | 0 26 U | 0 32 J | 0 04 U | 0 04 U |
| SODIUM | 46 8 U | 169 U | 48 9 U | 197 J | 51 3 U | 102 J | 87 1 J | 108 J |
| THALLIUM | 0 1 | 0 11 | 0 11 | 0 09 | 0 1 | 0 08 | 0 09 | 0 06 |
| VANADIUM | 16 | 16 3 J | 16 8 | 14 4 J | 15 4 | 26 5 J | 22 9 J | 14 4 J |
| ZINC | 230 J | 36 2 J | 44 8 J | 51 2 J | 211 J | 62 9 J | 43 9 J | 79 7 J |
| **Miscellaneous Parameters** | | | | | | | | |
| NITRATE mg/kg | 4 4 | 1 9 | 7 9 | 2 7 | 4 4 | 1 5 | 2 8 | 2 7 |
| NITRITE mg/kg | 21 UJ | 11 UR | 14 UJ | 11 UJ | 15 UJ | 12 UJ | 11 UJ | 2 3 UJ |
| NITRITE/NITRATE mg/kg | 4 4 J | 1 9 J | 7 9 J | 2 7 J | 4 4 J | 1 5 J | 2 8 J | 2 7 J |
| PERCENT MOISTURE % | 20 3 | 11 9 | 19 7 | 12 1 | 19 2 | 9 9 | 10 2 | 18 4 |
| PERCHLORATE µg/kg | 25 UJ | 23 UJ | 25 UJ | 23 UJ | 25 UJ | 20 U | 22 U | 20 U |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB02 | 03SB02 | 03SB04 | 03SB04 | 03SB05 | 03SB05 | 03SB06 | 03SB06 | 03SB07 | 03SB07 | 03SB08 | 03SB08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB020206 | 03SB020610 | 03SB040206 | 03SB040610 | 03SB050206 | 03SB050610 | 03SB060206 | 03SB060610 | 03SB070206 | 03SB070610 | 03SB080206 | 03SB080610 |
| SAMPLE | 03SB020206 | 03SB020610 | 03SB040206 | 03SB040610 | 03SB050206 | 03SB050610 | 03SB060206 | 03SB060610 | 03SB070206 | 03SB070610 | 03SB080206 | 03SB080610 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL |
| DEPTH RANGE | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | | | | | | | | | | | | |
| 1,2,3,4,6,7,8-HPCDD | | | | | | | | | | | | |
| 1,2,3,6,7,8-HXCDD | | | | | | | | | | | | |
| TEQ BIRD | | | | | | | | | | | | |
| TEQ FISH | | | | | | | | | | | | |
| TEQ HUMAN | | | | | | | | | | | | |
| TOTAL HPCDD | | | | | | | | | | | | |
| TOTAL PECDD | | | | | | | | | | | | |
| **Volatile Organics (µg/kg)** | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | | | | | | | | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | | | | | | | | | | | | |
| 2-HEXANONE | | | | | | | | | | | | |
| 4-METHYL-2-PENTANONE | | | | | | | | | | | | |
| CIS-1,2-DICHLOROETHENE | | | | | | | | | | | | |
| TRICHLOROETHENE | | | | | | | | | | | | |
| TRICHLOROFLUOROMETHANE | | | | | | | | | | | | |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | |
| 2-METHYLNAPHTHALENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| 2-METHYLPHENOL | 77 U | 74 U | 74 U | 74 UJ | 82 UJ | 74 U | 77 UJ | 75 U | 76 UJ | 74 U | 82 U | 77 U |
| 3&4-METHYLPHENOL | 77 U | 74 U | 74 U | 74 UJ | 82 UJ | 74 U | 77 UJ | 75 U | 76 UJ | 74 U | 82 U | 77 UJ |
| ACENAPHTHENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| ACENAPHTHYLENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| ACETOPHENONE | 77 U | 74 U | 74 U | 74 U | 82 UJ | 74 U | 77 U | 75 U | 76 U | 74 U | 82 U | 77 U |
| ANTHRACENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| BENZO(A)ANTHRACENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| BENZO(A)PYRENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| BENZO(B)FLUORANTHENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| BENZO(G,H,I)PERYLENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| BENZO(K)FLUORANTHENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | 77 U | 74 U | 74 U | 74 U | 82 UJ | 74 U | 77 UR | 75 U | 76 U | 3300 J | 82 U | 77 U |
| CHRYSENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| DI-N-BUTYL PHTHALATE | 77 U | 74 U | 74 U | 74 U | 82 UJ | 74 U | 77 UR | 75 U | 76 U | 74 U | 82 U | 77 U |
| DI-N-OCTYL PHTHALATE | 77 U | 74 U | 74 U | 74 U | 82 UJ | 74 U | 77 U | 75 U | 76 U | 110 J | 82 U | 77 U |
| FLUORANTHENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| FLUORENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| INDENO(1,2,3-CD)PYRENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| NAPHTHALENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| PHENANTHRENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |
| PHENOL | 77 U | 74 U | 74 U | 74 U | 82 UJ | 74 U | 77 U | 75 U | 76 U | 74 U | 82 U | 77 U |
| PYRENE | 1 49 U | 1 44 U | 1 44 U | 1 44 U | 1 59 U | 1 43 U | 1 49 U | 1 46 U | 1 48 U | 1 43 U | 1 55 U | 1 49 U |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB02 | 03SB02 | 03SB04 | 03SB04 | 03SB05 | 03SB05 | 03SB06 | 03SB06 | 03SB07 | 03SB07 | 03SB08 | 03SB08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB020206 | 03SB020610 | 03SB040206 | 03SB040610 | 03SB050206 | 03SB050610 | 03SB060206 | 03SB060610 | 03SB070206 | 03SB070610 | 03SB080206 | 03SB080610 |
| SAMPLE | 03SB020206 | 03SB020610 | 03SB040206 | 03SB040610 | 03SB050206 | 03SB050610 | 03SB060206 | 03SB060610 | 03SB070206 | 03SB070610 | 03SB080206 | 03SB080610 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL |
| DEPTH RANGE | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Energetics (mg/kg)** | | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| RDX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Inorganics (mg/kg)** | | | | | | | | | | | | |
| ALUMINUM | | | | | | | | | | | | |
| ANTIMONY | | | | | | | | | | | | |
| ARSENIC | | | | | | | | | | | | |
| BARIUM | | | | | | | | | | | | |
| BERYLLIUM | | | | | | | | | | | | |
| CADMIUM | | | | | | | | | | | | |
| CALCIUM | | | | | | | | | | | | |
| CHROMIUM | | | | | | | | | | | | |
| COBALT | | | | | | | | | | | | |
| COPPER | | | | | | | | | | | | |
| IRON | | | | | | | | | | | | |
| LEAD | | | | | | | | | | | | |
| MAGNESIUM | | | | | | | | | | | | |
| MANGANESE | | | | | | | | | | | | |
| MERCURY | | | | | | | | | | | | |
| NICKEL | | | | | | | | | | | | |
| POTASSIUM | | | | | | | | | | | | |
| SELENIUM | | | | | | | | | | | | |
| SILVER | | | | | | | | | | | | |
| SODIUM | | | | | | | | | | | | |
| THALLIUM | | | | | | | | | | | | |
| TIN | | | | | | | | | | | | |
| VANADIUM | | | | | | | | | | | | |
| ZINC | | | | | | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | | | | | | |
| NITRATE mg/kg | 2 1 | 2 1 | 1 9 | 1 9 | 2 3 | 1 9 | 1 7 | 2 3 | 4 3 | 1 1 UJ | 3 3 | 1 8 |
| NITRITE mg/kg | 13 UJ | 10 UJ | 2 2 UJ | 2 2 UJ | 12 UR | 12 UR | 2 2 UJ | 2 1 UJ | 14 UJ | 2 9 J | 4 UJ | 11 UR |
| NITRITE/NITRATE mg/kg | 2 1 J | 2 1 J | 1 9 J | 1 9 J | 2 3 J | 1 9 J | 1 7 J | 2 3 J | 4 3 J | 3 3 J | 3 3 J | 1 8 J |
| PERCENT MOISTURE % | 13 6 | 8 4 | 9 6 | 9 5 | 16 2 | 8 9 | 12 6 | 11 4 | 11 1 | 9 4 | 15 3 | 12 2 |
| PERCHLORATE µg/kg | 23 UJ | 22 UJ | 22 UJ | 22 UJ | 24 UJ | 22 UJ | 23 UJ | 23 UJ | 23 UJ | 22 UJ | 24 UJ | 23 UJ |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB09 | 03SB10 | 03SB10 | 03SB11 | 03SB11 | 03SB13 | 03SB13 | 03SB14 | 03SB14 | 03SB15 | 03SB15 | 03SB16 | 03SB16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB090204 | 03SB100206 | 03SB100610 | 03SB110206 | 03SB110610 | 03SB130206 | 03SB130610 | 03SB140206 | 03SB140610 | 03SB150206 | 03SB150610 | 03SB160206 | 03SB160610 |
| SAMPLE | 03SB090204 | 03SB100206 | 03SB100610 | 03SB110206 | 03SB110610 | 03SB130206 | 03SB130610 | 03SB140206 | 03SB140610 | 03SB150206 | 03SB150610 | 03SB160206 | 03SB160610 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 2 - 4 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | | | | | | | | | | | | | |
| 1,2,3,4,6,7,8-HPCDD | | | | | | | | | | | | | |
| 1,2,3,6,7,8-HXCDD | | | | | | | | | | | | | |
| TEQ BIRD | | | | | | | | | | | | | |
| TEQ FISH | | | | | | | | | | | | | |
| TEQ HUMAN | | | | | | | | | | | | | |
| TOTAL HPCDD | | | | | | | | | | | | | |
| TOTAL PECDD | | | | | | | | | | | | | |
| **Volatile Organics (µg/kg)** | | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | | | | | | | | | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | | | | | | | | | | | | | |
| 2-HEXANONE | | | | | | | | | | | | | |
| 4-METHYL-2-PENTANONE | | | | | | | | | | | | | |
| CIS-1,2-DICHLOROETHENE | | | | | | | | | | | | | |
| TRICHLOROETHENE | | | | | | | | | | | | | |
| TRICHLOROFLUOROMETHANE | | | | | | | | | | | | | |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | | |
| 2-METHYLNAPHTHALENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| 2-METHYLPHENOL | 67 U | 75 UJ | 75 U | 74 U | 74 U | 77 U | 78 UJ | 76 UJ | 76 UJ | 78 UJ | 77 U | 76 U | 77 U |
| 3&4-METHYLPHENOL | 67 U | 75 UJ | 75 U | 74 U | 74 U | 77 U | 78 UJ | 76 UJ | 76 UJ | 78 UJ | 77 U | 76 U | 77 U |
| ACENAPHTHENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| ACENAPHTHYLENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| ACETOPHENONE | 67 U | 75 U | 75 U | 74 U | 74 U | 77 U | 78 U | 76 UJ | 76 U | 78 U | 77 U | 76 U | 77 U |
| ANTHRACENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| BENZO(A)ANTHRACENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 9 | 1 49 U |
| BENZO(A)PYRENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 11 | 1 49 U |
| BENZO(B)FLUORANTHENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 14 | 1 49 U |
| BENZO(G,H,I)PERYLENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| BENZO(K)FLUORANTHENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | 67 U | 75 U | 75 U | 74 U | 74 U | 77 U | 78 U | 76 UJ | 79 J | 87 U | 77 U | 76 U | 77 U |
| CHRYSENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 16 | 1 49 U |
| DI-N-BUTYL PHTHALATE | 67 U | 75 U | 75 U | 74 U | 74 U | 77 U | 78 U | 76 UJ | 76 U | 78 U | 77 U | 170 J | 77 U |
| DI-N-OCTYL PHTHALATE | 67 U | 75 UJ | 75 UJ | 74 U | 74 U | 77 U | 78 U | 76 UR | 76 UR | 78 U | 77 U | 76 U | 77 U |
| FLUORANTHENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| FLUORENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| INDENO(1,2,3-CD)PYRENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| NAPHTHALENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| PHENANTHRENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 1 48 U | 1 49 U |
| PHENOL | 67 U | 75 UJ | 75 U | 74 U | 74 U | 77 U | 78 U | 76 UJ | 76 UJ | 78 UJ | 77 U | 76 U | 77 U |
| PYRENE | 1 3 U | 1 46 U | 1 46 U | 1 44 U | 1 43 U | 1 49 U | 1 51 U | 1 5 U | 1 5 UJ | 1 51 U | 1 49 U | 14 | 1 49 U |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB09 | 03SB10 | 03SB10 | 03SB11 | 03SB11 | 03SB13 | 03SB13 | 03SB14 | 03SB14 | 03SB15 | 03SB15 | 03SB16 | 03SB16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB090204 | 03SB100206 | 03SB100610 | 03SB110206 | 03SB110610 | 03SB130206 | 03SB130610 | 03SB140206 | 03SB140610 | 03SB150206 | 03SB150610 | 03SB160206 | 03SB160610 |
| SAMPLE | 03SB090204 | 03SB100206 | 03SB100610 | 03SB110206 | 03SB110610 | 03SB130206 | 03SB130610 | 03SB140206 | 03SB140610 | 03SB150206 | 03SB150610 | 03SB160206 | 03SB160610 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 2 - 4 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Energetics (mg/kg)** | | | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 97 | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 1 1 | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 55 | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| RDX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Inorganics (mg/kg)** | | | | | | | | | | | | | |
| ALUMINUM | | | | | | | | | | | | | |
| ANTIMONY | | | | | | | | | | | | | |
| ARSENIC | | | | | | | | | | | | | |
| BARIUM | | | | | | | | | | | | | |
| BERYLLIUM | | | | | | | | | | | | | |
| CADMIUM | | | | | | | | | | | | | |
| CALCIUM | | | | | | | | | | | | | |
| CHROMIUM | | | | | | | | | | | | | |
| COBALT | | | | | | | | | | | | | |
| COPPER | | | | | | | | | | | | | |
| IRON | | | | | | | | | | | | | |
| LEAD | | | | | | | | | | | | | |
| MAGNESIUM | | | | | | | | | | | | | |
| MANGANESE | | | | | | | | | | | | | |
| MERCURY | | | | | | | | | | | | | |
| NICKEL | | | | | | | | | | | | | |
| POTASSIUM | | | | | | | | | | | | | |
| SELENIUM | | | | | | | | | | | | | |
| SILVER | | | | | | | | | | | | | |
| SODIUM | | | | | | | | | | | | | |
| THALLIUM | | | | | | | | | | | | | |
| TIN | | | | | | | | | | | | | |
| VANADIUM | | | | | | | | | | | | | |
| ZINC | | | | | | | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | | | | | | | |
| NITRATE mg/kg | 1 2 | 2 5 | 2 | 2 6 | 1 1 UJ | 6 1 | 2 7 | 1 6 | 1 7 | 6 7 | 4 5 | 2 | 2 3 |
| NITRITE mg/kg | 11 UJ | 12 UR | 4 3 UR | 11 UJ | 3 7 J | 7 8 UR | 2 3 J | 10 UJ | 35 UJ | 11 UR | 11 UR | 11 UR | 44 UR |
| NITRITE/NITRATE mg/ikg | 1 2 J | 2 5 J | 2 J | 2 6 J | 4 3 J | 6 1 J | 5 J | 1 6 J | 1 7 J | 6 7 J | 4 5 J | 2 J | 2 3 J |
| PERCENT MOISTURE % | 8 9 | 10 3 | 10 9 | 8 9 | 8 6 | 12 8 | 13 8 | 11 7 | 11 7 | 13 7 | 12 5 | 9 3 | 12 5 |
| PERCHLORATE µg/kg | 22 UJ | 22 UJ | 22 UJ | 22 UJ | 22 UJ | 23 UJ | 23 UJ | 23 UJ | 23 UJ | 23 UJ | 23 UJ | 22 UJ | 32 J |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB17 | 03SB17 | 03SB18 | 03SB19 | 03SB19 | 03SB20 | 03SB20 | 03SB21 | 03SB21 | 03SB22 | 03SB22 | 03SB23 | 03SB24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB170406 | 03SB171214 | 03SB180204 | 03SB190204 | 03SB191215 | 03SB200810 | 03SB201215 | 03SB211012 | 03SB211215 | 03SB220204 | 03SB221215 | 03SB230610 | 03SB240406 |
| SAMPLE | 03SB170406 | 03SB171214 | 03SB180204 | 03SB190204 | 03SB191215 | 03SB200810 | 03SB201215 | 03SB211012 | 03SB211215 | 03SB220204 | 03SB221215 | 03SB230610 | 03SB240406 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 4 - 6 | 12 - 14 | 2 - 4 | 2 - 4 | 12 - 15 | 8 - 10 | 12 - 15 | 10 - 12 | 12 - 15 | 2 - 4 | 12 - 15 | 6 - 10 | 4 - 6 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | | | | | 174 J | | | | | | | | |
| 1,2,3,4,6,7,8-HPCDD | | | | | 1 2 J | | | | | | | | |
| 1,2,3,6,7,8-HXCDD | | | | | 0 1 U | | | | | | | | |
| TEQ BIRD | | | | | 0 019 | | | | | | | | |
| TEQ FISH | | | | | 0 019 | | | | | | | | |
| TEQ HUMAN | | | | | 0 029 | | | | | | | | |
| TOTAL HPCDD | | | | | 2 5 U | | | | | | | | |
| TOTAL PECDD | | | | | 0 27 | | | | | | | | |
| **Volatile Organics (µg/kg)** | | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 12 U | 17 J | 9 8 U | 4 9 U | 0 9 U | 1 UJ | 4 8 U | 12 U | 1 U | 12 U | 5 4 U | 2 J | 10 U |
| 1,1,2,2-TETRACHLOROETHANE | 12 U | 9 2 U | 9 8 U | 4 9 U | 0 9 U | 1 U | 4 8 U | 12 U | 1 U | 12 U | 5 4 U | 1 5 U | 10 U |
| 2-HEXANONE | 12 U | 10 J | 9 8 U | 4 9 UJ | 0 9 UJ | 1 UJ | 4 8 U | 12 U | 1 U | 13 J | 5 4 U | 1 5 U | 10 U |
| 4-METHYL-2-PENTANONE | 12 U | 9 2 U | 9 8 U | 4 9 UJ | 0 9 UJ | 1 U | 4 8 U | 12 U | 1 U | 12 U | 5 4 U | 1 5 U | 10 U |
| CIS-1,2-DICHLOROETHENE | 12 U | 9 2 U | 9 8 U | 4 9 U | 0 9 U | 1 U | 4 8 U | 12 U | 1 U | 12 U | 5 4 U | 1 5 U | 10 U |
| TRICHLOROETHENE | 12 U | 9 2 U | 9 8 U | 4 9 U | 0 9 U | 1 U | 4 8 U | 12 U | 1 U | 12 U | 5 4 U | 1 5 U | 10 U |
| TRICHLOROFLUOROMETHANE | 12 U | 9 2 U | 9 8 U | 4 9 U | 0 9 UJ | 1 U | 4 8 U | 12 U | 5 | 12 U | 5 4 U | 1 5 U | 10 U |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | | |
| 2-METHYLNAPHTHALENE | 1 5 U | 1 4 U | 56 | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 140 | 28 | 1 8 U | 260 |
| 2-METHYLPHENOL | 80 U | 74 U | 79 U | 73 U | 76 U | 80 U | 77 U | 77 U | 75 U | 83 J | 79 U | 92 U | 80 U |
| 3&4-METHYLPHENOL | 80 U | 74 U | 79 U | 73 U | 76 U | 80 U | 77 U | 77 U | 75 U | 130 J | 79 U | 92 U | 80 U |
| ACENAPHTHENE | 1 5 U | 1 4 U | 6 1 U | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 15 |
| ACENAPHTHYLENE | 1 5 U | 1 4 U | 6 1 U | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 20 |
| ACETOPHENONE | 80 U | 74 U | 79 U | 73 U | 76 U | 80 U | 77 U | 77 U | 75 U | 81 J | 79 U | 92 U | 120 J |
| ANTHRACENE | 1 5 U | 1 4 U | 6 1 U | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 25 | 12 |
| BENZO(A)ANTHRACENE | 1 5 U | 1 4 U | 72 | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 1 6 U |
| BENZO(A)PYRENE | 1 5 U | 1 4 U | 110 | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 1 6 U |
| BENZO(B)FLUORANTHENE | 1 5 U | 1 4 U | 290 | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 1 6 U |
| BENZO(G,H,I)PERYLENE | 1 5 U | 1 4 U | 100 | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 1 6 U |
| BENZO(K)FLUORANTHENE | 1 5 U | 1 4 U | 6 1 U | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 32 | 1 5 U | 1 8 U | 1 6 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | 80 U | 74 U | 260 J | 91 J | 76 UJ | 80 U | 77 U | 77 U | 75 U | 410 | 110 J | 92 U | 80 U |
| CHRYSENE | 1 5 U | 1 4 U | 140 | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 1 6 U |
| DI-N-BUTYL PHTHALATE | 80 U | 74 U | 2300 | 320 J | 76 U | 80 U | 77 U | 77 U | 75 U | 100 J | 79 U | 92 U | 80 U |
| DI-N-OCTYL PHTHALATE | 80 U | 74 U | 79 U | 73 U | 76 U | 80 U | 77 U | 77 U | 75 U | 80 U | 79 U | 92 U | 80 U |
| FLUORANTHENE | 1 5 U | 1 4 U | 100 | 29 | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 24 |
| FLUORENE | 1 5 U | 1 4 U | 6 1 U | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 19 |
| INDENO(1,2,3-CD)PYRENE | 1 5 U | 1 4 U | 77 J | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 6 3 U | 1 5 U | 1 8 U | 1 6 U |
| NAPHTHALENE | 1 5 U | 1 4 U | 110 | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 180 | 23 | 1 8 U | 270 |
| PHENANTHRENE | 1 5 U | 1 4 U | 85 | 5 7 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 45 | 1 5 U | 1 8 U | 57 |
| PHENOL | 80 U | 74 U | 79 U | 73 U | 76 U | 80 U | 77 U | 77 U | 75 U | 80 U | 79 U | 92 U | 100 J |
| PYRENE | 1 5 U | 1 4 U | 150 | 33 J | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 43 | 1 5 U | 1 8 U | 27 |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB17 | 03SB17 | 03SB18 | 03SB19 | 03SB19 | 03SB20 | 03SB20 | 03SB21 | 03SB21 | 03SB22 | 03SB22 | 03SB23 | 03SB24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB170406 | 03SB171214 | 03SB180204 | 03SB190204 | 03SB191215 | 03SB200810 | 03SB201215 | 03SB211012 | 03SB211215 | 03SB220204 | 03SB221215 | 03SB230610 | 03SB240406 |
| SAMPLE | 03SB170406 | 03SB171214 | 03SB180204 | 03SB190204 | 03SB191215 | 03SB200810 | 03SB201215 | 03SB211012 | 03SB211215 | 03SB220204 | 03SB221215 | 03SB230610 | 03SB240406 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 4 - 6 | 12 - 14 | 2 - 4 | 2 - 4 | 12 - 15 | 8 - 10 | 12 - 15 | 10 - 12 | 12 - 15 | 2 - 4 | 12 - 15 | 6 - 10 | 4 - 6 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Energetics (mg/kg)** | | | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 2 1 | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 76 |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 63 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 1 7 | 0 83 | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 1 1 | 0 65 | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 99 | 5 8 | 0 63 | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 53 R | 3 9 | 0 25 U | 3 4 R |
| RDX | 0 25 U | 0 25 U | 3 9 | 0 92 | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 2 1 | 0 25 U | 1 4 J |
| **Inorganics (mg/kg)** | | | | | | | | | | | | | |
| ALUMINUM | 6820 J | 2900 J | 8640 J | 7760 J | 3370 J | 7020 J | 2650 J | 1400 J | 2290 J | 7390 J | 3290 J | 8390 J | 9880 J |
| ANTIMONY | 0 25 U | 0 37 U | 1 4 U | 0 38 U | 0 27 U | 0 22 U | 0 19 U | 0 08 UJ | 0 18 U | 4 6 J | 0 64 J | 3 5 U | 3 2 J |
| ARSENIC | 3 8 J | 8 1 J | 4 5 J | 2 4 J | 2 8 J | 2 5 J | 3 1 J | 0 53 J | 2 J | 4 1 J | 4 2 J | 4 6 J | 7 6 J |
| BARIUM | 151 J | 38 7 J | 95 2 J | 100 J | 39 3 J | 135 J | 42 4 J | 10 8 J | 20 3 J | 69 5 J | 58 3 J | 933 J | 1340 J |
| BERYLLIUM | 0 62 J | 0 29 J | 0 63 | 0 44 J | 0 29 J | 0 84 J | 0 4 J | 0 11 J | 0 24 J | 0 35 | 0 36 J | 0 62 | 0 4 J |
| CADMIUM | 0 53 | 0 28 U | 3 6 | 3 1 | 0 37 | 0 4 | 0 28 U | 0 28 U | 0 29 U | 8 6 | 0 75 | 1 2 | 12 1 |
| CALCIUM | 1940 J | 1680 J | 113000 J | 74700 J | 3180 J | 22800 | 1990 J | 226 J | 274 J | 57500 J | 2300 J | 2240 J | 39300 J |
| CHROMIUM | 9 5 J | 10 1 J | 21 8 J | 6 3 J | 19 1 J | 6 7 J | 8 3 J | 3 J | 10 J | 11 4 J | 15 9 J | 11 3 J | 34 5 J |
| COBALT | 12 1 J | 6 2 J | 9 9 | 7 J | 5 3 J | 9 3 J | 3 5 J | 3 7 J | 3 4 J | 9 4 J | 5 6 J | 11 7 | 14 J |
| COPPER | 4 6 J | 4 3 J | 12 6 J | 4 3 J | 4 5 J | 5 5 J | 4 2 J | 1 4 J | 3 8 J | 12 9 J | 6 1 J | 19 7 J | 244 J |
| IRON | 11000 J | 13900 J | 27200 J | 7200 J | 12800 J | 9530 J | 11300 J | 2620 J | 8990 J | 10600 J | 18200 J | 13700 J | 21000 J |
| LEAD | 12 6 J | 7 5 J | 1110 J | 616 J | 45 J | 10 5 J | 4 5 J | 3 J | 4 3 J | 387 J | 26 8 J | 28 5 J | 277 J |
| MAGNESIUM | 534 J | 263 J | 7670 J | 4790 J | 563 J | 1470 J | 462 J | 146 J | 225 J | 2500 J | 457 J | 1530 J | 2540 J |
| MANGANESE | 1270 J | 378 J | 810 J | 797 J | 400 J | 450 J | 809 J | 130 J | 1070 J | 817 J | 406 J | 684 J | 1060 J |
| MERCURY | 0 019 J | 0 015 UJ | 0 026 J | 0 023 | 0 016 | 0 026 J | 0 018 UJ | 0 018 UJ | 0 018 UJ | 0 018 U | 0 027 | 0 57 J | 0 037 |
| NICKEL | 9 2 J | 8 7 J | 17 3 J | 10 6 J | 9 J | 10 3 J | 9 4 J | 3 J | 5 8 J | 9 5 J | 9 J | 13 6 J | 1600 J |
| POTASSIUM | 316 J | 227 J | 1250 J | 381 J | 293 J | 370 J | 260 J | 245 J | 261 J | 415 J | 304 J | 801 J | 794 J |
| SELENIUM | 0 27 J | 0 22 J | 0 17 U | 0 16 J | 0 16 J | 0 17 J | 0 16 J | 0 16 J | 0 17 J | 0 17 U | 0 17 J | 0 4 | 0 17 U |
| SILVER | 0 04 U | 0 04 U | 0 04 U | 0 04 U | 0 04 U | 0 04 U | 0 04 U | 0 04 U | 0 04 U | 0 04 U | 0 04 U | 0 92 U | 0 48 J |
| SODIUM | 39 U | 18 8 U | 644 J | 77 6 U | 24 9 U | 52 5 U | 34 8 U | 30 6 U | 27 6 U | 668 J | 41 U | 68 8 U | 489 J |
| THALLIUM | 0 11 | 0 05 | 0 08 | 0 06 | 0 05 | 0 1 | 0 06 | 0 04 U | 0 04 U | 0 07 | 0 06 | 0 21 | 0 08 |
| TIN | 0 24 U | 0 17 U | 0 64 U | 0 61 U | 0 37 U | 0 32 U | 0 29 U | 0 12 U | 0 16 U | 7 1 J | 0 29 U | 1 5 U | 15 6 J |
| VANADIUM | 15 7 J | 11 3 J | 20 9 | 9 2 J | 8 8 J | 10 8 J | 9 1 J | 2 6 J | 6 J | 10 9 J | 10 2 J | 18 2 | 18 4 J |
| ZINC | 18 3 J | 29 5 J | 112 J | 70 8 J | 21 5 J | 24 4 J | 13 3 J | 7 2 J | 14 2 J | 122 J | 31 1 J | 204 J | 1100 J |
| **Miscellaneous Parameters** | | | | | | | | | | | | | |
| NITRATE mg/kg | 2 J | 2 J | 3 9 | 2 4 | 2 1 J | 1 9 J | 1 8 J | 2 1 J | 2 8 J | 3 4 | 2 5 | 1 9 | 1 2 |
| NITRITE mg/kg | 11 UJ | 10 UJ | 15 UJ | 3 3 U | 11 U | 22 UJ | 17 UJ | 11 UJ | 11 UJ | 2 4 U | 11 U | 25 UJ | 2 4 U |
| NITRITE/NITRATE mg/kg | 2 J | 2 J | 3 9 J | 2 4 J | 2 1 | 1 9 J | 1 8 J | 2 1 J | 2 8 J | 3 4 J | 2 5 J | 1 9 J | 1 2 J |
| PERCENT MOISTURE % | 14 3 | 17 | 15 | 16 5 | 13 1 | 15 7 | 20 5 | 17 2 | 10 9 | 18 2 | 12 8 | 27 1 | 16 9 |
| PERCHLORATE µg/kg | 23 U | 24 U | 20 U | 24 U | 23 U | 24 U | 25 U | 24 U | 22 U | 24 U | 23 U | 20 U | 24 U |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB24 | 03SB25 | 03SB26 | 03SB27 | 03SB27 | 03SB28 | 03SB34 | 03SB34 | 03SB36 | 03SB36 | 03SB39 | 03SB39 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB241215 | 03SB250608 | 03SB260610 | 03SB270206 | 03SB270607 | 03SB280204 | 03SB340206 | 03SB340610 | 03SB360206 | 03SB360610 | 03SB390206 | 03SB390610 |
| SAMPLE | 03SB241215 | 03SB250608 | 03SB260610 | 03SB270206 | 03SB270607 | 03SB280204 | 03SB340206 | 03SB340610 | 03SB360206 | 03SB360610 | 03SB390206 | 03SB390610 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 12 - 15 | 6 - 8 | 6 - 10 | 2 - 6 | 6 - 7 | 2 - 4 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | 970 J | | | | | | | | | | | |
| 1,2,3,4,6,7,8-HPCDD | 7 6 | | | | | | | | | | | |
| 1,2,3,6,7,8-HXCDD | 0 35 J | | | | | | | | | | | |
| TEQ BIRD | 0 11 | | | | | | | | | | | |
| TEQ FISH | 0 11 | | | | | | | | | | | |
| TEQ HUMAN | 0 21 | | | | | | | | | | | |
| TOTAL HPCDD | 18 4 | | | | | | | | | | | |
| TOTAL PECDD | 0 14 U | | | | | | | | | | | |
| **Volatile Organics (µg/kg)** | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 12 U | 8 3 U | 13 U | 1 J | 21 J | 1 J | | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | 12 U | 8 3 U | 13 U | 1 1 U | 8 7 U | 1 1 U | | | | | | |
| 2-HEXANONE | 12 U | 12 J | 13 U | 1 1 U | 8 7 U | 2 J | | | | | | |
| 4-METHYL-2-PENTANONE | 12 U | 10 J | 13 U | 1 1 U | 8 7 U | 1 1 U | | | | | | |
| CIS-1,2-DICHLOROETHENE | 12 U | 8 3 U | 13 U | 1 1 U | 8 7 U | 1 1 U | | | | | | |
| TRICHLOROETHENE | 12 U | 8 3 U | 13 U | 1 1 U | 8 7 U | 1 BU | | | | | | |
| TRICHLOROFLUOROMETHANE | 12 U | 8 3 U | 13 U | 1 1 U | 8 7 U | 1 1 U | | | | | | |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | |
| 2-METHYLNAPHTHALENE | 23 | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| 2-METHYLPHENOL | 81 U | 78 UJ | 88 U | 82 U | 81 U | 82 U | 78 U | 76 U | 78 U | 79 U | 79 U | 75 UJ |
| 3&4-METHYLPHENOL | 81 U | 78 UJ | 88 U | 82 U | 81 U | 82 U | 78 U | 76 U | 78 U | 79 U | 79 U | 75 UJ |
| ACENAPHTHENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| ACENAPHTHYLENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| ACETOPHENONE | 81 U | 78 UJ | 88 U | 82 U | 81 U | 82 U | 78 U | 76 U | 78 U | 79 U | 79 U | 75 UJ |
| ANTHRACENE | 1 6 U | 1 5 U | 23 | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| BENZO(A)ANTHRACENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| BENZO(A)PYRENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| BENZO(B)FLUORANTHENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| BENZO(G,H,I)PERYLENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| BENZO(K)FLUORANTHENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | 81 U | 78 UJ | 88 U | 82 U | 81 U | 880 | 78 U | 76 U | 78 U | 79 U | 79 U | 75 UJ |
| CHRYSENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| DI-N-BUTYL PHTHALATE | 81 U | 78 UJ | 88 U | 82 U | 81 U | 82 U | 78 U | 76 U | 78 U | 79 U | 79 U | 75 UJ |
| DI-N-OCTYL PHTHALATE | 81 U | 78 UR | 88 U | 82 U | 81 U | 82 U | 78 UR | 76 UR | 78 U | 79 U | 79 U | 75 UJ |
| FLUORANTHENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| FLUORENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| INDENO(1,2,3-CD)PYRENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| NAPHTHALENE | 16 | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 8 | 1 4 U |
| PHENANTHRENE | 1 6 U | 1 5 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |
| PHENOL | 81 U | 78 UJ | 88 U | 82 U | 81 U | 82 U | 78 U | 76 U | 78 U | 79 U | 79 U | 75 UJ |
| PYRENE | 1 6 U | 1 5 UJ | 1 7 U | 1 6 U | 1 6 U | 1 6 U | 1 5 U | 1 5 UJ | 1 5 U | 1 5 U | 1 5 U | 1 4 U |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB24 | 03SB25 | 03SB26 | 03SB27 | 03SB27 | 03SB28 | 03SB34 | 03SB34 | 03SB36 | 03SB36 | 03SB39 | 03SB39 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB241215 | 03SB250608 | 03SB260610 | 03SB270206 | 03SB270607 | 03SB280204 | 03SB340206 | 03SB340610 | 03SB360206 | 03SB360610 | 03SB390206 | 03SB390610 |
| SAMPLE | 03SB241215 | 03SB250608 | 03SB260610 | 03SB270206 | 03SB270607 | 03SB280204 | 03SB340206 | 03SB340610 | 03SB360206 | 03SB360610 | 03SB390206 | 03SB390610 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 12 - 15 | 6 - 8 | 6 - 10 | 2 - 6 | 6 - 7 | 2 - 4 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Energetics (mg/kg)** | | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 1 9 | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 8 8 | 0 25 U | 1 2 | 0 25 U | 0 28 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| RDX | 4 4 | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Inorganics (mg/kg)** | | | | | | | | | | | | |
| ALUMINUM | 3580 J | 7120 J | 8580 J | 5140 J | 11500 J | 6140 J | 6730 J | 6410 J | 7100 J | 7220 J | 7030 J | 6960 J |
| ANTIMONY | 1 9 J | 0 26 U | 1 3 U | 0 81 U | 0 65 U | 0 57 U | 0 32 U | 0 45 U | 0 29 U | 0 34 U | 0 27 U | 0 75 U |
| ARSENIC | 12 6 J | 4 5 J | 6 6 J | 8 2 J | 6 2 J | 7 J | 5 7 J | 3 7 J | 5 4 | 5 8 | 4 9 | 5 5 |
| BARIUM | 60 2 J | 77 9 J | 989 J | 85 4 J | 85 4 J | 104 J | 77 1 J | 40 4 J | 116 J | 106 J | 95 1 J | 81 2 J |
| BERYLLIUM | 0 49 J | 0 58 | 0 59 | 0 75 | 0 59 | 0 73 | 0 43 | 0 57 | 0 79 | 1 | 0 64 | 0 96 |
| CADMIUM | 0 46 | 0 35 | 0 82 | 0 71 | 0 48 | 0 46 | 0 62 | 0 33 | 0 33 | 0 4 | 0 3 U | 0 35 |
| CALCIUM | 1750 J | 2180 J | 2900 J | 1010 J | 1280 J | 976 J | 73500 J | 1140 J | 4220 J | 1860 J | 2070 J | 1660 J |
| CHROMIUM | 10 7 J | 9 6 J | 12 8 J | 18 3 J | 18 4 J | 13 8 J | 8 9 J | 20 2 J | 11 1 J | 24 5 J | 10 2 J | 21 2 J |
| COBALT | 7 J | 14 6 J | 14 3 | 12 | 9 2 | 13 7 | 10 9 J | 13 9 J | 15 5 J | 17 2 J | 13 7 J | 18 2 J |
| COPPER | 9 2 J | 7 J | 27 3 J | 1230 J | 26 3 J | 255 J | 8 5 J | 7 3 J | 8 4 J | 9 5 J | 9 2 J | 8 5 J |
| IRON | 18300 J | 18300 J | 17300 J | 35900 J | 22600 J | 26200 J | 16900 J | 44000 J | 22500 J | 34400 J | 16900 J | 36900 J |
| LEAD | 23 6 J | 12 5 J | 34 J | 49 J | 14 5 J | 20 8 J | 12 2 J | 16 J | 13 9 J | 16 6 J | 15 J | 16 7 J |
| MAGNESIUM | 330 J | 801 J | 1310 J | 748 J | 1870 J | 766 J | 2350 J | 547 J | 952 J | 805 J | 989 J | 668 J |
| MANGANESE | 1060 J | 1420 J | 1080 J | 1150 J | 495 J | 1060 J | 996 J | 906 J | 1550 J | 1480 J | 879 J | 1370 J |
| MERCURY | 0 019 U | 0 023 J | 0 28 J | 0 035 J | 0 098 J | 0 027 J | 0 022 J | 0 021 J | 0 33 J | 0 047 J | 0 035 J | 0 21 J |
| NICKEL | 14 9 J | 11 1 J | 18 7 J | 22 7 J | 13 8 J | 17 2 J | 10 8 J | 14 1 J | 14 4 J | 19 2 J | 12 J | 16 8 J |
| POTASSIUM | 317 J | 474 J | 960 J | 836 J | 1790 J | 707 J | 764 J | 372 J | 461 J | 457 J | 464 J | 392 J |
| SELENIUM | 0 38 J | 0 17 J | 0 31 | 0 19 U | 0 3 | 0 25 | 0 41 J | 0 16 UJ | 0 38 | 0 35 | 0 38 | 0 21 |
| SILVER | 0 04 U | 0 04 U | 0 05 U | 0 09 U | 0 04 U | 0 05 U | 0 04 U | 0 04 U | 0 05 U | 0 04 U | 0 04 U | 0 04 U |
| SODIUM | 20 6 U | 99 5 J | 52 8 U | 32 4 U | 54 4 U | 45 U | 223 J | 86 8 J | 182 U | 133 U | 101 U | 103 U |
| THALLIUM | 0 15 | 0 1 | 0 11 | 0 1 | 0 17 | 0 1 | 0 11 | 0 09 | 0 11 | 0 1 | 0 09 | 0 09 |
| TIN | 0 3 U | 0 2 U | 1 3 U | 3 8 U | 1 8 U | 2 7 U | 0 37 U | 0 16 U | 0 26 U | 0 22 U | 0 25 U | 0 33 U |
| VANADIUM | 16 5 J | 14 7 J | 16 9 | 20 2 | 23 5 | 19 4 | 13 3 J | 17 J | 15 2 J | 22 9 J | 15 J | 20 9 J |
| ZINC | 78 J | 27 8 J | 217 J | 126 J | 66 4 J | 137 J | 30 2 J | 30 7 J | 34 3 J | 44 5 J | 33 2 J | 37 2 J |
| **Miscellaneous Parameters** | | | | | | | | | | | | |
| NITRATE mg/kg | 1 1 U | 12 | 2 1 | 2 2 | 2 1 | 2 1 | 18 | 14 | 17 | 2 8 | 38 | 14 |
| NITRITE mg/kg | 16 U | 15 J | 110 UJ | 12 UJ | 11 UJ | 17 UJ | 12 UJ | 11 UJ | 6 4 J | 2 2 UR | 11 UR | 2 3 J |
| NITRITE/NITRATE mg/kg | 1 1 UJ | 27 J | 2 1 J | 2 2 J | 2 1 J | 2 1 J | 18 J | 14 J | 23 J | 2 8 J | 38 J | 16 J |
| PERCENT MOISTURE % | 27 3 | 14 7 | 24 4 | 19 3 | 15 2 | 18 8 | 16 3 | 11 1 | 15 4 | 15 5 | 14 9 | 9 4 |
| PERCHLORATE µg/kg | 28 U | 23 U | 20 U | 20 U | 20 U | 20 U | 24 UJ | 22 UJ | 24 UJ | 24 UJ | 43 J | 22 UJ |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB40 | 03SB40 | 03SB42 | 03SB42 | 03SB44 | 03SB44 | 03SB46 | 03SB46 | 03SB47 | 03SB47 | 03SB48 | 03SB48 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB400206 | 03SB400610 | 03SB420206 | 03SB420610 | 03SB440206 | 03SB440610 | 03SB460206 | 03SB460610 | 03SB470206 | 03SB470610 | 03SB480206 | 03SB480610 |
| SAMPLE | 03SB400206 | 03SB400610 | 03SB420206 | 03SB420610 | 03SB440206 | 03SB440610 | 03SB460206 | 03SB460610 | 03SB470206 | 03SB470610 | 03SB480206 | 03SB480610 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Dioxins (ng/kg)** | | | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | | | | | | | | | | | | |
| 1,2,3,4,6,7,8-HPCDD | | | | | | | | | | | | |
| 1,2,3,6,7,8-HXCDD | | | | | | | | | | | | |
| TEQ BIRD | | | | | | | | | | | | |
| TEQ FISH | | | | | | | | | | | | |
| TEQ HUMAN | | | | | | | | | | | | |
| TOTAL HPCDD | | | | | | | | | | | | |
| TOTAL PECDD | | | | | | | | | | | | |
| **Volatile Organics (µg/kg)** | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | | | | | | | 1 U | 0 95 U | 1 2 U | 1 1 U | 1 3 U | 12 U |
| 1,1,2,2-TETRACHLOROETHANE | | | | | | | 1 U | 2 J | 1 2 U | 1 J | 1 3 U | 12 U |
| 2-HEXANONE | | | | | | | 1 U | 0 95 U | 1 2 U | 1 1 U | 1 3 U | 12 U |
| 4-METHYL-2-PENTANONE | | | | | | | 1 U | 0 95 U | 1 2 U | 1 1 U | 1 3 U | 12 U |
| CIS-1,2-DICHLOROETHENE | | | | | | | 1 U | 0 95 U | 1 2 U | 1 J | 8 | 18 J |
| TRICHLOROETHENE | | | | | | | 10 J | 6 J | 18 J | 15 J | 20 J | 33 J |
| TRICHLOROFLUOROMETHANE | | | | | | | 1 J | 0 95 U | 1 2 U | 1 1 U | 1 3 U | 12 U |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | |
| 2-METHYLNAPHTHALENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| 2-METHYLPHENOL | 78 U | 76 U | 79 U | 76 U | 78 U | 73 U | 80 U | 74 U | 76 UJ | 75 U | 74 U | 78 U |
| 3&4-METHYLPHENOL | 78 U | 76 U | 79 U | 76 U | 78 U | 73 U | 80 U | 74 U | 76 UJ | 75 U | 74 U | 78 U |
| ACENAPHTHENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| ACENAPHTHYLENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| ACETOPHENONE | 78 U | 76 U | 79 U | 76 U | 78 U | 73 U | 80 U | 74 U | 76 U | 75 U | 74 U | 78 U |
| ANTHRACENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| BENZO(A)ANTHRACENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| BENZO(A)PYRENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| BENZO(B)FLUORANTHENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| BENZO(G,H,I)PERYLENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| BENZO(K)FLUORANTHENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| BIS(2-ETHYLHEXYL)PHTHALATE | 78 U | 76 U | 79 U | 76 U | 78 U | 73 U | 80 U | 74 U | 76 UJ | 75 U | 74 U | 78 U |
| CHRYSENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| DI-N-BUTYL PHTHALATE | 78 U | 76 U | 79 U | 76 U | 78 U | 73 U | 80 U | 74 U | 76 U | 75 U | 2700 | 890 |
| DI-N-OCTYL PHTHALATE | 78 U | 76 U | 79 U | 76 U | 78 UR | 73 UR | 80 UR | 74 UR | 76 UR | 75 UR | 74 UR | 78 UR |
| FLUORANTHENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| FLUORENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| INDENO(1,2,3-CD)PYRENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| NAPHTHALENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| PHENANTHRENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |
| PHENOL | 78 U | 76 U | 79 U | 76 U | 78 U | 73 U | 80 U | 74 U | 76 UJ | 75 U | 74 U | 78 U |
| PYRENE | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 5 U | 1 4 U | 1 5 U | 1 4 UJ | 1 5 UJ | 1 5 UJ | 1 4 UJ | 1 5 UJ |

TABLE 4-2

SUMMARY OF CHEMICALS DETECTED IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SB40 | 03SB40 | 03SB42 | 03SB42 | 03SB44 | 03SB44 | 03SB46 | 03SB46 | 03SB47 | 03SB47 | 03SB48 | 03SB48 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SB400206 | 03SB400610 | 03SB420206 | 03SB420610 | 03SB440206 | 03SB440610 | 03SB460206 | 03SB460610 | 03SB470206 | 03SB470610 | 03SB480206 | 03SB480610 |
| SAMPLE | 03SB400206 | 03SB400610 | 03SB420206 | 03SB420610 | 03SB440206 | 03SB440610 | 03SB460206 | 03SB460610 | 03SB470206 | 03SB470610 | 03SB480206 | 03SB480610 |
| MATRIX | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO | SO |
| SUBMATRIX | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB | SB |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 | 2 - 6 | 6 - 10 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Energetics (mg/kg)** | | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 42 J | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| RDX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Inorganics (mg/kg)** | | | | | | | | | | | | |
| ALUMINUM | 6080 J | 5780 J | 7210 J | 5600 J | 7100 J | 5380 J | 6360 J | 4540 J | 5680 J | 4090 J | 391 J | 4250 J |
| ANTIMONY | 0 28 U | 0 39 U | 0 28 U | 0 51 U | 0 37 U | 1 3 J | 0 23 U | 0 5 U | 0 62 U | 0 4 U | 30 J | 12 4 J |
| ARSENIC | 4 1 | 6 2 | 4 4 | 2 6 | 7 4 J | 11 2 J | 4 9 J | 8 2 J | 6 7 J | 5 4 J | 3 7 J | 4 6 J |
| BARIUM | 139 J | 94 5 J | 153 J | 107 J | 119 J | 83 1 J | 138 J | 72 3 J | 77 9 J | 87 8 J | 614 J | 822 J |
| BERYLLIUM | 0 75 | 0 73 | 0 78 | 0 87 | 1 4 | 0 87 | 0 87 | 0 74 | 0 96 | 0 53 | 0 26 | 0 56 |
| CADMIUM | 0 35 | 0 35 | 0 36 | 0 41 | 0 49 | 0 37 | 0 83 | 0 7 | 0 41 | 0 32 | 0 63 | 0 86 |
| CALCIUM | 4260 J | 6890 J | 1950 J | 2880 J | 10300 J | 7790 J | 1390 J | 2960 J | 1090 J | 467 J | 869 J | 3430 J |
| CHROMIUM | 9 9 J | 21 8 J | 8 5 J | 18 6 J | 27 5 J | 20 4 J | 12 1 J | 20 J | 24 1 J | 19 4 J | 32 7 J | 32 3 J |
| COBALT | 14 6 J | 16 7 J | 14 9 J | 19 7 J | 21 2 J | 20 1 J | 15 4 J | 17 3 J | 15 J | 12 1 J | 740 J | 487 J |
| COPPER | 16 4 J | 8 6 J | 10 2 J | 6 9 J | 10 3 J | 9 3 J | 7 6 J | 9 J | 92 6 J | 9 6 J | 22500 J | 9580 J |
| IRON | 17300 J | 43800 J | 16700 J | 26500 J | 44400 J | 56400 J | 16400 J | 42000 J | 40300 J | 42700 J | 50900 J | 49800 J |
| LEAD | 12 6 J | 16 2 J | 13 5 J | 15 J | 20 J | 18 5 J | 13 3 J | 17 1 J | 34 J | 13 6 J | 3590 J | 3410 J |
| MAGNESIUM | 747 J | 799 J | 826 J | 685 J | 835 J | 750 J | 770 J | 428 J | 528 J | 464 J | 199 J | 710 J |
| MANGANESE | 1440 J | 1390 J | 1680 J | 1680 J | 1730 J | 1450 J | 1790 J | 1310 J | 1320 J | 799 J | 1200 J | 1440 J |
| MERCURY | 0 027 J | 0 022 J | 0 027 J | 0 023 J | 0 027 J | 0 02 J | 0 026 J | 0 019 J | 0 018 J | 0 018 J | 0 025 J | 0 025 J |
| NICKEL | 15 5 J | 15 9 J | 15 9 J | 20 3 J | 23 7 J | 19 9 J | 16 J | 17 9 J | 171 J | 19 2 J | 79100 J | 48300 J |
| POTASSIUM | 448 J | 403 J | 403 J | 386 J | 413 J | 355 J | 395 J | 327 J | 380 J | 383 J | 273 J | 505 J |
| SELENIUM | 0 32 | 0 22 | 0 39 | 0 2 | 0 27 J | 0 22 J | 0 43 J | 0 17 UJ | 0 23 J | 0 17 UJ | 0 16 UJ | 0 17 UJ |
| SILVER | 0 04 U | 0 04 U | 0 11 | 0 05 | 0 04 U | 0 04 U | 0 06 U | 0 04 U | 0 51 J | 0 13 U | 33 9 J | 16 6 J |
| SODIUM | 130 U | 109 U | 116 U | 163 U | 113 J | 117 J | 144 J | 121 J | 80 6 J | 141 J | 140 J | 220 J |
| THALLIUM | 0 09 | 0 08 | 0 12 | 0 1 | 0 11 | 0 08 | 0 11 | 0 08 | 0 11 | 0 06 | 0 04 U | 0 04 U |
| TIN | 0 25 U | 0 16 U | 0 42 U | 0 2 U | 0 18 U | 0 15 U | 0 26 U | 0 16 U | 0 82 U | 0 07 U | 1630 J | 507 J |
| VANADIUM | 13 J | 23 6 J | 14 1 J | 19 8 J | 28 3 J | 27 8 J | 16 8 J | 22 3 J | 24 9 J | 17 7 J | 4 5 J | 19 7 J |
| ZINC | 32 5 J | 37 2 J | 37 9 J | 31 7 J | 41 4 J | 43 9 J | 26 J | 51 6 J | 74 5 J | 40 7 J | 253 J | 157 J |
| **Miscellaneous Parameters** | | | | | | | | | | | | |
| NITRATE mg/kg | 1 9 | 1 7 | 1 7 | 1 9 | 2 4 | 2 1 | 1 2 | 1 5 | 1 6 | 1 5 | 1 UJ | 1 1 |
| NITRITE mg/kg | 11 UR | 11 UR | 2 2 UR | 2 2 UR | 2 7 UJ | 2 2 UJ | 2 2 UJ | 2 UJ | 11 UJ | 11 UJ | 2 UJ | 2 3 UJ |
| NITRITE/NITRATE mg/kg | 1 9 J | 1 7 J | 1 7 J | 1 9 J | 2 4 J | 2 1 J | 1 2 J | 1 5 J | 1 6 J | 1 5 J | 1 UJ | 2 8 J |
| PERCENT MOISTURE % | 14 | 11 8 | 15 7 | 10 | 14 1 | 9 1 | 17 9 | 8 6 | 11 6 | 11 3 | 10 7 | 13 5 |
| PERCHLORATE µg/kg | 23 UJ | 23 UJ | 24 UJ | 22 UJ | 23 UJ | 22 UJ | 20 U | 20 U | 23 U | 23 U | 20 U | 20 U |

TABLE 4-3

SUMMARY OF DETECTED CHEMICALS IN GROUND WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03-07 | 03-10 | 03-11 | 03-12 | 03-13 | 03-14 | 03-15 | 03-17 | 03-18 | 03-20 | 03-21 | 03-22 | 03-23 | 03-24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03GW0701 | 03GW1001 | 03GW1101 | 03GW1201 | 03GW1301 | 03GW1401 | 03GW1501 | 03GW1701 | 03GW1801 | 03GW2001 | 03GW2101 | 03GW2201 | 03GW2301 | 03GW2401 |
| SAMPLE | 03GW0701 | 03GW1001 | 03GW1101 | 03GW1201 | 03GW1301 | 03GW1401 | 03GW1501 | 03GW1701 | 03GW1801 | 03GW2001 | 03GW2101 | 03GW2201 | 03GW2301 | 03GW2401 |
| MATRIX | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW |
| SACODE | ORIG | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/L)** | | | | | | | | | | | | | | |
| 1,1,2,2-TETRACHLOROETHANE | 530 | 0 3 U | 0 3 U | 0 3 U | 0 3 U | 0 3 U | 100 | 0 3 U | 0 3 U | 0 3 U | 0 3 U | 5 | 0 3 U | 3 9 J |
| 1,1,2-TRICHLOROETHANE | 12 | 0 3 U | 0 3 U | 0 3 U | 0 3 U | 0 3 U | 2 3 | 0 3 U | 0 3 U | 0 3 U | 0 3 U | 0 3 U | 0 3 U | 0 5 J |
| 1,1-DICHLOROETHENE | 1 1 J | 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 | 0 3 U |
| BROMOMETHANE | 0 5 U | 0 5 U | 0 5 UJ | 0 5 UJ | 0 5 UJ | 0 5 UJ | 0 4 J | 0 5 UJ | 0 5 UJ | 0 6 | 0 5 U | 0 5 U | 0 5 | 0 5 UJ |
| CIS-1,2-DICHLOROETHENE | 150 | 0 5 U | 0 5 U | 0 3 J | 0 5 U | 0 5 U | 7 9 | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 6 | 0 5 U | 7 7 |
| ETHYL METHACRYLATE | 0 5 U | 0 5 U | 0 5 J | 0 5 U | 0 5 U | 0 5 UJ | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 UJ |
| TETRACHLOROETHENE | 5 7 | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 3 J | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U |
| TRANS-1,2-DICHLOROETHENE | 37 | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 1 9 | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 1 2 J |
| TRICHLOROETHENE | 640 | 0 9 U | 0 5 U | 3 7 J | 0 5 U | 0 5 U | 57 J | 0 5 U | 0 5 U | 0 3 J | 1 6 U | 6 J | 0 5 U | 23 J |
| VINYL CHLORIDE | 3 9 | 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 | 0 3 U |
| **Semivolatile Organics (µg/L)** | | | | | | | | | | | | | | |
| BIS(2-ETHYLHEXYL)PHTHALATE | 1 U | 1 U | 1 U | 0 97 U | 0 98 U | 1 U | 0 94 U | 1 U | 1 1 U | 1 1 U | 1 U | 0 94 U | 2 J | 0 95 U |
| **Energetics (µg/L)** | | | | | | | | | | | | | | |
| 1,3,5-TRINITROBENZENE | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 61 | 0 35 U | 0 35 U | 0 35 U |
| 2,4,6-TRINITROTOLUENE | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 17 | 0 35 U | 0 35 U | 0 35 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 35 U | 0 12 U | 0 35 U | 1 | 0 47 R | 0 55 J | 0 12 U | 0 35 U | 0 35 U | 0 35 U | 2 6 | 0 12 U | 0 35 U | 0 35 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 35 U | 0 35 U | 0 35 U | 1 5 | 0 77 J | 0 82 J | 0 35 U | 0 35 U | 0 35 U | 0 35 U | 10 | 0 35 U | 0 62 J | 0 35 U |
| HMX | 0 35 U | 0 35 U | 0 35 U | 66 | 37 | 26 | 1 3 | 8 6 | 3 5 | 0 35 U | 170 J | 0 35 U | 26 | 0 35 U |
| RDX | 1 5 J | 14 | 0 35 U | 35 | 16 | 11 | 4 8 | 4 2 | 3 8 | 0 35 U | 280 J | 18 | 12 | 7 2 |
| **Total Metals (µg/L)** | | | | | | | | | | | | | | |
| ALUMINUM | 7 5 | 7 5 U | 228 | 63 6 | 340 | 13 U | 21 2 U | 26 5 | 218 | 46 8 | 4 U | 29 5 U | 11 4 | 78 8 |
| ANTIMONY | 0 1 U | 0 1 U | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 12 | 0 5 U | 0 5 U | 0 1 U | 0 1 | 0 1 U | 0 1 U | 0 5 U |
| ARSENIC | 0 2 U | 0 21 | 1 U | 1 U | 1 U | 1 U | 0 2 U | 1 U | 1 U | 0 2 U | 0 24 | 0 3 | 0 2 U | 1 U |
| BARIUM | 153 J | 71 3 J | 88 6 J | 46 2 J | 66 8 J | 96 5 J | 88 5 J | 26 2 J | 58 6 J | 44 8 J | 275 J | 173 J | 58 3 J | 50 9 J |
| CADMIUM | 0 7 U | 0 7 U | 3 5 U | 3 5 U | 3 5 U | 3 5 U | 0 7 U | 3 5 U | 12 | 0 7 U | 0 7 U | 0 7 U | 0 7 U | 3 5 U |
| CALCIUM | 75700 J | 117000 J | 73400 J | 42300 J | 69400 J | 91500 J | 33500 J | 50600 J | 27600 J | 13400 J | 88400 J | 149000 J | 57100 J | 76500 J |
| CHROMIUM | 0 47 U | 0 24 | 1 3 J | 90 8 J | 1 J | 3 6 J | 0 7 | 0 7 J | 1 J | 0 41 U | 0 29 | 0 82 | 0 34 U | 1 2 J |
| COBALT | 0 46 | 0 12 U | 0 5 U | 2 2 | 1 6 | 0 5 U | 0 1 U | 0 5 U | 0 5 U | 0 1 U | 0 1 U | 0 16 | 0 12 | 0 5 |
| COPPER | 2 4 J | 0 61 U | 3 J | 1 4 J | 0 95 J | 1 1 J | 0 63 U | 3 J | 1 2 J | 0 19 U | 0 65 U | 0 87 U | 0 42 U | 0 5 U |
| IRON | 238 J | 230 J | 722 J | 1210 J | 1650 J | 430 J | 126 J | 408 J | 564 J | 103 J | 196 J | 356 J | 207 J | 374 J |
| LEAD | 0 17 | 0 1 U | 0 85 | 0 5 U | 0 95 | 0 5 U | 0 13 U | 0 5 U | 0 85 | 0 1 U | 0 1 U | 0 3 U | 0 1 U | 0 5 U |
| MAGNESIUM | 24200 J | 18000 J | 8210 | 7820 | 7290 | 11500 | 12600 J | 3850 | 3880 | 2340 J | 17400 J | 33400 J | 9770 J | 22600 |
| MANGANESE | 255 J | 0 54 U | 31 5 J | 38 3 J | 445 J | 2 1 J | 2 5 J | 4 J | 18 J | 3 7 J | 0 55 U | 8 8 J | 16 J | 20 J |
| NICKEL | 3 6 J | 2 1 J | 3 2 J | 91 2 J | 8 3 J | 4 6 J | 3 J | 2 J | 1 9 J | 1 7 J | 1 8 J | 3 6 J | 2 2 J | 2 4 J |
| POTASSIUM | 9440 J | 2100 J | 2670 J | 2680 J | 1840 J | 3400 J | 3780 J | 1240 J | 1640 J | 1140 J | 3340 J | 8310 J | 1610 J | 1390 J |
| SELENIUM | 0 4 U | 0 41 J | 2 U | 2 U | 2 U | 2 U | 0 71 J | 2 U | 2 U | 0 4 U | 0 57 J | 0 79 J | 0 4 U | 2 U |
| SODIUM | 952 J | 3530 J | 1080 J | 3140 J | 4980 J | 2350 J | 1700 J | 1900 J | 1610 J | 1290 J | 1560 J | 2570 J | 4070 J | 8930 J |
| THALLIUM | 0 1 U | 0 1 UJ | 0 5 U | 0 5 U | 0 5 U | 0 5 U | 0 1 UJ | 0 5 U | 0 5 U | 0 1 U | 0 1 UJ | 0 1 UJ | 0 1 U | 0 5 U |
| VANADIUM | 0 1 U | 0 37 U | 0 7 | 0 6 | 1 | 0 5 U | 0 45 U | 0 5 U | 0 65 | 0 1 U | 0 78 U | 0 53 U | 0 1 U | 0 5 U |
| ZINC | 6 5 J | 0 5 U | 5 4 | 2 5 U | 3 2 | 4 3 | 2 7 U | 3 8 | 6 | 1 4 U | 12 2 J | 20 4 J | 2 U | 5 7 |

TABLE 4-3

SUMMARY OF DETECTED CHEMICALS IN GROUND WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03-07 | 03-10 | 03-11 | 03-12 | 03-13 | 03-14 | 03-15 | 03-17 | 03-18 | 03-20 | 03-21 | 03-22 | 03-23 | 03-24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03GW0701 | 03GW1001 | 03GW1101 | 03GW1201 | 03GW1301 | 03GW1401 | 03GW1501 | 03GW1701 | 03GW1801 | 03GW2001 | 03GW2101 | 03GW2201 | 03GW2301 | 03GW2401 |
| SAMPLE | 03GW0701 | 03GW1001 | 03GW1101 | 03GW1201 | 03GW1301 | 03GW1401 | 03GW1501 | 03GW1701 | 03GW1801 | 03GW2001 | 03GW2101 | 03GW2201 | 03GW2301 | 03GW2401 |
| MATRIX | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW | GW |
| SACODE | ORIG | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Dissolved Metals (µg/L)** | | | | | | | | | | | | | | |
| ALUMINUM, FILTERED | | | | | | | | | | | | | | |
| BARIUM, FILTERED | | | | | | | | | | | | | | |
| CALCIUM, FILTERED | | | | | | | | | | | | | | |
| CHROMIUM, FILTERED | | | | | | | | | | | | | | |
| COPPER, FILTERED | | | | | | | | | | | | | | |
| IRON, FILTERED | | | | | | | | | | | | | | |
| MAGNESIUM, FILTERED | | | | | | | | | | | | | | |
| MANGANESE, FILTERED | | | | | | | | | | | | | | |
| MERCURY, FILTERED | | | | | | | | | | | | | | |
| NICKEL, FILTERED | | | | | | | | | | | | | | |
| POTASSIUM, FILTERED | | | | | | | | | | | | | | |
| SODIUM, FILTERED | | | | | | | | | | | | | | |
| TIN, FILTERED | | | | | | | | | | | | | | |
| **Field Parameters** | | | | | | | | | | | | | | |
| DISSOLVED OXYGEN (mg/l) | 0 77 | 2 78 | 5 9 | 4 58 | - 6 51 | 1 52 | 7 47 | 7 22 | 6 99 | 8 47 | 11 8 | 4 31 | 1 73 | 10 01 |
| NITRATE (mg/l) | 0 02 | 1 65 > | 0 | 0 32 | 0 23 | 0 01 | 0 16 | 0 18 | 0 17 | 0 36 | 0 32 | 0 14 | 0 04 | 0 37 |
| NITRITE (mg/l) | 0 | 0 | 0 | 0 | 0 | 0 001 | 0 | 0 001 | 0 006 | 0 | 0 001 | 0 03 | 0 | 0 002 |
| OXIDATION REDUCTION POTENTIAL (MV) | 531 | 492 | 603 2 | 371 2 | 49 | 439 | 733 | 521 | 510 9 | 462 | 530 | 591 | 544 | 531 7 |
| PH (S U ) | 4 92 | 6 23 | 3 2 | 6 09 | 6 32 | 6 2 | 5 5 | 3 74 | 5 43 | 5 66 | 5 48 | 5 34 | 4 09 | 5 54 |
| SPECIFIC CONDUCTANCE (MS/CM) | 0 643 | 0 639 | 0 424 | 0 309 | 0 395 | 0 617 | 0 27 | 0 334 | 0 231 | 0 149 | 0 546 | 0 874 | 0 458 | 0 616 |
| TEMPERATURE (C) | 14 3 | 15 15 | 16 4 | 13 2 | 13 5 | 14 3 | 16 3 | 13 7 | 14 8 | 12 6 | 15 1 | 16 4 | 13 7 | 14 |
| TURBIDITY (NTU) | 7 5 | 2 2 | 3 7 | 3 7 | 9 | 0 6 | 1 4 | 3 2 | 3 8 | 3 6 | 0 4 | 9 4 | 5 8 | 9 |

TABLE 4-3

SUMMARY OF DETECTED CHEMICALS IN GROUND WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03-25 | 03-25 | 03-16 |
|---|---|---|---|
| NSAMPLE | 03GW2501 | 03GW2501-F | 03GW1601 |
| SAMPLE | 03GW2501 | 03GW2501-F | 03GW1601 |
| MATRIX | GW | GW | BACKGROUND |
| SACODE | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - |
| VALIDATED | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/L)** | | | |
| 1,1,2,2-TETRACHLOROETHANE | 0 3 U | | 0 3 U |
| 1,1,2-TRICHLOROETHANE | 0 3 U | | 0 3 U |
| 1,1-DICHLOROETHENE | 0 3 U | | 0 3 U |
| BROMOMETHANE | 0 3 J | | 0 5 U |
| CIS-1,2-DICHLOROETHENE | 0 5 U | | 0 5 U |
| ETHYL METHACRYLATE | 0 5 UJ | | 0 5 U |
| TETRACHLOROETHENE | 0 5 U | | 0 5 U |
| TRANS-1,2-DICHLOROETHENE | 0 5 U | | 0 5 U |
| TRICHLOROETHENE | 0 5 U | | 0 5 U |
| VINYL CHLORIDE | 0 3 U | | 0 3 U |
| **Semivolatile Organics (µg/L)** | | | |
| BIS(2-ETHYLHEXYL)PHTHALATE | 0 98 U | | 1 UJ |
| **Energetics (µg/L)** | | | |
| 1,3,5-TRINITROBENZENE | 0 35 U | | 0 35 U |
| 2,4,6-TRINITROTOLUENE | 0 35 U | | 0 35 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 35 U | | 0 12 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 35 U | | 0 35 U |
| HMX | 0 35 U | | 1 3 |
| RDX | 0 35 U | | 24 |
| **Total Metals (µg/L)** | | | |
| ALUMINUM | 372 | | 32 6 J |
| ANTIMONY | 0 5 U | | 0 39 |
| ARSENIC | 1 U | | 0 44 |
| BARIUM | 19 4 J | | 43 J |
| CADMIUM | 3 5 U | | 0 70 U |
| CALCIUM | 25400 J | | 50900 J |
| CHROMIUM | 3 J | | 1 |
| COBALT | 0 5 U | | 0 10 U |
| COPPER | 0 5 U | | 0 37 U |
| IRON | 768 J | | 193 J |
| LEAD | 0 8 | | 0 21 U |
| MAGNESIUM | 1230 | | 4650 J |
| MANGANESE | 27 J | | 6 7 J |
| NICKEL | 1 3 J | | 1 2 J |
| POTASSIUM | 923 J | | 1140 J |
| SELENIUM | 2 U | | 0 40 U |
| SODIUM | 2310 J | | 4750 J |
| THALLIUM | 0 5 | | 0 10 UJ |
| VANADIUM | 1 2 | | 0 65 U |
| ZINC | 4 4 | | 0 50 U |

TABLE 4-3

SUMMARY OF DETECTED CHEMICALS IN GROUND WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03-25 | 03-25 | 03-16 |
|---|---|---|---|
| NSAMPLE | 03GW2501 | 03GW2501-F | 03GW1601 |
| SAMPLE | 03GW2501 | 03GW2501-F | 03GW1601 |
| MATRIX | GW | GW | BACKGROUND |
| SACODE | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - |
| VALIDATED | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB |
| **Dissolved Metals (µg/L)** | | | |
| ALUMINUM, FILTERED | | 23 7 | |
| BARIUM, FILTERED | | 18 1 J | |
| CALCIUM, FILTERED | | 24400 J | |
| CHROMIUM, FILTERED | | 2 6 J | |
| COPPER, FILTERED | | 0 95 J | |
| IRON, FILTERED | | 98 8 J | |
| MAGNESIUM, FILTERED | | 1190 | |
| MANGANESE, FILTERED | | 1 J | |
| MERCURY, FILTERED | | 4 7 | |
| NICKEL, FILTERED | | 0 85 J | |
| POTASSIUM, FILTERED | | 950 J | |
| SODIUM, FILTERED | | 2460 J | |
| TIN, FILTERED | | 4 9 J | |
| **Field Parameters** | | | |
| DISSOLVED OXYGEN (mg/l) | 19 32 | | 9 75 |
| NITRATE (mg/l) | 0 18 | | 1 29 |
| NITRITE (mg/l) | 0 | | 0 007 |
| OXIDATION REDUCTION POTENTIAL (MV) | 490 1 | | 545 |
| PH (S U ) | 7 39 | | 5 25 |
| SPECIFIC CONDUCTANCE (MS/CM) | 0 15 | | 0 339 |
| TEMPERATURE (C) | 14 | | 15 94 |
| TURBIDITY (NTU) | 25 | | 10 |

TABLE 4-4

SUMMARY OF DETECTED CHEMICALS IN SHALLOW SEDIMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SD05 | 03SWSD06 | 03SD07 | 03SWSD08 | 03SWSD09 | 03SD10 | 03SWSD11 | 03SD12 | 03SWSD13 | 03SWSD14 | 03SWSD15 | 03SWSD16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SD050006 | 03SD060006 | 03SD070006 | 03SD080006 | 03SD090006 | 03SD100006 | 03SD110006 | 03SD120006 | 03SD130006 | 03SD140006 | 03SD150006 | 03SD160006 |
| SAMPLE | 03SD050006 | 03SD060006 | 03SD070006 | 03SD080006 | 03SD090006 | 03SD100006 | 03SD110006 | 03SD120006 | 03SD130006 | 03SD140006 | 03SD150006 | 03SD160006 |
| MATRIX | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD |
| SACODE | ORIG | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL |
| DEPTH RANGE | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 1 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/kg)** | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 6 4 U | 1 2 U | 5 9 U | 7 2 U | 7 7 U | 2 6 U | 13 U | 1 1 U | 1 U | 3 2 U | 1 6 U | 1 2 U |
| 2-BUTANONE | 6 4 UJ | 1 2 UJ | 5 9 UJ | 7 2 UJ | 7 7 UJ | 2 6 U | 13 UJ | 1 1 U | 1 U | 3 2 UJ | 1 6 U | 1 2 U |
| 4-METHYL-2-PENTANONE | 6 4 UJ | 1 2 U | 5 9 U | 7 2 U | 7 7 U | 2 6 U | 13 UJ | 1 1 U | 1 U | 3 2 UJ | 1 6 U | 1 2 U |
| ACETONE | 160 J | 36 J | 69 U | 240 U | 7 7 UJ | 35 BU | 130 U | 1 1 U | 1 U | 45 BU | 6 U | 1 2 U |
| CARBON DISULFIDE | 6 4 UJ | 1 4 J | 5 9 UJ | 7 2 UJ | 7 7 UJ | 2 6 UJ | 13 UJ | 1 1 UJ | 1 UJ | 3 2 UJ | 1 6 UJ | 1 2 UJ |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | |
| ACENAPHTHENE | 1 7 U | 1 6 U | 1 5 U | 1 9 U | 1 8 U | 1 4 U | 1 7 U | 1 5 U | 1 5 U | 1 7 U | 2 1 U | 1 6 U |
| DI-N-BUTYL PHTHALATE | 85 U | 490 BU | 79 U | 96 U | 93 U | 77 J | 590 | 75 U | 77 U | 86 U | 110 U | 240 BU |
| DIPHENYLAMINE | 85 U | 83 U | 96 J | 96 U | 93 U | 74 U | 88 U | 100 J | 77 U | 86 U | 420 J | 84 U |
| FLUORANTHENE | 1 7 U | 1 6 U | 1 5 U | 1 9 U | 1 8 U | 1 4 U | 11 | 1 5 U | 1 5 U | 12 J | 2 1 U | 1 6 U |
| PHENANTHRENE | 1 7 U | 1 6 U | 1 5 U | 1 9 U | 1 8 U | 1 4 U | 1 7 U | 1 5 U | 1 5 U | 14 J | 2 1 U | 1 6 U |
| PYRENE | 1 7 U | 1 6 U | 1 5 U | 1 9 U | 1 8 U | 1 4 U | 11 | 1 5 U | 1 5 U | 26 U | 2 1 U | 1 6 U |
| **Energetics (mg/kg)** | | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 55 | 0 25 U | 0 25 U | 0 29 J | 0 69 | 0 25 U | 0 62 | 0 25 U | 0 25 U | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 1 1 | 0 33 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 37 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 25 U | 0 25 U | 6 1 | 0 25 U | 0 25 U | 0 25 U | 130 | 0 25 U | 1 1 | 0 25 U | 0 25 U | 0 25 U |
| **Pesticides/PCB's (µg/kg)** | | | | | | | | | | | | |
| METHOXYCHLOR | 11 U | 11 U | 11 U | 13 U | 13 U | 10 U | 12 U | 10 U | 10 U | 12 U | 15 U | 11 U |
| **Herbicides (µg/kg)** | | | | | | | | | | | | |
| 2,4,5-T | 1 8 UJ | 2 7 J | 1 6 U | 2 U | 1 9 U | 1 6 U | 1 8 U | 3 5 | 1 6 U | 2 8 J | 2 3 U | 1 8 U |
| 2,4,5-TP (SILVEX) | 4 3 J | 2 6 J | 1 6 U | 2 U | 1 9 U | 1 6 U | 1 8 U | 2 4 J | 1 6 U | 2 3 R | 2 5 J | 1 8 U |
| 2,4-D | 1 8 U | 1 7 U | 14 J | 20 J | 9 7 R | 7 4 R | 12 J | 8 3 J | 8 4 J | 4 9 J | 10 R | 5 6 J |
| DINOSEB | 1 8 UJ | 1 7 U | 1 6 U | 8 2 J | 11 R | 1 6 U | 4 2 J | 1 6 U | 1 6 U | 3 1 J | 2 3 U | 1 8 U |
| HEXACHLOROPHENE | 8 5 U | 8 3 U | 7 9 U | 3 5 J | 9 3 U | 7 4 U | 8 8 UJ | 7 5 U | 7 7 U | 8 6 U | 11 U | 8 4 U |
| PENTACHLOROPHENOL | 0 43 UJ | 0 42 U | 0 75 R | 1 6 R | 0 47 U | 0 38 U | 0 44 U | 3 7 R | 0 39 U | 0 44 U | 1 4 R | 0 43 U |

TABLE 4-4

SUMMARY OF DETECTED CHEMICALS IN SHALLOW SEDIMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SD05 | 03SWSD06 | 03SD07 | 03SWSD08 | 03SWSD09 | 03SD10 | 03SWSD11 | 03SD12 | 03SWSD13 | 03SWSD14 | 03SWSD15 | 03SWSD16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SD050006 | 03SD060006 | 03SD070006 | 03SD080006 | 03SD090006 | 03SD100006 | 03SD110006 | 03SD120006 | 03SD130006 | 03SD140006 | 03SD150006 | 03SD160006 |
| SAMPLE | 03SD050006 | 03SD060006 | 03SD070006 | 03SD080006 | 03SD090006 | 03SD100006 | 03SD110006 | 03SD120006 | 03SD130006 | 03SD140006 | 03SD150006 | 03SD160006 |
| MATRIX | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD |
| SACODE | ORIG | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | NORMAL | NORMAL |
| DEPTH RANGE | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 1 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Inorganics (mg/kg)** | | | | | | | | | | | | |
| ALUMINUM | 21500 J | 8780 J | 9870 | 6250 | 6780 | 16400 | 17900 | 8740 J | 11100 J | 6770 J | 23200 J | 8950 J |
| ANTIMONY | 3 5 J | 1 9 J | 1 1 J | 0 38 U | 0 45 U | 2 1 U | 3 3 J | 2 J | 2 5 J | 0 87 U | 7 6 J | 1 6 J |
| ARSENIC | 6 7 | 6 9 | 19 1 | 4 7 | 4 4 | 10 | 6 | 13 4 | 9 8 | 4 3 | 22 | 10 7 |
| BARIUM | 853 J | 189 J | 194 J | 91 6 J | 104 J | 342 J | 500 J | 353 J | 326 J | 139 J | 334 J | 165 J |
| BERYLLIUM | 0 64 | 0 69 | 1 4 | 0 59 | 0 73 | 1 6 | 0 61 | 1 1 | 0 94 | 0 43 | 1 7 | 1 3 |
| CADMIUM | 1 8 J | 0 62 J | 1 2 J | 0 42 J | 0 59 J | 1 3 J | 3 5 J | 1 4 | 1 4 | 1 1 | 1 7 | 1 1 |
| CALCIUM | 12900 | 27800 | 4600 J | 2480 J | 37500 J | 5870 J | 3440 J | 3730 J | 4720 J | 3380 J | 3280 J | 3190 J |
| CHROMIUM | 23 1 J | 18 6 J | 29 9 J | 8 4 J | 11 4 J | 40 7 J | 13 J | 35 6 J | 25 5 J | 8 8 J | 40 8 J | 38 6 J |
| COBALT | 11 4 | 13 4 | 19 7 | 12 2 | 11 1 | 27 3 | 12 3 | 18 7 J | 19 5 J | 7 9 J | 31 2 J | 23 4 J |
| COPPER | 78 J | 27 4 J | 51 3 | 8 1 | 8 6 | 60 1 | 115 | 71 9 | 91 9 | 29 | 198 | 43 7 |
| IRON | 16500 J | 21700 J | 50300 J | 12900 J | 13300 J | 61200 J | 15100 J | 53900 J | 40800 J | 13300 J | 68600 J | 62100 J |
| LEAD | 204 J | 653 J | 215 | 13 3 | 14 6 | 93 2 | 257 | 184 J | 139 J | 43 J | 118 J | 87 J |
| MAGNESIUM | 4300 J | 5540 J | 1360 J | 1020 J | 14700 J | 1450 J | 1450 J | 1310 J | 1190 J | 1270 J | 1490 J | 520 J |
| MANGANESE | 930 J | 912 J | 1420 J | 887 J | 814 J | 1470 J | 1560 J | 1650 J | 1700 J | 444 J | 2780 J | 1610 J |
| MERCURY | 0 1 | 0 02 | 0 04 J | 0 03 J | 0 03 J | 0 1 J | 0 18 J | 0 06 | 0 08 | 0 14 | 0 31 | 0 03 |
| NICKEL | 16 5 | 23 7 | 33 1 J | 14 6 J | 14 9 J | 36 3 J | 16 5 J | 25 8 J | 25 6 J | 11 7 J | 33 8 J | 31 1 J |
| POTASSIUM | 813 J | 1260 J | 463 J | 478 J | 567 J | 426 J | 529 J | 338 J | 373 J | 657 J | 453 J | 294 J |
| SELENIUM | 0 18 U | 0 18 U | 0 49 U | 0 8 U | 0 69 U | 0 34 U | 0 19 U | 0 16 U | 0 16 U | 0 2 | 0 26 | 0 18 U |
| SILVER | 0 09 U | 0 04 U | 0 04 U | 0 05 U | 0 05 U | 0 11 U | 0 71 J | 0 05 U | 0 46 J | 0 12 U | 0 06 U | 0 05 U |
| SODIUM | 94 7 J | 138 J | 3 4 U | 4 1 U | 55 5 U | 3 4 U | 3 7 U | 17 5 U | 15 1 U | 22 7 U | 31 9 U | 10 U |
| THALLIUM | 0 07 | 0 11 | 0 08 | 0 09 | 0 08 | 0 07 | 0 09 | 0 07 | 0 08 | 0 08 | 0 12 | 0 1 |
| TIN | 4 5 U | 2 1 U | 1 3 U | 0 35 U | 0 41 U | 1 3 U | 4 4 J | 13 8 J | 3 4 U | 1 2 U | 3 2 U | 2 2 U |
| VANADIUM | 15 8 | 19 5 | 26 | 14 5 | 15 | 37 9 | 15 4 | 31 J | 26 J | 12 3 J | 44 1 J | 35 8 J |
| ZINC | 206 J | 100 J | 194 J | 27 5 J | 36 9 J | 192 J | 308 J | 260 J | 229 J | 114 J | 270 J | 385 J |
| **Miscellaneous Parameters (mg/kg)** | | | | | | | | | | | | |
| NITRATE | 4 | 3 4 | 3 7 | 8 4 | 4 7 | 1 1 UJ | 4 1 | 2 8 | 3 7 | 3 4 | 4 7 | 3 6 |
| NITRITE | 12 UJ | 2 3 UJ | 2 2 UR | 13 UR | 5 2 UR | 3 4 J | 12 UR | 3 UJ | 3 8 UJ | 17 UJ | 3 3 UJ | 2 4 UJ |
| NITRITE/NITRATE | 4 | 3 4 | 3 7 | 8 4 | 4 7 | 3 8 | 4 1 | 2 8 | 3 7 | 3 4 | 4 7 | 3 6 |
| TOTAL ORGANIC CARBON | 8000 J | 1000 U | 8999 9 | 28000 | 26000 | 6200 | 13000 | 4800 | 7300 | 6700 | 10000 | 5600 |
| **Miscellaneous Parameters (%)** | | | | | | | | | | | | |
| PERCENT MOISTURE | 21 1 | 22 5 | 9 5 | 34 9 | 22 1 | 7 4 | 21 8 | 13 4 | 11 5 | 22 1 | 28 1 | 15 6 |
| **Miscellaneous Parameters (S U )** | | | | | | | | | | | | |
| PH | 7 9 J | 7 6 J | 8 1 J | 7 J | 7 7 J | 8 J | 7 8 J | 8 J | 7 9 J | 7 7 J | 7 7 J | 7 4 J |

TABLE 4-4

SUMMARY OF DETECTED CHEMICALS IN SHALLOW SEDIMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD17 | 03SWSD18 | 03SWSD19 | 03SWSD01 | 03SWSD02 | 03SWSD03 | 03SWSD04 |
|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SD170006 | 03SD180006 | 03SD190006 | 03SD010006 | 03SD020006 | 03SD030006 | 03SD040006 |
| SAMPLE | 03SD170006 | 03SD180006 | 03SD190006 | 03SD010006 | 03SD020006 | 03SD030006 | 03SD040006 |
| MATRIX | SD | SD | SD | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/kg)** | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 3 7 U | 2 J | 1 1 U | 2 8 U | 12 U | 3 2 U | 12 U |
| 2-BUTANONE | 18 J | 1 2 U | 1 1 U | 2 8 UJ | 12 UJ | 3 2 UJ | 12 UJ |
| 4-METHYL-2-PENTANONE | 3 7 U | 1 2 UJ | 2 J | 2 8 U | 12 UJ | 3 2 U | 12 UJ |
| ACETONE | 95 BU | 1 2 U | 10 U | 110 J | 250 U | 3 2 UJ | 12 UJ |
| CARBON DISULFIDE | 3 7 UJ | 2 J | 1 UJ | 2 8 UJ | 12 UJ | 3 2 UJ | 12 UJ |
| **Semivolatile Organics (µg/kg)** | | | | | | | |
| ACENAPHTHENE | 1 7 U | 25 | 1 6 U | 1 8 U | 1 6 U | 1 6 U | 1 6 U |
| DI-N-BUTYL PHTHALATE | 190 BU | 86 U | 85 U | 92 U | 82 UJ | 85 U | 84 U |
| DIPHENYLAMINE | 88 U | 86 U | 85 U | 92 U | 82 UJ | 85 U | 84 U |
| FLUORANTHENE | 1 7 U | 1 7 U | 1 6 U | 1 8 U | 1 6 U | 1 6 U | 1 6 U |
| PHENANTHRENE | 1 7 U | 1 7 U | 1 6 U | 1 8 U | 1 6 U | 1 6 U | 1 6 U |
| PYRENE | 1 7 U | 1 7 U | 1 6 U | 1 8 U | 1 6 U | 1 6 U | 1 6 U |
| **Energetics (mg/kg)** | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2,4-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Pesticides/PCB's (µg/kg)** | | | | | | | |
| METHOXYCHLOR | 12 U | 17 J | 11 U | 12 U | 11 U | 11 UJ | 11 UJ |
| **Herbicides (µg/kg)** | | | | | | | |
| 2,4,5-T | 1 8 U | 1 8 U | 4 8 J | 1 9 UJ | 1 7 U | 1 8 U | 1 7 U |
| 2 4,5-TP (SILVEX) | 1 8 U | 4 5 J | 1 8 U | 1 9 UJ | 1 7 U | 1 8 U | 1 7 U |
| 2,4-D | 5 1 R | 1 8 U | 4 4 R | 10 J | 23 J | 10 J | 4 4 R |
| DINOSEB | 1 8 U | 1 8 U | 1 8 UJ | 1 9 UJ | 8 1 J | 1 8 U | 1 7 U |
| HEXACHLOROPHENE | 8 8 U | 8 6 U | 8 5 U | 9 2 UJ | 2 1 J | 8 5 U | 1 7 J |
| PENTACHLOROPHENOL | 0 45 U | 0 44 U | 0 43 U | 2 3 J | 5 | 1 4 J | 0 43 U |

TABLE 4-4

SUMMARY OF DETECTED CHEMICALS IN SHALLOW SEDIMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD17 | 03SWSD18 | 03SWSD19 | 03SWSD01 | 03SWSD02 | 03SWSD03 | 03SWSD04 |
|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SD170006 | 03SD180006 | 03SD190006 | 03SD010006 | 03SD020006 | 03SD030006 | 03SD040006 |
| SAMPLE | 03SD170006 | 03SD180006 | 03SD190006 | 03SD010006 | 03SD020006 | 03SD030006 | 03SD040006 |
| MATRIX | SD | SD | SD | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND |
| SACODE | NORMAL | NORMAL | ORIG | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 | 0 - 0 5 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Inorganics (mg/kg)** | | | | | | | |
| ALUMINUM | 4590 J | 10900 J | 6190 J | 9570 J | 6650 | 5480 | 9720 |
| ANTIMONY | 0 66 U | 1 2 U | 1 1 U | 0 49 U | 0 65 U | 0 68 U | 0 43 U |
| ARSENIC | 4 9 | 11 6 | 8 6 | 5 6 | 42 4 | 7 9 | 12 9 |
| BARIUM | 124 J | 166 J | 114 J | 57 8 J | 65 8 J | 45 4 J | 37 3 J |
| BERYLLIUM | 0 48 | 1 1 | 0 09 | 0 95 | 1 7 | 0 68 | 1 5 |
| CADMIUM | 0 37 | 0 87 | 0 67 | 0 79 J | 0 54 J | 0 32 J | 0 31 U |
| CALCIUM | 833 J | 915 J | 941 J | 1940 | 464 J | 277 J | 959 J |
| CHROMIUM | 9 5 J | 27 6 J | 25 3 J | 27 1 J | 42 1 J | 15 1 J | 18 3 J |
| COBALT | 9 4 J | 17 9 J | 16 J | 11 9 | 29 6 | 16 | 19 4 |
| COPPER | 9 2 | 29 6 | 19 7 | 7 7 J | 12 | 8 7 | 25 3 |
| IRON | 14600 J | 40900 J | 37300 J | 33500 J | 52400 J | 20200 J | 42900 J |
| LEAD | 20 1 J | 53 5 J | 33 8 J | 13 0 J | 32 9 | 20 2 | 23 6 |
| MAGNESIUM | 489 J | 602 J | 502 J | 2320 J | 511 J | 628 J | 2440 J |
| MANGANESE | 653 J | 1340 J | 1040 J | 342 J | 1680 J | 952 J | 364 J |
| MERCURY | 0 02 | 0 04 | 0 03 | 0 03 | 0 02 | 0 05 | 0 07 |
| NICKEL | 10 3 J | 21 5 J | 19 6 J | 27 6 | 37 1 J | 13 9 J | 70 7 J |
| POTASSIUM | 342 J | 323 J | 307 J | 2230 J | 330 J | 369 J | 1140 J |
| SELENIUM | 0 23 | 0 19 U | 0 18 U | 0 22 U | 0 60 U | 0 64 U | 0 61 U |
| SILVER | 0 06 U | 0 15 U | 0 5 J | 0 05 U | 0 04 U | 0 05 U | 0 04 |
| SODIUM | 12 2 U | 16 U | 11 4 U | 64 1 J | 3 5 U | 7 2 U | 13 5 U |
| THALLIUM | 0 06 | 0 08 | 0 07 | 0 11 | 0 11 | 0 09 | 0 08 |
| TIN | 1 1 U | 3 U | 1 1 U | 0 56 U | 0 28 U | 0 31 U | 0 44 U |
| VANADIUM | 12 2 J | 27 8 J | 23 2 J | 19 1 | 34 5 | 18 8 | 16 6 |
| ZINC | 41 1 J | 133 J | 91 1 J | 33 1 J | 62 4 J | 36 2 J | 176 J |
| **Miscellaneous Parameters (mg/kg)** | | | | | | | |
| NITRATE | 1 3 U | 3 8 | 2 2 | 4 4 | 3 4 | 3 8 | 2 9 |
| NITRITE | 3 5 J | 2 5 UJ | 2 5 UJ | 27 0 UJ | 2 3 UR | 2 5 UR | 160 UR |
| NITRITE/NITRATE | 3 9 | 3 8 J | 2 2 J | 4 4 | 3 4 | 3 8 | 2 9 |
| TOTAL ORGANIC CARBON | 7100 | 6700 | 4600 | 3300 J | 7200 | 10000 | 7900 |
| **Miscellaneous Parameters (%)** | | | | | | | |
| PERCENT MOISTURE | 22 4 | 25 9 | 21 9 | 18 | 18 4 | 18 | 19 3 |
| **Miscellaneous Parameters (S U )** | | | | | | | |
| PH | 7 5 J | 7 2 J | 7 6 J | 6 6 J | 5 7 J | 5 3 J | 6 0 J |

TABLE 4-5

SUMMARY OF DETECTED CHEMICALS IN DEEP SEDIMENT
SWMU 03 OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SD05 | 03SWSD06 | 03SD07 | 03SWSD08 | 03SWSD09 | 03SD10 | 03SWSD11 | 03SD12 | 03SWSD13 | 03SWSD14 | 03SWSD15 | 03SWSD16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SD050612 | 03SD060612 | 03SD070612 | 03SD080612 | 03SD090612 | 03SD100612 | 03SD110612 | 03SD120612 | 03SD130612 | 03SD140612 | 03SD150612 | 03SD160612 |
| SAMPLE | 03SD050612 | 03SD060612 | 03SD070612 | 03SD080612 | 03SD090612 | 03SD100612 | 03SD110612 | 03SD120612 | 03SD130612 | 03SD140612 | 03SD150612 | 03SD160612 |
| MATRIX | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/kg)** | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 2 8 U | 1 1 U | 2 J | 4 3 U | 1 J | 2 7 U | 3 U | 2 7 U | 2 J | 3 3 U | 1 3 U | 2 J |
| 2-BUTANONE | 15 J | 1 1 UJ | 0 96 UJ | 4 3 U | 1 UJ | 2 7 U | 3 U | 2 7 UJ | 1 2 U | 3 3 UJ | 1 3 U | 1 2 U |
| ACETONE | 86 J | 29 J | 45 BJ | 4 3 UJ | 14 BU | 39 BU | 38 BU | 2 7 U | 6 U | 72 BU | 1 3 U | 1 2 U |
| CARBON DISULFIDE | 2 8 U | 1 1 J | 0 96 UJ | 4 3 UJ | 1 UJ | 2 7 UJ | 3 UJ | 2 7 UJ | 1 2 UJ | 3 3 UJ | 1 3 UJ | 1 J |
| TOLUENE | 2 8 U | 1 1 U | 0 96 U | 4 3 U | 1 U | 2 7 U | 3 U | 2 7 U | 1 2 U | 3 3 U | 1 3 U | 1 2 U |
| TRICHLOROFLUOROMETHANE | 2 8 U | 1 1 U | 0 96 U | 4 3 U | 2 J | 2 7 U | 3 U | 2 7 U | 1 2 U | 3 3 U | 1 3 U | 1 2 U |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | |
| BENZO(A)ANTHRACENE | 1 9 U | 1 5 U | 1 4 U | 2 1 U | 1 5 U | 1 6 U | 1 5 U | 1 6 U | 1 4 U | 1 7 U | 1 7 U | 11 |
| BENZO(B)FLUORANTHENE | 1 9 U | 1 5 U | 1 4 U | 2 1 U | 1 5 U | 1 6 U | 1 5 U | 1 6 U | 1 4 U | 1 7 U | 1 7 U | 15 |
| CHRYSENE | 1 9 U | 1 5 U | 1 4 U | 2 1 U | 1 5 U | 1 6 U | 1 5 U | 1 6 U | 1 4 U | 1 7 U | 1 7 U | 10 |
| DI-N-BUTYL PHTHALATE | 98 U | 330 BU | 73 U | 110 U | 78 U | 110 J | 880 | 81 U | 74 U | 89 U | 89 U | 83 U |
| FLUORANTHENE | 1 9 U | 1 5 U | 1 4 U | 2 1 U | 1 5 U | 1 6 U | 1 5 U | 1 6 U | 1 4 U | 1 7 U | 1 7 U | 27 |
| PHENANTHRENE | 1 9 U | 1 5 U | 1 4 U | 2 1 U | 1 5 U | 1 6 U | 1 5 U | 1 6 U | 1 4 U | 1 7 U | 1 7 U | 23 |
| PYRENE | 1 9 U | 1 5 U | 1 4 U | 2 1 U | 1 5 U | 1 6 U | 1 5 U | 1 6 U | 1 4 U | 1 7 U | 1 7 U | 19 |
| **Energetics (mg/kg)** | | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 56 | 1 1 | 2 2 | 0 34999 J | 0 5 | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 73 | 0 35 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 1 U | 0 4 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 48 J | 19 | 0 68 | 0 37 J | 0 25 U | 0 25 U | 0 25 U |
| RDX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 45 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Herbicides (µg/kg)** | | | | | | | | | | | | |
| 2,4,5-T | 2 1 U | 1 7 U | 1 5 U | 2 3 U | 1 6 U | 1 7 U | 4 5 | 4 | 3 6 | 1 9 U | 1 9 U | 2 5 J |
| 2,4,5-TP (SILVEX) | 2 1 U | 2 9 J | 1 5 U | 2 3 U | 1 6 U | 1 7 U | 1 6 U | 1 7 U | 1 6 U | 1 9 U | 1 9 U | 2 3 J |
| 2,4-D | 28 J | 1 7 U | 1 5 U | 7 8 R | 1 6 U | 14 J | 1 6 U | 8 8 | 5 R | 4 2 R | 1 9 U | 7 2 |
| DINOSEB | 2 1 U | 1 7 U | 1 5 U | 2 3 U | 1 6 U | 1 7 U | 1 6 U | 1 7 U | 1 6 U | 3 5 J | 1 9 U | 1 7 U |
| HEXACHLOROPHENE | 9 8 U | 8 U | 7 3 U | 7 6 J | 7 8 U | 2 8 J | 7 6 U | 8 1 U | 7 4 U | 8 9 U | 8 9 U | 8 3 U |
| PENTACHLOROPHENOL | 3 7 J | 0 4 U | 0 37 U | 3 3 R | 0 4 U | 0 41 U | 0 39 U | 0 82 R | 0 38 U | 1 9 R | 0 86 R | 0 42 U |

TABLE 4-5

SUMMARY OF DETECTED CHEMICALS IN DEEP SEDIMENT
SWMU 03 OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SD05 | 03SWSD06 | 03SD07 | 03SWSD08 | 03SWSD09 | 03SD10 | 03SWSD11 | 03SD12 | 03SWSD13 | 03SWSD14 | 03SWSD15 | 03SWSD16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SD050612 | 03SD060612 | 03SD070612 | 03SD080612 | 03SD090612 | 03SD100612 | 03SD110612 | 03SD120612 | 03SD130612 | 03SD140612 | 03SD150612 | 03SD160612 |
| SAMPLE | 03SD050612 | 03SD060612 | 03SD070612 | 03SD080612 | 03SD090612 | 03SD100612 | 03SD110612 | 03SD120612 | 03SD130612 | 03SD140612 | 03SD150612 | 03SD160612 |
| MATRIX | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD | SD |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Inorganics (mg/kg)** | | | | | | | | | | | | |
| ALUMINUM | 8140 J | 5790 J | 3150 | 7420 | 11000 | 21000 | 56900 | 17200 J | 8720 J | 6680 J | 15500 J | 12900 J |
| ANTIMONY | 1 1 J | 1 2 J | 0 85 J | 0 6 U | 0 36 U | 4 1 J | 6 7 J | 2 3 J | 1 6 J | 1 1 U | 3 4 J | 1 3 U |
| ARSENIC | 5 4 | 7 1 | 4 1 | 5 9 | 3 5 | 9 5 | 14 | 16 | 10 2 | 4 7 | 17 5 | 13 2 |
| BARIUM | 152 J | 138 J | 47 5 J | 105 J | 55 8 J | 419 J | 981 J | 744 J | 180 J | 196 J | 353 J | 126 J |
| BERYLLIUM | 0 67 | 1 | 0 72 | 0 65 | 0 44 | 0 87 | 1 5 | 1 4 | 1 | 0 43 | 1 5 | 1 1 |
| CADMIUM | 0 63 J | 1 J | 0 39 J | 0 55 J | 0 31 U | 1 8 J | 2 9 J | 4 | 2 5 | 1 1 | 2 | 0 96 |
| CALCIUM | 2250 | 32300 | 701 J | 2800 J | 1410 J | 2970 J | 10900 J | 2090 J | 3130 J | 1890 J | 2770 J | 1150 J |
| CHROMIUM | 13 9 J | 28 3 J | 16 3 J | 10 9 J | 9 2 J | 26 2 J | 48 9 J | 40 7 J | 41 9 J | 8 J | 48 7 J | 30 2 J |
| COBALT | 12 3 | 14 8 | 7 9 | 11 9 | 15 9 | 15 4 | 19 9 | 14 6 J | 19 2 J | 9 J | 29 1 J | 20 5 J |
| COPPER | 16 2 J | 12 5 J | 9 5 | 8 8 | 7 9 | 148 | 273 | 89 3 | 49 7 | 41 9 | 105 | 33 3 |
| IRON | 18500 J | 87700 J | 33700 J | 15400 J | 15500 J | 39600 J | 70800 J | 51300 J | 62500 J | 12500 J | 74600 J | 50400 J |
| LEAD | 34 6 J | 181 J | 26 5 | 15 8 | 11 8 | 149 | 445 | 122 J | 98 3 J | 59 3 J | 159 J | 53 9 J |
| MAGNESIUM | 1760 J | 4980 J | 414 J | 1220 J | 945 J | 1390 J | 3010 J | 768 J | 655 J | 613 J | 1040 J | 671 J |
| MANGANESE | 423 J | 1070 J | 423 J | 1020 J | 1060 J | 1350 J | 2050 J | 1020 J | 1530 J | 316 J | 2320 J | 1390 J |
| MERCURY | 0 07 | 0 02 | 0 05 J | 0 03 J | 0 03 J | 0 12 J | 0 08 J | 0 13 | 0 03 | 0 13 | 0 05 | 0 04 |
| NICKEL | 17 9 | 26 2 | 15 2 J | 13 9 J | 10 1 J | 21 9 J | 36 1 J | 23 7 J | 21 6 J | 12 6 J | 35 7 J | 25 7 J |
| POTASSIUM | 802 J | 421 J | 236 J | 523 J | 773 J | 509 J | 476 J | 513 J | 341 J | 455 J | 350 J | 361 J |
| SELENIUM | 0 22 U | 0 17 U | 0 28 U | 0 78 U | 0 45 U | 0 17 U | 0 16 U | 0 18 U | 0 36 | 0 2 U | 0 19 U | 0 19 U |
| SILVER | 0 28 U | 0 04 U | 0 04 U | 0 06 U | 0 04 U | 0 16 U | 0 43 J | 0 1 U | 0 23 J | 0 26 J | 0 1 U | 0 05 U |
| SODIUM | 48 5 U | 88 5 J | 5 5 U | 5 U | 3 5 U | 3 4 U | 11 3 U | 18 5 U | 12 3 U | 18 5 U | 19 8 U | 10 5 U |
| THALLIUM | 0 11 | 0 07 | 0 05 | 0 1 | 0 12 | 0 07 | 0 08 | 0 07 | 0 08 | 0 06 | 0 12 | 0 08 |
| TIN | 1 1 U | 2 7 U | 1 5 J | 0 42 U | 0 39 U | 4 1 J | 1 7 J | 2 4 U | 0 79 U | 3 4 U | 3 8 U | 0 96 U |
| VANADIUM | 17 5 | 36 9 | 10 2 | 18 5 | 17 | 21 2 | 47 1 | 30 8 J | 31 9 J | 10 6 J | 43 5 J | 30 J |
| ZINC | 55 6 J | 111 J | 54 6 J | 31 5 J | 21 4 J | 412 J | 1120 J | 421 J | 185 J | 133 J | 319 J | 136 J |
| **Miscellaneous Parameters (mg/kg)** | | | | | | | | | | | | |
| NITRATE | 3 | 1 6 | 3 1 | 5 9 | 2 6 | 4 8 | 3 4 | 6 5 | 1 1 U | 3 8 | 3 5 | 3 6 |
| NITRITE | 14 UJ | 2 6 J | 2 UR | 3 UR | 22 UR | 2 3 UR | 2 3 UR | 12 UJ | 2 7 J | 52 UJ | 2 4 UJ | 4 UJ |
| NITRITE/NITRATE | 3 | 4 2 | 3 1 | 5 9 | 2 6 | 4 8 | 3 4 | 6 5 | 3 3 | 3 8 | 3 5 | 3 6 |
| TOTAL ORGANIC CARBON | 6900 J | 2300 J | 3199 9 | 34000 | 3600 | 18000 | 9100 | 14000 | 4100 | 11000 | 5700 | 6000 |
| **Miscellaneous Parameters (%)** | | | | | | | | | | | | |
| PERCENT MOISTURE | 21 5 | 22 | 8 2 | 24 | 13 5 | 17 5 | 17 8 | 25 7 | 24 2 | 25 6 | 28 9 | 26 7 |
| **Miscellaneous Parameters (S U )** | | | | | | | | | | | | |
| PH | 7 5 J | 7 7 J | 7 6 J | 6 8 J | 7 5 J | 7 7 J | 8 J | 7 5 J | 7 9 J | 7 2 J | 7 8 J | 7 4 J |

TABLE 4-5

SUMMARY OF DETECTED CHEMICALS IN DEEP SEDIMENT
SWMU 03 OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD17 | 03SWSD18 | 03SWSD19 | 03SWSD01 | 03SWSD02 | 03SWSD03 | 03SWSD04 |
|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SD170612 | 03SD180612 | 03SD190612 | 03SD010612 | 03SD020612 | 03SD030612 | 03SD040612 |
| SAMPLE | 03SD170612 | 03SD180612 | 03SD190612 | 03SD010612 | 03SD020612 | 03SD030612 | 03SD040612 |
| MATRIX | SD | SD | SD | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/kg)** | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 1 2 U | 1 3 U | 4 | 2 J | 2 7 U | 10 U | 3 6 U |
| 2-BUTANONE | 10 | 60 | 1 1 U | 1 2 UJ | 2 7 U | 10 UJ | 3 6 U |
| ACETONE | 28 U | 220 J | 1 1 U | 12 U | 2 7 UJ | 320 U | 3 6 UJ |
| CARBON DISULFIDE | 1 2 UJ | 5 UJ | 1 J | 1 2 UJ | 2 7 UJ | 10 UJ | 3 6 UJ |
| TOLUENE | 1 2 U | 54 | 1 1 U | 1 2 U | 2 7 U | 10 U | 3 6 U |
| TRICHLOROFLUOROMETHANE | 1 2 U | 1 3 U | 1 1 U | 2 J | 2 7 U | 10 UJ | 3 6 U |
| **Semivolatile Organics (µg/kg)** | | | | | | | |
| BENZO(A)ANTHRACENE | 1 8 U | 1 9 U | 1 6 U | 1 7 U | 1 6 U | 1 6 U | 81 U |
| BENZO(B)FLUORANTHENE | 1 8 U | 11 | 1 6 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U |
| CHRYSENE | 1 8 U | 1 9 U | 1 6 U | 1 7 U | 1 6 U | 1 6 U | 81 U |
| DI-N-BUTYL PHTHALATE | 94 U | 95 U | 180 BU | 85 U | 80 U | 83 U | 81 U |
| FLUORANTHENE | 1 8 U | 1 9 U | 1 6 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U |
| PHENANTHRENE | 1 8 U | 1 9 U | 1 6 U | 1 7 U | 1 6 U | 1 6 U | 1 6 U |
| PYRENE | 1 8 U | 1 9 U | 1 6 U | 1 7 U | 1 6 U | 1 6 U | 81 U |
| **Energetics (mg/kg)** | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 2-AMINO-4,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| 4-AMINO-2,6-DINITROTOLUENE | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| HMX | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| RDX | 0 25 U | 0 44999 J | 0 25 U | 0 25 U | 0 25 U | 0 25 U | 0 25 U |
| **Herbicides (µg/kg)** | | | | | | | |
| 2,4,5-T | 2 U | 2 U | 3 1 J | 1 8 U | 1 7 U | 3 3 J | 3 9 |
| 2,4,5-TP (SILVEX) | 2 U | 2 U | 1 7 U | 1 8 U | 2 4 J | 1 7 U | 1 7 U |
| 2,4-D | 6 9 J | 2 U | 1 7 U | 1 8 U | 1 7 U | 9 3 R | 7 8 J |
| DINOSEB | 3 5 J | 2 U | 1 7 U | 1 8 U | 7 5 J | 1 7 U | 1 7 U |
| HEXACHLOROPHENE | 9 4 U | 9 5 U | 8 3 U | 8 5 U | 2 6 J | 8 3 U | 8 1 U |
| PENTACHLOROPHENOL | 0 48 U | 2 1 | 0 42 U | 0 43 U | 4 4 J | 1 7 J | 0 41 U |

TABLE 4-5

SUMMARY OF DETECTED CHEMICALS IN DEEP SEDIMENT
SWMU 03 OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD17 | 03SWSD18 | 03SWSD19 | 03SWSD01 | 03SWSD02 | 03SWSD03 | 03SWSD04 |
|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SD170612 | 03SD180612 | 03SD190612 | 03SD010612 | 03SD020612 | 03SD030612 | 03SD040612 |
| SAMPLE | 03SD170612 | 03SD180612 | 03SD190612 | 03SD010612 | 03SD020612 | 03SD030612 | 03SD040612 |
| MATRIX | SD | SD | SD | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| DEPTH RANGE | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 | 0 5 - 1 |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Inorganics (mg/kg)** | | | | | | | |
| ALUMINUM | 4650 J | 12500 J | 5250 J | 9960 | 5910 | 7820 | 8950 |
| ANTIMONY | 0 62 U | 1 3 U | 1 3 U | 0 13 U | 0 79 J | 1 0 J | 0 45 U |
| ARSENIC | 6 5 | 16 1 | 6 7 | 0 29 | 9 5 | 9 4 | 9 6 |
| BARIUM | 57 3 J | 228 J | 112 J | 129 J | 45 1 J | 65 0 J | 54 2 J |
| BERYLLIUM | 0 65 | 1 3 | 1 3 | 1 2 | 1 1 | 1 5 | 1 2 |
| CADMIUM | 0 47 | 1 6 | 0 56999 | 0 56 J | 0 38 J | 0 48 J | 0 33 U |
| CALCIUM | 2140 J | 1030 J | 676 J | 2860 J | 424 J | 391 J | 643 J |
| CHROMIUM | 20 9 J | 37 9 J | 43 9 J | 10 8 J | 24 1 J | 53 7 J | 16 4 J |
| COBALT | 11 2 J | 19 8 J | 25 2 J | 20 | 15 2 | 31 | 19 4 |
| COPPER | 9 5 | 52 8 | 20 1 | 8 3 | 11 8 | 12 1 | 17 8 |
| IRON | 23200 J | 51400 J | 64400 J | 9070 J | 38700 J | 62800 J | 40200 J |
| LEAD | 16 5 J | 61 1 J | 37 J | 3 6 | 20 1 | 26 4 | 20 2 |
| MAGNESIUM | 444 J | 552 J | 368 J | 3350 J | 602 J | 815 J | 1790 J |
| MANGANESE | 328 J | 1140 J | 1190 J | 221 J | 764 J | 1870 J | 516 J |
| MERCURY | 0 03 U | 0 03 | 0 01999 U | 0 020 UJ | 0 03 | 0 03 | 0 02 U |
| NICKEL | 13 5 J | 26 7 J | 28 1 J | 48 6 J | 16 4 J | 31 2 J | 30 1 J |
| POTASSIUM | 344 J | 320 J | 269 J | 3220 J | 349 J | 392 J | 837 J |
| SELENIUM | 0 2 U | 0 2 U | 0 18 U | 0 36 U | 0 75 U | 0 53 U | 0 63 U |
| SILVER | 0 05 U | 0 07 U | 0 28 J | 0 04 U | 0 04 U | 0 05 U | 0 05 U |
| SODIUM | 12 7 U | 14 U | 4 4 U | 38 6 U | 3 4 U | 3 7 U | 3 8 U |
| THALLIUM | 0 07 | 0 07 | 0 07999 | 0 08 | 0 08 U | 0 1 | 0 1 |
| TIN | 1 U | 1 4 U | 0 46 U | 0 48 U | 0 30 U | 0 33 U | 0 35 U |
| VANADIUM | 17 8 J | 32 6 J | 32 4 J | 3 4 | 27 9 | 36 2 | 21 6 |
| ZINC | 50 1 J | 186 J | 113 J | 21 6 J | 36 3 J | 58 0 J | 80 9 J |
| **Miscellaneous Parameters (mg/kg)** | | | | | | | |
| NITRATE | 3 2 | 3 3 | 2 7 | 3 1 | 2 6 | 2 8 | 2 8 |
| NITRITE | 4 7 UJ | 2 6 UJ | 2 3 UJ | 24 0 UR | 16 0 UR | 20 0 UR | 23 0 UR |
| NITRITE/NITRATE | 3 2 | 3 3 J | 2 7 J | 3 1 | 2 6 | 2 8 | 2 8 |
| TOTAL ORGANIC CARBON | 9500 | 11000 | 2600 | 2800 | 7099 9 | 5000 | 4499 9 |
| **Miscellaneous Parameters (%)** | | | | | | | |
| PERCENT MOISTURE | 27 2 | 38 8 | 14 1 | 17 3 | 16 7 | 13 4 | 16 3 |
| **Miscellaneous Parameters (S U )** | | | | | | | |
| PH | 7 5 J | 7 2 J | 7 5 J | 7 0 J | 5 3 J | 5 0 J | 6 0 J |

TABLE 4-6

SUMMARY OF DETECTED CHEMICALS IN LOW-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD06 | 03SWSD06 | 03SWSD15 | 03SWSD15 | 03SWSD16 | 03SWSD16 | 03SWSD17 | 03SWSD17 | 03SWSD18 | 03SWSD18 | 03SWSD19 | 03SWSD19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SW0601 | 03SW0601-F | 03SW1501 | 03SW1501-F | 03SW1601 | 03SW1601-F | 03SW1701 | 03SW1701-F | 03SW1801 | 03SW1801-F | 03SW1901 | 03SW1901-F |
| SAMPLE | 03SW0601 | 03SW0601-F | 03SW1501 | 03SW1501-F | 03SW1601 | 03SW1601-F | 03SW1701 | 03SW1701-F | 03SW1801 | 03SW1801-F | 03SW1901 | 03SW1901-F |
| MATRIX | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | ORIG |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/L)** | | | | | | | | | | | | |
| 2-BUTANONE | 0 5 UR | | 0 5 U | | 0 5 U | | 0 6 J | | 0 5 UJ | | 0 5 UJ | |
| BROMOMETHANE | 0 5 U | | 0 8 | | 1 | | 1 6 | | 0 5 U | | 0 5 U | |
| TRICHLOROETHENE | 0 5 U | | 0 5 U | | 0 5 U | | 0 4 J | | 0 5 U | | 0 5 U | |
| **Energetics (µg/L)** | | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 35 U | | 0 35 U | | 0 35 U | | 0 56 | | 0 35 U | | 0 35 U | |
| 2-AMINO-4,6-DINITROTOLUENE | 0 75 J | | 0 35 U | | 0 35 U | | 0 37 J | | 0 35 U | | 0 35 U | |
| 4-AMINO-2,6-DINITROTOLUENE | 1 7 | | 0 35 U | | 0 35 U | | 0 83 | | 0 68 J | | 0 54 J | |
| HMX | 12 | | 3 1 | | 3 1 J | | 7 2 J | | 7 2 | | 6 5 J | |
| RDX | 4 4 | | 2 4 J | | 2 3 | | 11 | | 9 5 | | 7 7 J | |
| **Herbicides (µg/L)** | | | | | | | | | | | | |
| 2,4,5-T | 0 064 J | | 0 04 U | | 0 04 U | | 0 042 R | | 0 04 U | | 0 04 U | |
| **Total Metals (µg/L)** | | | | | | | | | | | | |
| ALUMINUM | 213 J | | 86 7 | | 24 | | 73 7 | | 46 | | 29 9 | |
| ARSENIC | 0 56 | | 0 23 | | 0 23 | | 0 29 | | 0 3 | | 0 26 | |
| BARIUM | 120 J | | 61 6 | | 83 1 | | 96 1 | | 98 3 | | 97 5 | |
| BERYLLIUM | 0 10 U | | 0 10 U | | 0 10 U | | 0 10 U | | 0 10 U | | 0 10 U | |
| CALCIUM | 31600 | | 26400 J | | 27400 J | | 27300 J | | 27800 J | | 31000 J | |
| CHROMIUM | 0 6 J | | 0 47 U | | 0 33 U | | 0 49 U | | 0 4 U | | 0 33 U | |
| COBALT | 0 31 | | 0 13 | | 0 1 U | | 0 16 | | 0 15 | | 0 12 | |
| COPPER | 2 5 | | 0 75 | | 2 2 | | 1 5 | | 1 3 | | 1 1 | |
| IRON | 373 | | 203 J | | 114 J | | 221 J | | 179 J | | 150 J | |
| LEAD | 20 | | 0 25 | | 0 21 | | 0 83 | | 0 38 | | 0 2 | |
| MAGNESIUM | 10300 J | | 6830 J | | 6290 J | | 8120 J | | 7920 J | | 7560 J | |
| MANGANESE | 29 5 | | 7 4 J | | 10 2 J | | 21 3 J | | 15 7 J | | 34 8 J | |
| NICKEL | 1 9 J | | 1 2 | | 1 | | 1 4 | | 1 | | 1 1 | |
| POTASSIUM | 5100 | | 1170 J | | 1300 J | | 2150 J | | 2150 J | | 2000 J | |
| SODIUM | 5850 | | 4290 | | 3730 | | 4700 | | 4520 | | 4440 | |
| TIN | 2 6 U | | 2 8 J | | 4 9 J | | 3 8 J | | 4 2 J | | 4 9 J | |
| VANADIUM | 0 54 | | 0 16 | | 0 1 U | | 0 15 | | 0 12 | | 0 1 U | |
| ZINC | 6 3 U | | 2 1 | | 2 5 | | 3 4 | | 3 1 | | 1 8 | |

TABLE 4-6

SUMMARY OF DETECTED CHEMICALS IN LOW-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD06 | 03SWSD06 | 03SWSD15 | 03SWSD15 | 03SWSD16 | 03SWSD16 | 03SWSD17 | 03SWSD17 | 03SWSD18 | 03SWSD18 | 03SWSD19 | 03SWSD19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SW0601 | 03SW0601-F | 03SW1501 | 03SW1501-F | 03SW1601 | 03SW1601-F | 03SW1701 | 03SW1701-F | 03SW1801 | 03SW1801-F | 03SW1901 | 03SW1901-F |
| SAMPLE | 03SW0601 | 03SW0601-F | 03SW1501 | 03SW1501-F | 03SW1601 | 03SW1601-F | 03SW1701 | 03SW1701-F | 03SW1801 | 03SW1801-F | 03SW1901 | 03SW1901-F |
| MATRIX | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | ORIG |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Dissolved Metals (µg/L)** | | | | | | | | | | | | |
| ALUMINUM, FILTERED | | 19 3 U | | 10 6 | | 2 6 U | | 2 6 U | | 2 6 U | | 5 6 |
| ANTIMONY, FILTERED | | 1 2 J | | 0 2 U | | 0 14 U | | 0 36 U | | 0 32 U | | 0 2 U |
| ARSENIC, FILTERED | | 0 42 | | 0 2 U | | 0 23 | | 0 26 | | 0 21 | | 0 24 |
| BARIUM, FILTERED | | 114 J | | 63 1 | | 81 7 | | 105 | | 97 7 | | 98 3 |
| CALCIUM, FILTERED | | 31200 | | 27100 J | | 27100 J | | 29200 J | | 26900 J | | 26900 J |
| CADMIUM, FILTERED | | 0 70 U | | 0 70 U | | 0 70 U | | 0 70 U | | 0 70 U | | 0 70 U |
| CHROMIUM, FILTERED | | 0 19 U | | 0 43 U | | 0 37 U | | 0 53 J | | 0 38 U | | 0 37 U |
| COBALT, FILTERED | | 0 19 | | 0 11 | | 0 73 | | 0 11 | | 0 13 | | 0 13 |
| COPPER, FILTERED | | 1 5 | | 0 54 | | 1 2 | | 1 4 | | 1 2 | | 1 |
| IRON, FILTERED | | 154 J | | 105 | | 107 | | 108 | | 98 6 | | 97 6 |
| LEAD, FILTERED | | 1 1 | | 0 1 U | | 0 1 U | | 0 1 U | | 0 1 U | | 0 1 U |
| MAGNESIUM, FILTERED | | 10400 J | | 6770 J | | 6000 J | | 7810 J | | 7880 J | | 7330 J |
| MANGANESE, FILTERED | | 10 2 | | 3 4 J | | 4 6 J | | 12 2 J | | 12 1 J | | 35 6 J |
| NICKEL, FILTERED | | 1 2 J | | 1 1 | | 1 2 | | 1 4 | | 1 2 | | 1 1 |
| POTASSIUM, FILTERED | | 5010 | | 1150 J | | 1250 J | | 2080 J | | 2090 J | | 1930 J |
| SELENIUM, FILTERED | | 0 52 J | | 0 4 U | | 0 4 U | | 0 4 U | | 0 4 U | | 0 4 U |
| SODIUM, FILTERED | | 6020 | | 4200 | | 3540 | | 4410 | | 4480 | | 4210 |
| TIN, FILTERED | | 4 4 U | | 4 6 J | | 4 9 J | | 5 6 J | | 5 4 J | | 5 J |
| VANADIUM, FILTERED | | 0 18 | | 0 1 U | | 0 1 U | | 0 1 U | | 0 1 U | | 0 1 U |
| ZINC, FILTERED | | 0 5 UJ | | 1 5 | | 1 6 | | 2 8 | | 2 3 | | 2 6 |
| **Miscellaneous Parameters (mg/L)** | | | | | | | | | | | | |
| TOTAL SUSPENDED SOLIDS | 20 J | | 2 U | | 2 U | | 9 | | 2 U | | 2 U | |
| **Field Parameters** | | | | | | | | | | | | |
| DISSOLVED OXYGEN (mg/L) | 9 06 | | 10 92 | | 7 9 | | 9 62 | | 10 53 | | 10 27 | |
| NITRATE (mg/L) | 0 1 | | 0 19 | | 0 14 | | 0 2 | | 0 15 | | 0 13 | |
| NITRITE (mg/L) | 0 | | 0 003 | | 0 001 | | 0 004 | | 0 001 | | 0 002 | |
| OXIDATION REDUCTION POTENTIAL (MV) | 316 4 | | 342 | | 335 | | 372 | | 396 | | 394 | |
| PH (S U ) | 8 25 | | 7 79 | | 7 61 | | 7 26 | | 7 32 | | 6 62 | |
| SPECIFIC CONDUCTANCE (MS/CM) | 0 312 | | 0 263 | | 0 261 | | 0 292 | | 0 276 | | 0 275 | |
| TEMPERATURE (C) | 25 45 | | 15 | | 16 01 | | 14 5 | | 14 7 | | 14 6 | |
| TURBIDITY (NTU) | 8 4 | | 0 | | 0 | | 0 7 | | 1 6 | | 1 3 | |

TABLE 4-6

SUMMARY OF DETECTED CHEMICALS IN LOW-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD01 | 03SWSD01 | 03SWSD02 | 03SWSD02 | 03SWSD03 | 03SWSD03 |
|---|---|---|---|---|---|---|
| NSAMPLE | 03SW0101 | 03SW0101-F | 03SW0201 | 03SW0201-F | 03SW0301 | 03SW0301-F |
| SAMPLE | 03SW0101 | 03SW0101-F | 03SW0201 | 03SW0201-F | 03SW0301 | 03SW0301-F |
| MATRIX | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/L)** | | | | | | |
| 2-BUTANONE | 0 5 UR | | 0 5 UR | | 0 5 UR | |
| BROMOMETHANE | 0 5 U | | 0 5 U | | 0 5 U | |
| TRICHLOROETHENE | 0 5 U | | 0 5 U | | 0 5 U | |
| **Energetics (µg/L)** | | | | | | |
| 2,4,6-TRINITROTOLUENE | 0 35 U | | 0 35 U | | 0 35 U | |
| 2-AMINO-4,6-DINITROTOLUENE | 0 35 U | | 0 35 U | | 0 35 U | |
| 4-AMINO-2,6-DINITROTOLUENE | 0 35 U | | 0 35 U | | 0 35 U | |
| HMX | 0 35 U | | 0 35 U | | 0 35 U | |
| RDX | 0 35 U | | 0 35 U | | 0 35 U | |
| **Herbicides (µg/L)** | | | | | | |
| 2,4,5-T | 0 04 U | | 0 04 U | | 0 04 U | |
| **Total Metals (µg/L)** | | | | | | |
| ALUMINUM | 221 J | | 53 9 J | | 368 J | |
| ARSENIC | 0 24 | | 0 20 U | | 0 3 | |
| BARIUM | 63 0 J | | 76 0 J | | 73 9 J | |
| BERYLLIUM | 0 10 U | | 0 10 U | | 0 13 | |
| CALCIUM | 12700 | | 10800 | | 7620 | |
| CHROMIUM | 0 24 U | | 0 10 U | | 0 38 U | |
| COBALT | 0 3 | | 0 17 | | 1 | |
| COPPER | 0 78 | | 0 41 | | 1 4 | |
| IRON | 451 | | 148 | | 543 | |
| LEAD | 0 43 | | 0 14 | | 0 88 | |
| MAGNESIUM | 6280 J | | 7160 J | | 5870 J | |
| MANGANESE | 25 8 | | 48 2 | | 141 | |
| NICKEL | 1 2 J | | 3 7 J | | 5 3 J | |
| POTASSIUM | 1160 | | 1230 | | 1360 | |
| SODIUM | 9080 | | 5320 | | 4070 | |
| TIN | 2 5 U | | 4 3 U | | 1 4 U | |
| VANADIUM | 0 41 | | 0 10 U | | 0 58 | |
| ZINC | 0 81 U | | 2 9 U | | 9 7 U | |

TABLE 4-6

SUMMARY OF DETECTED CHEMICALS IN LOW-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD01 | 03SWSD01 | 03SWSD02 | 03SWSD02 | 03SWSD03 | 03SWSD03 |
|---|---|---|---|---|---|---|
| NSAMPLE | 03SW0101 | 03SW0101-F | 03SW0201 | 03SW0201-F | 03SW0301 | 03SW0301-F |
| SAMPLE | 03SW0101 | 03SW0101-F | 03SW0201 | 03SW0201-F | 03SW0301 | 03SW0301-F |
| MATRIX | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Dissolved Metals (µg/L)** | | | | | | |
| ALUMINUM, FILTERED | | 18 8 U | | 23 8 U | | 18 2 U |
| ANTIMONY, FILTERED | | 1 5 J | | 0 10 U | | 0 11 U |
| ARSENIC, FILTERED | | 0 20 U | | 0 20 U | | 0 20 U |
| BARIUM, FILTERED | | 58 2 J | | 72 8 J | | 60 9 J |
| CALCIUM, FILTERED | | 12100 | | 10400 | | 7380 |
| CADMIUM, FILTERED | | 5 8 | | 0 70 U | | 0 70 U |
| CHROMIUM, FILTERED | | 0 10 U | | 0 10 U | | 0 10 U |
| COBALT, FILTERED | | 0 10 U | | 0 14 | | 0 51 |
| COPPER, FILTERED | | 0 44 | | 0 79 | | 0 62 |
| IRON, FILTERED | | 45 7 J | | 31 5 J | | 43 2 J |
| LEAD, FILTERED | | 0 10 U | | 0 10 U | | 0 13 |
| MAGNESIUM, FILTERED | | 5970 J | | 6970 J | | 5790 J |
| MANGANESE, FILTERED | | 2 4 | | 45 6 | | 135 |
| NICKEL, FILTERED | | 0 80 J | | 3 4 J | | 3 2 J |
| POTASSIUM, FILTERED | | 1100 | | 1180 | | 1320 |
| SELENIUM, FILTERED | | 0 40 U | | 0 40 U | | 0 40 U |
| SODIUM, FILTERED | | 9180 | | 5190 | | 4140 |
| TIN, FILTERED | | 5 5 U | | 4 8 U | | 4 8 U |
| VANADIUM, FILTERED | | 0 10 U | | 0 10 U | | 0 10 U |
| ZINC, FILTERED | | 1 6 U | | 2 8 U | | 1 9 U |
| **Miscellaneous Parameters (mg/L)** | | | | | | |
| TOTAL SUSPENDED SOLIDS | 78 0 J | | 2 0 J | | 31 0 J | |
| **Field Parameters** | | | | | | |
| DISSOLVED OXYGEN (mg/L) | 8 19 | | 5 33 | | 9 44 | |
| NITRATE (mg/L) | 0 21 | | 0 26 | | 0 32 | |
| NITRITE (mg/L) | 0 | | 0 | | 0 002 | |
| OXIDATION REDUCTION POTENTIAL (MV) | 315 1 | | 334 4 | | 386 | |
| PH (S U ) | 7 46 | | 7 03 | | 7 32 | |
| SPECIFIC CONDUCTANCE (MS/CM) | 0 193 | | 0 174 | | 0 14 | |
| TEMPERATURE (C) | 17 85 | | 16 98 | | 18 6 | |
| TURBIDITY (NTU) | 0 9 | | 1 4 | | 0 7 | |

TABLE 4-7

SUMMARY OF DETECTED CHEMICALS IN HIGH-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA
PAGE 1 OF 6

| LOCATION | 03SWSD06 | 03SWSD06 | 03SWSD08 | 03SWSD08 | 03SWSD09 | 03SWSD09 | 03SWSD11 | 03SWSD11 | 03SWSD13 | 03SWSD13 | 03SWSD14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SW0602 | 03SW0602-F | 03SW0802 | 03SW0802-F | 03SW0902 | 03SW0902-F | 03SW1102 | 03SW1102-F | 03SW1302 | 03SW1302-F | 03SW1402 |
| SAMPLE | 03SW0602 | 03SW0602-F | 03SW0802 | 03SW0802-F | 03SW0902 | 03SW0902-F | 03SW1102 | 03SW1102-F | 03SW1302 | 03SW1302-F | 03SW1402 |
| MATRIX | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW |
| SACODE | ORIG | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/L)** | | | | | | | | | | | |
| ACETONE | 0 5 UR | | 23 U | | 64 BJ | | 0 5 UR | | 26 U | | 0 5 UR |
| METHYLENE CHLORIDE | 0 5 U | | 9 5 J | | 13 BJ | | 0 5 U | | 5 3 U | | 0 5 U |
| **Semivolatile Organics (µg/L)** | | | | | | | | | | | |
| ACENAPHTHYLENE | 0 02 U | | 0 019 U | | 0 22 | | 0 019 U | | 0 019 U | | 0 019 U |
| BIS(2-ETHYLHEXYL)PHTHALATE | 1 U | | 1 U | | 4 | | 0 96 U | | 0 94 U | | 6 |
| **Energetics (µg/L)** | | | | | | | | | | | |
| 2-AMINO-4,6-DINITROTOLUENE | 0 35 U | | 0 35 U | | 0 35 U | | 0 35 U | | 0 35 U | | 0 35 U |
| 4-AMINO-2,6-DINITROTOLUENE | 1 4 J | | 0 35 U | | 0 35 U | | 0 35 U | | 0 35 U | | 0 35 U |
| HMX | 16 | | 0 35 U | | 90 | | 14 | | 20 | | 11 |
| NITROCELLULOSE | 1000 U | | 1000 U | | 1000 U | | 1000 U | | 1000 U | | 1000 U |
| RDX | 8 3 | | 0 35 U | | 1 5 J | | 4 8 | | 0 94 | | 0 35 U |
| **Herbicides (µg/L)** | | | | | | | | | | | |
| 2,4,5-T | 0 04 U | | 0 04 U | | 0 63 J | | 0 32 J | | 0 23 J | | 0 34 R |
| 2,4-D | 0 04 UJ | | 0 04 UJ | | 0 36 J | | 0 04 UJ | | 0 28 J | | 0 04 UJ |
| PENTACHLOROPHENOL | 0 084 R | | 0 01 U | | 0 041 R | | 0 71 J | | 0 01 U | | 0 021 R |
| **Total Metals (µg/L)** | | | | | | | | | | | |
| ALUMINUM | 824 | | 1490 | | 1580 | | 2010 | | 1830 | | 746 |
| ANTIMONY | 3 J | | 0 14 U | | 0 96 U | | 2 J | | 0 36 U | | 0 32 U |
| ARSENIC | 1 9 | | 1 3 | | 1 8 | | 2 5 | | 1 6 | | 0 84 |
| BARIUM | 124 J | | 58 7 J | | 126 J | | 103 J | | 76 1 J | | 45 6 J |
| BERYLLIUM | 0 1 U | | 0 12 | | 0 13 | | 0 12 | | 0 13 | | 0 1 U |
| CADMIUM | 0 83 | | 0 7 U | | 0 7 U | | 0 98 | | 0 7 U | | 1 4 |
| CALCIUM | 44700 | | 34400 | | 21400 | | 28100 | | 9580 | | 6890 |
| CHROMIUM | 2 7 J | | 2 2 J | | 3 2 J | | 4 5 J | | 2 4 J | | 1 5 J |
| COBALT | 0 83 | | 1 3 | | 1 9 | | 1 5 | | 1 3 | | 0 74 |
| COPPER | 13 9 | | 4 | | 17 5 | | 18 4 | | 13 3 | | 6 1 |
| IRON | 1080 J | | 2470 J | | 2470 J | | 2550 J | | 2510 J | | 1130 J |
| LEAD | 111 | | 3 9 | | 50 3 | | 285 | | 12 7 | | 7 9 |
| MAGNESIUM | 14300 | | 5000 U | | 6460 | | 8270 | | 5000 U | | 5000 U |
| MANGANESE | 66 9 | | 117 | | 175 | | 106 | | 98 5 | | 60 1 |
| NICKEL | 3 1 | | 3 4 | | 5 3 | | 4 2 | | 3 7 | | 1 9 |
| POTASSIUM | 21600 J | | 5000 U | | 8360 J | | 13700 J | | 5300 J | | 5000 U |
| SELENIUM | 0 62 | | 0 4 U | | 0 4 U | | 0 52 | | 0 4 U | | 0 4 U |
| SODIUM | 6210 | | 5000 U | | 5000 U | | 8070 | | 5000 U | | 5000 U |
| TIN | 3 8 J | | 0 22 U | | 0 9 U | | 0 2 U | | 0 1 U | | 0 36 U |
| VANADIUM | 2 | | 3 8 | | 3 3 | | 3 9 | | 3 5 | | 1 7 |
| ZINC | 78 7 | | 38 7 | | 49 6 | | 111 | | 34 5 | | 17 9 |

TABLE 4-7

SUMMARY OF DETECTED CHEMICALS IN HIGH-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD06 | 03SWSD06 | 03SWSD08 | 03SWSD08 | 03SWSD09 | 03SWSD09 | 03SWSD11 | 03SWSD11 | 03SWSD13 | 03SWSD13 | 03SWSD14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SW0602 | 03SW0602-F | 03SW0802 | 03SW0802-F | 03SW0902 | 03SW0902-F | 03SW1102 | 03SW1102-F | 03SW1302 | 03SW1302-F | 03SW1402 |
| SAMPLE | 03SW0602 | 03SW0602-F | 03SW0802 | 03SW0802-F | 03SW0902 | 03SW0902-F | 03SW1102 | 03SW1102-F | 03SW1302 | 03SW1302-F | 03SW1402 |
| MATRIX | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW |
| SACODE | ORIG | ORIG | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Dissolved Metals (µg/L)** | | | | | | | | | | | |
| ALUMINUM, FILTERED | | 200 U | | 289 | | 260 | | 267 | | 332 | |
| ANTIMONY, FILTERED | | 2 4 J | | 0 18 U | | 1 J | | 1 9 J | | 0 54 U | |
| ARSENIC, FILTERED | | 0 81 | | 0 32 | | 0 68 | | 1 | | 0 67 | |
| BARIUM, FILTERED | | 106 J | | 40 4 J | | 85 8 J | | 75 7 J | | 51 8 J | |
| BERYLLIUM, FILTERED | | | | | | | | | | | |
| CADMIUM, FILTERED | | 0 7 U | | 0 7 U | | 0 7 U | | 0 7 U | | 0 7 U | |
| CALCIUM, FILTERED | | 36200 | | 21100 | | 18800 | | 15700 | | 9520 | |
| CHROMIUM, FILTERED | | 1 1 J | | 0 56 J | | 1 4 J | | 1 3 J | | 0 8 J | |
| COBALT, FILTERED | | 0 33 | | 0 19 | | 0 33 | | 0 34 | | 0 24 | |
| COPPER, FILTERED | | 5 3 | | 1 8 | | 7 6 | | 6 4 | | 7 3 | |
| IRON, FILTERED | | 100 U | | 100 U | | 109 | | 100 U | | 171 | |
| LEAD, FILTERED | | 9 4 J | | 0 22 J | | 4 4 J | | 22 6 J | | 1 1 J | |
| MAGNESIUM, FILTERED | | 14000 | | 5000 U | | 6000 | | 7490 | | 5000 U | |
| MANGANESE, FILTERED | | 17 4 | | 15 U | | 21 3 | | 15 U | | 15 U | |
| NICKEL, FILTERED | | 1 7 | | 1 2 | | 2 4 | | 1 1 | | 1 5 | |
| POTASSIUM, FILTERED | | 22900 | | 5000 U | | 9370 | | 13600 | | 5220 | |
| SELENIUM, FILTERED | | 0 51 | | 0 4 U | | 0 4 U | | 0 4 U | | 0 4 U | |
| SODIUM, FILTERED | | 9390 | | 5000 U | | 5000 U | | 8420 | | 5000 U | |
| TIN, FILTERED | | 7 3 J | | 4 3 J | | 4 3 J | | 4 4 J | | 3 5 J | |
| VANADIUM, FILTERED | | 0 38 | | 0 41 | | 0 52 | | 0 61 | | 0 59 | |
| ZINC, FILTERED | | 4 7 | | 10 1 | | 6 6 | | 15 7 | | 6 9 | |
| **Miscellaneous Parameters (mg/L)** | | | | | | | | | | | |
| TOTAL SUSPENDED SOLIDS | 34 J | | 91 | | 87 | | 100 | | 59 | | 19 |
| **Field Parameters** | | | | | | | | | | | |
| DISSOLVED OXYGEN (mg/L) | 12 69 | | 13 9 | | 12 1 | | 13 94 | | 13 41 | | 12 61 |
| NITRATE (mg/L) | 1 44 | | 0 6 | | 0 46 | | 0 66 | | 0 15 | | 0 3 |
| NITRITE (mg/L) | 0 023 | | 0 | | 0 006 | | 0 | | 0 004 | | 0 002 |
| OXIDATION REDUCTION POTENTIAL (MV) | 203 | | 210 | | 150 | | 270 | | 238 | | 223 |
| PH (S U ) | 8 34 | | 8 31 | | 8 73 | | 8 14 | | 7 81 | | 7 7 |
| SPECIFIC CONDUCTANCE (MS/CM) | 0 366 | | 0 133 | | 0 118 | | 0 197 | | 0 081 | | 0 058 |
| TEMPERATURE (C) | 22 7 | | 21 6 | | 21 4 | | 23 5 | | 22 4 | | 22 7 |
| TURBIDITY (NTU) | 75 | | 140 | | 100 | | 190 | | 90 | | 45 |

TABLE 4-7

SUMMARY OF DETECTED CHEMICALS IN HIGH-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD14 | 03SWSD15 | 03SWSD15 | 03SWSD16 | 03SWSD16 | 03SWSD17 | 03SWSD17 | 03SWSD18 | 03SWSD18 | 03SWSD19 | 03SWSD19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SW1402-F | 03SW1502 | 03SW1502-F | 03SW1602 | 03SW1602-F | 03SW1702 | 03SW1702-F | 03SW1802 | 03SW1802-F | 03SW1902 | 03SW1902-F |
| SAMPLE | 03SW1402-F | 03SW1502 | 03SW1502-F | 03SW1602 | 03SW1602-F | 03SW1702 | 03SW1702-F | 03SW1802 | 03SW1802-F | 03SW1902 | 03SW1902-F |
| MATRIX | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | ORIG |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/L)** | | | | | | | | | | | |
| ACETONE | | 0 5 UR | | 0 5 UR | | 0 5 UR | | 0 5 UR | | 0 5 UR | |
| METHYLENE CHLORIDE | | 0 5 U | | 0 5 U | | 0 5 U | | 0 5 U | | 0 5 U | |
| **Semivolatile Organics (µg/L)** | | | | | | | | | | | |
| ACENAPHTHYLENE | | 0 02 U | | 0 02 U | | 0 02 U | | 0 02 U | | 0 02 U | |
| BIS(2-ETHYLHEXYL)PHTHALATE | | 0 98 U | | 0 98 U | | 0 99 U | | 0 99 U | | 0 99 U | |
| **Energetics (µg/L)** | | | | | | | | | | | |
| 2-AMINO-4,6-DINITROTOLUENE | | 0 35 U | | 0 35 U | | 1 5 J | | 0 35 U | | 0 35 U | |
| 4-AMINO-2,6-DINITROTOLUENE | | 0 35 U | | 0 35 U | | 2 9 | | 0 35 U | | 0 35 U | |
| HMX | | 1 1 J | | 1 5 | | 17 | | 10 | | 4 7 | |
| NITROCELLULOSE | | 3200 | | 1000 U | | 1000 U | | 1000 U | | 1000 U | |
| RDX | | 0 84 | | 0 62 | | 63 | | 39 J | | 10 | |
| **Herbicides (µg/L)** | | | | | | | | | | | |
| 2,4,5-T | | 0 04 U | | 0 04 U | | 0 04 U | | 0 04 U | | 0 04 U | |
| 2,4-D | | 0 04 UJ | | 0 04 UJ | | 0 04 UJ | | 0 04 UJ | | 0 04 UJ | |
| PENTACHLOROPHENOL | | 0 01 U | | 0 01 U | | 0 01 U | | 0 01 U | | 0 01 U | |
| **Total Metals (µg/L)** | | | | | | | | | | | |
| ALUMINUM | | 200 U | | 200 U | | 200 U | | 200 U | | 211 | |
| ANTIMONY | | 0 1 U | | 0 2 U | | 0 21 U | | 0 27 U | | 0 1 U | |
| ARSENIC | | 0 29 | | 0 32 | | 0 4 | | 0 43 | | 0 68 | |
| BARIUM | | 74 3 J | | 132 J | | 131 J | | 156 J | | 145 J | |
| BERYLLIUM | | 0 1 U | | 0 1 U | | 0 1 U | | 0 1 U | | 0 1 U | |
| CADMIUM | | 0 7 U | | 0 7 U | | 0 7 U | | 0 7 U | | 0 7 U | |
| CALCIUM | | 51300 | | 51900 | | 58900 | | 50200 | | 44800 | |
| CHROMIUM | | 0 71 J | | 0 46 U | | 0 75 J | | 0 47 U | | 0 67 J | |
| COBALT | | 0 12 | | 0 15 | | 0 15 | | 0 23 | | 0 58 | |
| COPPER | | 0 98 | | 1 4 | | 0 94 | | 1 3 | | 1 5 | |
| IRON | | 137 J | | 115 J | | 100 U | | 195 J | | 623 J | |
| LEAD | | 0 25 | | 0 26 | | 0 4 | | 0 59 | | 1 | |
| MAGNESIUM | | 11500 | | 9300 | | 12400 | | 11200 | | 9770 | |
| MANGANESE | | 15 U | | 46 9 | | 33 1 | | 56 4 | | 201 | |
| NICKEL | | 1 7 | | 1 5 | | 1 9 | | 1 8 | | 2 | |
| POTASSIUM | | 5000 U | | 5000 U | | 5000 U | | 5000 U | | 5000 U | |
| SELENIUM | | 0 4 U | | 0 4 U | | 0 43 | | 0 4 U | | 0 4 U | |
| SODIUM | | 8000 | | 5000 U | | 6150 | | 5880 | | 5090 | |
| TIN | | 4 4 J | | 4 7 J | | 4 7 J | | 4 6 J | | 3 J | |
| VANADIUM | | 0 22 | | 0 27 | | 0 29 | | 0 35 | | 0 69 | |
| ZINC | | 2 8 | | 2 5 | | 2 8 | | 2 5 | | 9 6 | |

TABLE 4-7

SUMMARY OF DETECTED CHEMICALS IN HIGH-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD14 | 03SWSD15 | 03SWSD15 | 03SWSD16 | 03SWSD16 | 03SWSD17 | 03SWSD17 | 03SWSD18 | 03SWSD18 | 03SWSD19 | 03SWSD19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSAMPLE | 03SW1402-F | 03SW1502 | 03SW1502-F | 03SW1602 | 03SW1602-F | 03SW1702 | 03SW1702-F | 03SW1802 | 03SW1802-F | 03SW1902 | 03SW1902-F |
| SAMPLE | 03SW1402-F | 03SW1502 | 03SW1502-F | 03SW1602 | 03SW1602-F | 03SW1702 | 03SW1702-F | 03SW1802 | 03SW1802-F | 03SW1902 | 03SW1902-F |
| MATRIX | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW | SW |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | ORIG | ORIG |
| QC_TYPE | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Dissolved Metals (µg/L)** | | | | | | | | | | | |
| ALUMINUM, FILTERED | 264 | | 200 U | | 200 U | | 200 U | | 200 U | | 200 U |
| ANTIMONY, FILTERED | 0 57 U | | 0 13 U | | 0 24 U | | 0 29 U | | 0 32 U | | 0 15 U |
| ARSENIC, FILTERED | 0 41 | | 0 25 | | 0 32 | | 0 39 | | 0 33 | | 0 4 |
| BARIUM, FILTERED | 37 7 J | | 80 J | | 136 J | | 141 J | | 147 J | | 138 J |
| BERYLLIUM, FILTERED | | | | | | | | | | | |
| CADMIUM, FILTERED | 0 7 U | | 0 7 U | | 1 2 | | 0 7 U | | 0 7 U | | 0 7 U |
| CALCIUM, FILTERED | 7550 | | 55300 | | 52100 | | 61200 | | 52200 | | 43100 |
| CHROMIUM, FILTERED | 0 7 J | | 0 7 J | | 0 41 U | | 0 75 J | | 0 51 J | | 0 36 U |
| COBALT, FILTERED | 0 19 | | 0 11 | | 0 19 | | 0 14 | | 0 15 | | 0 72 |
| COPPER, FILTERED | 3 1 | | 0 94 | | 1 | | 1 5 | | 0 84 | | 0 95 |
| IRON, FILTERED | 100 U | | 100 U | | 100 U | | 100 U | | 100 U | | 100 U |
| LEAD, FILTERED | 0 76 J | | 0 14 J | | 0 1 U | | 0 12 J | | 0 1 U | | 0 2 J |
| MAGNESIUM, FILTERED | 5000 U | | 11600 | | 9480 | | 13200 | | 11300 | | 9630 |
| MANGANESE, FILTERED | 15 U | | 15 U | | 36 9 | | 28 5 | | 29 3 | | 100 |
| NICKEL, FILTERED | 0 88 | | 1 6 | | 1 6 | | 1 9 | | 1 6 | | 1 6 |
| POTASSIUM, FILTERED | 5000 U | | 5000 U | | 5000 U | | 5000 U | | 5000 U | | 5000 U |
| SELENIUM, FILTERED | 0 4 U | | 0 4 U | | 0 4 U | | 0 43 | | 0 4 U | | 0 4 U |
| SODIUM, FILTERED | 5000 U | | 7960 | | 7660 | | 9830 | | 8790 | | 5000 |
| TIN, FILTERED | 4 7 J | | 5 J | | 5 2 J | | 5 3 J | | 5 8 J | | 5 4 J |
| VANADIUM, FILTERED | 0 39 | | 0 18 | | 0 21 | | 0 22 | | 0 18 | | 0 23 |
| ZINC, FILTERED | 4 6 | | 6 9 | | 2 8 | | 5 3 | | 2 2 | | 21 7 |
| **Miscellaneous Parameters (mg/L)** | | | | | | | | | | | |
| TOTAL SUSPENDED SOLIDS | | 2 U | | 2 | | 2 U | | 2 U | | 7 | |
| **Field Parameters** | | | | | | | | | | | |
| DISSOLVED OXYGEN (mg/L) | | 6 25 | | 2 39 | | 5 68 | | 3 95 | | 3 24 | |
| NITRATE (mg/L) | | 0 11 | | 0 13 | | | | 0 18 | | 0 02 | |
| NITRITE (mg/L) | | 0 002 | | 0 | | | | 0 | | 0 | |
| OXIDATION REDUCTION POTENTIAL (MV) | | 293 6 | | 296 6 | | 303 9 | | 303 6 | | 320 7 | |
| PH (S U) | | 7 59 | | 7 31 | | 7 37 | | 7 28 | | 7 2 | |
| SPECIFIC CONDUCTANCE (MS/CM) | | 0 378 | | 0 377 | | 0 427 | | 0 391 | | 0 369 | |
| TEMPERATURE (C) | | 17 52 | | 21 46 | | 16 73 | | 20 81 | | 21 35 | |
| TURBIDITY (NTU) | | 1 52 | | 0 75 | | 2 8 | | 5 1 | | 7 7 | |

TABLE 4-7

SUMMARY OF DETECTED CHEMICALS IN HIGH-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD01 | 03SWSD01 | 03SWSD02 | 03SWSD02 | 03SWSD03 | 03SWSD03 |
|---|---|---|---|---|---|---|
| NSAMPLE | 03SW0102 | 03SW0102-F | 03SW0202 | 03SW0202-F | 03SW0302 | 03SW0302-F |
| SAMPLE | 03SW0102 | 03SW0102-F | 03SW0202 | 03SW0202-F | 03SW0302 | 03SW0302-F |
| MATRIX | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Volatile Organics (µg/L)** | | | | | | |
| ACETONE | 0 5 UR | | 0 5 UR | | 0 5 UR | |
| METHYLENE CHLORIDE | 0 5 U | | 0 5 U | | 0 5 U | |
| **Semivolatile Organics (µg/L)** | | | | | | |
| ACENAPHTHYLENE | 0 02 U | | 0 02 U | | 0 021 U | |
| BIS(2-ETHYLHEXYL)PHTHALATE | 1 U | | 0 97 U | | 1 U | |
| **Energetics (µg/L)** | | | | | | |
| 2-AMINO-4,6-DINITROTOLUENE | 0 35 U | | 0 35 U | | 0 35 U | |
| 4-AMINO-2,6-DINITROTOLUENE | 0 35 U | | 0 35 U | | 0 35 U | |
| HMX | 0 35 U | | 0 35 U | | 0 35 U | |
| NITROCELLULOSE | 1000 U | | 1000 U | | 1000 U | |
| RDX | 0 35 U | | 0 35 U | | 0 35 U | |
| **Herbicides (µg/L)** | | | | | | |
| 2,4,5-T | 0 04 U | | 0 04 U | | 0 04 U | |
| 2,4-D | 0 04 UJ | | 0 04 UJ | | 0 04 UJ | |
| PENTACHLOROPHENOL | 0 01 U | | 0 01 U | | 0 023 R | |
| **Total Metals (µg/L)** | | | | | | |
| ALUMINUM | 1400 | | 958 | | 569 | |
| ANTIMONY | 0 023 U | | 0 10 U | | 0 10 U | |
| ARSENIC | 0 67 | | 0 74 | | 0 4 | |
| BARIUM | 56 7 J | | 55 7 J | | 78 7 J | |
| BERYLLIUM | 0 15 | | 0 10 U | | 0 48 | |
| CADMIUM | 0 70 U | | 0 070 U | | 0 70 U | |
| CALCIUM | 11800 | | 6450 | | 5000 U | |
| CHROMIUM | 1 8 J | | 1 2 J | | 0 80 J | |
| COBALT | 0 63 | | 0 62 | | 0 85 | |
| COPPER | 2 | | 1 8 | | 2 3 | |
| IRON | 1580 J | | 1270 J | | 577 J | |
| LEAD | 1 1 | | 1 2 | | 0 91 | |
| MAGNESIUM | 5140 | | 5000 U | | 5500 | |
| MANGANESE | 42 8 | | 80 6 | | 72 8 | |
| NICKEL | 3 | | 4 | | 19 | |
| POTASSIUM | 5000 U | | 5000 U | | 5000 U | |
| SELENIUM | 0 40 U | | 0 40 U | | 0 40 U | |
| SODIUM | 5000 U | | 5000 U | | 5000 U | |
| TIN | 0 10 U | | 0 22 U | | 0 93 U | |
| VANADIUM | 2 2 | | 1 9 | | 0 67 | |
| ZINC | 5 7 | | 8 9 | | 25 2 | |

TABLE 4-7

SUMMARY OF DETECTED CHEMICALS IN HIGH-FLOW SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| LOCATION | 03SWSD01 | 03SWSD01 | 03SWSD02 | 03SWSD02 | 03SWSD03 | 03SWSD03 |
|---|---|---|---|---|---|---|
| NSAMPLE | 03SW0102 | 03SW0102-F | 03SW0202 | 03SW0202-F | 03SW0302 | 03SW0302-F |
| SAMPLE | 03SW0102 | 03SW0102-F | 03SW0202 | 03SW0202-F | 03SW0302 | 03SW0302-F |
| MATRIX | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND | BACKGROUND |
| SACODE | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| QC_TYPE | NM | NM | NM | NM | NM | NM |
| STATUS | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL | NORMAL |
| SAMPLE DATE | - - | - - | - - | - - | - - | - - |
| VALIDATED | Y | Y | Y | Y | Y | Y |
| COLLECTION METHOD | GRAB | GRAB | GRAB | GRAB | GRAB | GRAB |
| **Dissolved Metals (µg/L)** | | | | | | |
| ALUMINUM, FILTERED | | 235 | | 200 U | | 312 |
| ANTIMONY, FILTERED | | 0 14 U | | 0 11 U | | 0 13 U |
| ARSENIC, FILTERED | | 0 23 | | 0 24 | | 0 20 U |
| BARIUM, FILTERED | | 47 1 J | | 47 0 J | | 76 5 J |
| BERYLLIUM, FILTERED | | 0 10 U | | 0 10 U | | 0 37 |
| CADMIUM, FILTERED | | 0 70 U | | 2 3 | | 0 70 U |
| CALCIUM, FILTERED | | 12500 | | 6310 | | 5130 |
| CHROMIUM, FILTERED | | 0 49 U | | 0 44 U | | 0 45 U |
| COBALT, FILTERED | | 0 18 | | 0 23 | | 0 24 |
| COPPER, FILTERED | | 1 1 | | 0 8 | | 1 9 |
| IRON, FILTERED | | 100 U | | 125 | | 100 U |
| LEAD, FILTERED | | 0 20 J | | 0 21 J | | 0 30 J |
| MAGNESIUM, FILTERED | | 5100 | | 5000 U | | 5430 |
| MANGANESE, FILTERED | | 15 0 U | | 37 6 | | 36 3 |
| NICKEL, FILTERED | | 1 3 | | 3 | | 17 9 |
| POTASSIUM, FILTERED | | 5000 U | | 5000 U | | 5000 U |
| SELENIUM, FILTERED | | 0 40 U | | 0 40 U | | 0 40 U |
| SODIUM, FILTERED | | 7010 | | 5000 U | | 5000 U |
| TIN, FILTERED | | 3 5 J | | 3 8 J | | 4 9 J |
| VANADIUM, FILTERED | | 0 26 | | 0 25 | | 0 10 U |
| ZINC, FILTERED | | 2 9 | | 5 5 | | 25 2 |
| **Miscellaneous Parameters (mg/L)** | | | | | | |
| TOTAL SUSPENDED SOLIDS | 28 | | 18 | | 19 | |
| **Field Parameters** | | | | | | |
| DISSOLVED OXYGEN (mg/L) | 10 76 | | 10 78 | | 10 12 | |
| NITRATE (mg/L) | 1 65 > | | 0 75 | | 1 65 > | |
| NITRITE (mg/L) | 0 001 | | 0 002 | | 0 004 | |
| OXIDATION REDUCTION POTENTIAL (MV) | 206 | | 248 | | 288 | |
| PH (S U ) | 7 51 | | 6 71 | | 5 8 | |
| SPECIFIC CONDUCTANCE (MS/CM) | 0 135 | | 0 095 | | 0 1 | |
| TEMPERATURE (C) | 20 8 | | 21 2 | | 19 4 | |
| TURBIDITY (NTU) | 22 | | 31 | | 17 | |

TABLE 4-8

SCREENING CRITERIA USED IN SELECTION OF HUMAN HEALTH CHEMICAL OF POTENTIAL CONCERN - SOIL/SEDIMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULFUR CREEK
NSWC CRANE
CRANE, INDIANA


| CAS Number | Chemical | EPA Region 9 PRG[1] Residential | EPA Soil Screening Levels[2] Soil to Ground water | EPA Soil Screening Levels[2] Soil to Air | IDEM[3] Residential | IDEM[3] Soil to Ground water |
|---|---|---|---|---|---|---|
| **Dioxins/Furans (ng/kg)** | | | | | | |
| 3268-87-9 | 1,2,3,4,6,7,8,9-OCDD | 39000 (4) C | 2870 (4) | 4 30E+11 (4) | NA | NA |
| 39001-02-0 | 1,2,3,4,6,7,8,9-OCDF | 39000 (4) C | 2870 (4) | 4 30E+11 (4) | NA | NA |
| 35822-46-9 | 1,2,3,4,6,7,8-HPCDD | 390 (4) C | 28 7 (4) | 4 30E+09 (4) | NA | NA |
| 67562-39-4 | 1,2,3,4,6,7,8-HPCDF | 390 (4) C | 28 7 (4) | 4 30E+09 (4) | NA | NA |
| 55673-89-7 | 1,2,3,4,7,8,9-HPCDF | 390 (4) C | 28 7 (4) | 4 30E+09 (4) | NA | NA |
| 39227-28-6 | 1,2,3,4,7,8-HXCDD | 39 (4) C | 2 87 (4) | 4 30E+08 (4) | NA | NA |
| 70648-26-9 | 1,2,3,4,7,8-HXCDF | 39 (4) C | 2 87 (4) | 4 30E+08 (4) | NA | NA |
| 57653-85-7 | 1,2,3,6,7,8-HXCDD | 39 (4) C | 2 87 (4) | 4 30E+08 (4) | NA | NA |
| 57117-44-9 | 1,2,3,6,7,8-HXCDF | 39 (4) C | 2 87 (4) | 4.30E+08 (4) | NA | NA |
| 19408-74-3 | 1,2,3,7,8,9-HXCDD | 39 (4) C | 2 87 (4) | 4 30E+08 (4) | NA | NA |
| 72918-21-9 | 1,2,3,7,8,9-HXCDF | 39 (4) C | 2 87 (4) | 4 30E+08 (4) | NA | NA |
| 40321-76-4 | 1,2,3,7,8-PECDD | 3 9 (4) C | 0 287 (4) | 4 30E+07 (4) | NA | NA |
| 57117-41-6 | 1,2,3,7,8-PECDF | 78 (4) C | 5.74 (4) | 8 60E+08 (4) | NA | NA |
| 60851-34-5 | 2,3,4,6,7,8-HXCDF | 39 (4) C | 2 87 (4) | 4.30E+08 (4) | NA | NA |
| 57117-31-4 | 2,3,4,7,8-PECDF | 7 8 (4) C | 0 574 (4) | 8 60E+07 (4) | NA | NA |
| 1746-01-6 | 2,3,7,8-TCDD | 3 9 C | 0 287 | 4 30E+07 | NA | NA |
| 51207-31-9 | 2,3,7,8-TCDF | 39 (4) C | 2 87 (4) | 4 30E+08 (4) | NA | NA |
| 37871-00-4 | TOTAL HPCDD | 390 (4) C | 28 7 (4) | 4 30E+09 (4) | NA | NA |
| 38998-75-3 | TOTAL HPCDF | 390 (4) C | 28 7 (4) | 4 30E+09 (4) | NA | NA |
| 34465-46-8 | TOTAL HXCDD | 39 (4) C | 2 87 (4) | 4 30E+08 (4) | NA | NA |
| 55684-94-1 | TOTAL HXCDF | 39 (4) C | 2 87 (4) | 4 30E+08 (4) | NA | NA |
| 36088-22-9 | TOTAL PECDD | 3 9 (4) C | 0 287 (4) | 4 30E+07 (4) | NA | NA |
| 41903-57-5 | TOTAL TCDD | 3 9 (4) C | 0 287 (4) | 4 30E+07 (4) | NA | NA |
| **Volatile Organic Compounds (µg/kg)** | | | | | | |
| 71-55-6 | 1,1,1-Trichloroethane | 630000 N | 100 | 1200000 | 1800000 N | 1900 N |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 380 C | 0 2 | 600 | 5000 C | 7 C |
| 78-93-3 | 2-Butanone | 7300000 N | NA | NA | 20000000 N | 11000 N |
| 591-78-6 | 2-Hexanone | 3100000 (5) N | NA | NA | NA | NA |
| 108-10-1 | 4-Methyl-2-Pentanone | 790000 N | NA | NA | 1000000 N | 990 N |
| 67-64-1 | Acetone | 1600000 N | 800 | 100000000 | 3900000 N | 3100 N |
| 75-15-0 | Carbon Disulfide | 360000 N | 2000 | 720000 | 900000 N | 10000 N |
| 156-59-2 | Cis-1,2-Dichloroethene | 43000 N | 20 | 1200000 | 110000 N | 400 N |
| 127-18-4 | Tetrachloroethene | 5700 C | 3 | 11000 | 48000 C | 58 C |
| 108-88-3 | Toluene | 520000 sat | 600 | 650000 | 1700000 N | 12000 N |
| 1330-20-7 | Total Xylenes | 210000 sat | 9000 | 410000 | 4800000 N | 190000 N |
| 79-01-6 | Trichloroethene | 2800 C | 3 | 5000 | 45000 C | 57 C |
| 75-69-4 | Trichlorofluoromethane | 390000 N | NA | NA | NA | NA |
| **Semi-Volatile Organic Compounds (µg/kg)** | | | | | | |
| 106-50-3 | 1,4-Phenylenediamine | 12000000 N | NA | NA | NA | NA |
| 91-57-6 | 2-Methylnaphthalene | 56000 (6) N | NA | NA | NA | NA |
| 95-48-7 | 2-Methylphenol | 3100000 N | 800 | NA | 7500000 N | 14000 N |
| | 3&4-Methylphenol | 310000 (7) N | NA | NA | 910000 (7) N | 1100 (7) N |
| 83-32-9 | Acenaphthene | 3700000 N | 29000 | NA | 9500000 N | 130000 N |
| 208-96-8 | Acenaphthylene | 3700000 (8) N | NA | NA | 9500000 (8) N | NA |
| 98-86-2 | Acetophenone | 490 N | NA | NA | NA | NA |
| 120-12-7 | Anthracene | 22000000 N | 590000 | NA | 47000000 N | 51000 N |
| 56-55-3 | Benzo(a)anthracene | 620 C | 80 | NA | 5000 C | 19000 C |
| 50-32-8 | Benzo(a)pyrene | 62 C | 400 | NA | 500 C | 8200 C |
| 205-99-2 | Benzo(b)fluoranthene | 620 C | 200 | NA | 5000 C | 57000 C |
| 191-24-2 | Benzo(g,h,i)perylene | 2300000 (9) N | NA | NA | 5500000 (9) N | NA |
| 207-08-9 | Benzo(k)fluoranthene | 6200 C | 2000 | NA | 50000 C | 39000 C |
| 117-81-7 | Bis(2-ethylhexyl)phthalate | 35000 C | 180000 | 31000000 | 300000 C | 3600000 C |
| 218-01-9 | Chrysene | 62000 C | 8000 | NA | 500000 C | 25000 C |
| 84-74-2 | Di-n-Butyl Phthalate | 6100000 N | 270000 | 2300000 | 18000000 N | 5000000 N |
| 117-84-0 | Di-n-Octyl Phthalate | 1200000 N | 10000000 | 10000000 | 3700000 N | 67000000 N |
| 53-70-3 | Dibenzo(a,h)anthracene | 62 C | 80 | NA | 500 C | 18000 C |

TABLE 4-8

SCREENING CRITERIA USED IN SELECTION OF HUMAN HEALTH CHEMICAL OF POTENTIAL CONCERN - SOIL/SEDIMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULFUR CREEK
NSWC CRANE
CRANE, INDIANA


| CAS Number | Chemical | EPA Region 9 PRG[1] Residential | EPA Soil Screening Levels[2] | | IDEM[3] | |
|---|---|---|---|---|---|---|
| | | | Soil to Ground water | Soil to Air | Residential | Soil to Ground water |
| 122-39-4 | Diphenylamine | 1500000 N | NA | NA | NA | NA |
| **Semi-Volatile Organic Compounds (µg/kg) (Continued)** | | | | | | |
| 86-73-7 | Fluorene | 2600000 N | 28000 | NA | 6300000 N | 170000 N |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 620 C | 700 | NA | 5000 C | 3100 C |
| 91-20-3 | Naphthalene | 56000 N | 4000 | NA | 3200000 N | 700 N |
| 85-01-8 | Phenanthrene | 2300000 (9) N | NA | NA | 5500000 (9) | NA |
| 108-95-2 | Phenol | 37000000 N | 5000 | NA | 88000000 N | 110000 N |
| 129-00-0 | Pyrene | 2300000 N | 210000 | NA | 5500000 N | 570000 N |
| **Energetics (mg/kg)** | | | | | | |
| 99-35-4 | 1,3,5-Trinitrobenzene | 1800 N | NA | NA | NA | NA |
| 118-96-7 | 2,4,6-Trinitrotoluene | 16 C | NA | NA | NA | NA |
| 121-14-2 | 2,4-Dinitrotoluene | 120 N | 0 00004 | NA | NA | NA |
| 35572-78-2 | 2-Amino-4,6-Dinitrotoluene | 4 7 (5) N | NA | NA | NA | NA |
| 88-72-2 | 2-Nitrotoluene | 370 N | NA | NA | NA | NA |
| 19406-51-0 | 4-Amino-2,6-Dinitrotoluene | 4 7 (5) N | NA | NA | NA | NA |
| 2691-41-0 | HMX | 3100 N | NA | NA | NA | NA |
| 98-95-3 | Nitrobenzene | 20 N | 0 007 | 92 | 91 N | 0.028 N |
| 121-82-4 | RDX | 4 4 C | NA | NA | NA | NA |
| **Pesticides (µg/kg)** | | | | | | |
| 72-43-5 | Methoxychlor | 310000 N | 8000 | NA | 910000 N | 160000 N |
| | **Herbicides (µg/kg)** | | | | | |
| 93-76-5 | 2,4,5-T | 610000 N | NA | NA | NA | NA |
| 93-72-1 | 2,4,5-TP (SILVEX) | 490000 N | NA | NA | NA | NA |
| 94-75-7 | 2,4-D | 690000 N | NA | NA | NA | NA |
| 88-85-7 | Dinoseb | 61000 N | NA | NA | NA | NA |
| 70-30-4 | Hexachlorophene | 18000 N | NA | NA | NA | NA |
| 87-86-5 | Pentachlorophenol | 3000 C | 1 | NA | 20000 C | 28 C |
| **Inorganics (mg/kg)** | | | | | | |
| 7429-90-5 | Aluminum | 76000 N | NA | NA | NA | NA |
| 7440-36-0 | Antimony | 31 N | 0 3 | NA | 140 N | 5 4 N |
| 7440-38-2 | Arsenic | 0 39 N | 1 | 750 | 3 9 C | 29 C |
| 7440-39-3 | Barium | 5400 N | 82 | 690000 | 23000 N | 1600 N |
| 7440-41-7 | Beryllium | 150 N | 3 | 1300 | 680 N | 63 C |
| 7440-43-9 | Cadmium | 37 N | 0 4 | 1800 | 12 N | 7 5 C |
| 7440-70-2 | Calcium | NA | NA | NA | NA | NA |
| 7440-47-3 | Chromium VI | 30 C | 2 | 270 | 430 C | 38 C |
| 7440-48-4 | Cobalt | 4700 N | NA | NA | NA | NA |
| 7440-50-8 | Copper | 2900 N | NA | NA | 13000 N | 580 N |
| 7439-89-6 | Iron | 23000 N | NA | NA | NA | NA |
| 7439-92-1 | Lead | 400 N | NA | NA | 400 | 81 |
| 7439-95-4 | Magnesium | NA | NA | NA | NA | NA |
| 7439-96-5 | Manganese | 1800 N | NA | NA | NA | NA |
| 7439-97-6 | Mercury | 23 N | 0 1 | 10 | 55 N | 2 1 N |
| 7440-02-0 | Nickel | 1600 N | 7 | 13000 | 6900 N | 950 C |
| 7440-09-7 | Potassium | NA | NA | NA | NA | NA |
| 7782-49-2 | Selenium | 390 N | 0 3 | NA | 1700 N | 5 2 N |
| 7440-22-4 | Silver | 390 N | 2 | NA | 1700 N | 31 N |
| 7440-23-5 | Sodium | NA | NA | NA | NA | NA |
| 7440-28-0 | Thallium | 5 2 N | 0 04 | NA | 31 N | 2 8 N |
| 7440-31-5 | Tin | 47000 N | NA | NA | NA | NA |
| 7440-62-2 | Vanadium | 550 N | 300 | NA | NA | NA |
| 7440-66-6 | Zinc | 23000 N | 620 | NA | 100000 N | 14000 N |

TABLE 4-8

SCREENING CRITERIA USED IN SELECTION OF HUMAN HEALTH CHEMICAL OF POTENTIAL CONCERN - SOIL/SEDIMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULFUR CREEK
NSWC CRANE
CRANE, INDIANA


| CAS Number | Chemical | EPA Region 9 PRG[1] Residential | EPA Soil Screening Levels[2] | | IDEM[3] | |
|---|---|---|---|---|---|---|
| | | | Soil to Ground water | Soil to Air | Residential | Soil to Ground water |
| **Miscellaneous Parameters (µg/kg)** | | | | | | |
| 14797-55-8 | Nitrate | 130000 (5) N | NA | NA | NA | NA |
| 14797-65-0 | Nitrite | 7800 (5) N | NA | NA | NA | NA |
| TTNUS029 | Nitrite/Nitrate | NA | NA | NA | NA | NA |
| 14797-73-0 | Perchlorate | 39000 N | NA | NA | NA | NA |

Notes
1 - U S EPA Region 9 Preliminary Remediation Goal Table, November 1, 2000 (Cancer benchmark value = 1E-06, HI = 1 0)
2 - U S EPA Soil Screening Level Guidance Technical Background Document May 1996 A dilution attenuation factor of 1 is used for the soil to groundwater criteria
3 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) residential closure levels for groundwater, July 2001
4 - Value is derived by multiplying criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor
5 - No U S EPA Region 9 PRG available, value is from U S EPA Region 3 Risk-Based Concentration table, April 2, 2002
6 - Value is for naphthalene
7 - Value is for 4-methylphenol
8 - Value is for acenaphthene
9 - Value is for pyrene

sat - Saturation concentration
N - Noncarcinogenic
C - Carcinogenic
NA - No criteria available

TABLE 4-9

SCREENING CRITERIA USED IN SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN
- GROUND WATER/SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULFUR CREEK
NSWC CRANE
CRANE, INDIANA


| CAS Number | Chemical | U.S. EPA Region 9 PRG[1] Tap Water | U.S. EPA MCL[2] | IDEM Ground water Residential[3] |
|---|---|---|---|---|
| **Volatile Organics (µg/L)** | | | | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 0.055 C | NA | 0.9 C |
| 79-00-5 | 1,1,2-Trichloroethane | 0.20 C | 5 | 5 |
| 75-35-4 | 1,1-Dichloroethene | 0.046 C | 7 | 7 |
| 78-93-3 | 2-Butanone | 1900 N | NA | 2500 N |
| 67-64-1 | Acetone | 610 N | NA | 770 N |
| 74-83-9 | Bromomethane | 8.7 N | NA | 11 N |
| 67-66-3 | Chloroform | 0.16 C | 80 | 100 |
| 156-59-2 | cis-1,2-Dichloroethene | 61 N | 70 | 70 |
| 97-63-2 | Ethyl Methacrylate | 550 N | NA | NA |
| 75-09-2 | Methylene Chloride | 4.3 C | 5 | 5 |
| 127-18-4 | Tetrachloroethene | 1.1 C | 5 | 5 |
| 156-60-5 | trans-1,2-Dichloroethene | 120 N | 100 | 100 |
| 79-01-6 | Trichloroethene | 1.6 C | 5 | 5 |
| 75-01-4 | Vinyl Chloride | 0.041 C | 2 | 2 |
| **Semi-Volatile Organics (µg/L)** | | | | |
| 208-96-8 | Acenaphthylene | 370 (4) N | NA | NA |
| 117-81-7 | bis(2-ethylhexyl)phthalate | 4.8 C | 6 | 6 |
| **Energetics (µg/L)** | | | | |
| 99-35-4 | 1,3,5-Trinitrobenzene | 1100 N | NA | NA |
| 118-96-7 | 2,4,6-Trinitrotoluene | 2.2 C | NA | NA |
| 606-20-2 | 2,6-Dinitrotoluene | 36 N | NA | NA |
| 35572-78-2 | 2-amino-4,6-Dinitrotoluene | 2.2 (5) N | NA | NA |
| 19406-51-0 | 4-amino-2,6-Dinitrotoluene | 2.2 (5) N | NA | NA |
| 2691-41-0 | HMX | 1800 N | NA | NA |
| 9004-70-0 | Nitrocellulose | NA | NA | NA |
| 121-82-4 | RDX | 0.61 C | NA | NA |
| **Herbicides (µg/L)** | | | | |
| 93-76-5 | 2,4,5-T | 360 N | NA | NA |
| 94-75-7 | 2,4-D | 360 N | 70 | NA |
| 87-86-5 | Pentachlorophenol | 0.56 C | 1 | 1 |

TABLE 4-9

SCREENING CRITERIA USED IN SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN
- GROUND WATER/SURFACE WATER
SWMU 03 - OLD JEEP TRAIL/LITTLE SULFUR CREEK
NSWC CRANE
CRANE, INDIANA


| CAS Number | Chemical | U.S. EPA Region 9 PRG[1] Tap Water | U.S. EPA MCL[2] | IDEM Ground water Residential[3] |
|---|---|---|---|---|
| **Inorganics (µg/L)** | | | | |
| 7429-90-5 | Aluminum | 36000 N | 50 to 200 (6) | NA |
| 7440-36-0 | Antimony | 15 N | 6 | 6 |
| 7440-38-2 | Arsenic | 0.045 C | 10 | 50 |
| 7440-39-3 | Barium | 2600 N | 2000 | 2000 |
| 7440-41-7 | Beryllium | 73 N | 4 | 4 |
| 7440-43-9 | Cadmium | 18 N | 5 | 5 |
| 7440-70-2 | Calcium | NA | NA | NA |
| 7440-47-3 | Chromium VI | 110 N | 100 | 100 |
| 7440-48-4 | Cobalt | 2200 N | NA | NA |
| 7440-50-8 | Copper | 1400 N | 1300 | 1300 |
| 7439-89-6 | Iron | 11000 N | 300 (6) | NA |
| 7439-92-1 | Lead | 15 (7) | 15 | 15 |
| 7439-95-4 | Magnesium | NA | NA | NA |
| 7439-96-5 | Manganese | 880 N | 50 (6) | NA |
| 7439-97-6 | Mercury | 11 N | 2 | 2 |
| 7440-02-0 | Nickel | 730 N | NA | 730 N |
| 7440-09-7 | Potassium | NA | NA | NA |
| 7782-49-2 | Selenium | 180 N | 50 | 50 |
| 7440-23-5 | Sodium | NA | NA | NA |
| 7440-28-0 | Thallium | 2.4 N | 2 | 2 |
| 7440-31-5 | Tin | 22000 N | NA | NA |
| 7440-62-2 | Vanadium | 260 N | NA | NA |
| 7440-66-6 | Zinc | 11000 N | 5000 (6) | 11000 N |

Notes
1 - U S EPA Region 9 Preliminary Remediation Goal Table, November 1, 2000 (Cancer benchmark value = 1E-06, HI = 1 0)
2 - U S EPA Drinking Water Regulations and Health Advisories, Summer 2000
3 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) residential closure levels for groundwater, July 2001
4 - Value is for acenaphthene
5 - No U S EPA Region 9 PRG available, value is from U.S EPA Region 3 Risk-Based Concentration table, April 2, 2002
6 - Secondary MCL
7 - Action level (U S EPA, Summer 2000)

N - Noncarcinogenic
C - Carcinogenic
NA - No criteria available

TABLE 4-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Soil
Exposure Medium Surface Soil (0 to 2 feet)
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects[2] | Concentration Used for Screening[3] | Site Above Background?[4] | U S EPA Region 9 PRG-Residential[5] | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dioxins** | | | | | | | | | | | | | | | | |
| 3268-87-9 | 1,2,3,4,6,7,8,9-OCDD | 176 | J | 3440 | J | ng/kg | 03SS470002 | 11/11 | NA | 3440 | NA | 39000 C | NA | NA | No | BSL |
| 39001-02-0 | 1,2,3,4,6,7,8,9-OCDF | 7 6 | J | 62 2 | J | ng/kg | 03SS170002 | 3/11 | 0 3 - 2 1 | 62 2 | NA | 39000 C | NA | NA | No | BSL |
| 35822-46-9 | 1,2,3,4,6,7,8-HPCDD | 3 2 | | 233 | | ng/kg | 03SS170002 | 11/11 | NA | 233 | NA | 390 C | NA | NA | No | BSL |
| 67562-39-4 | 1,2,3,4,6,7,8-HPCDF | 0 19 | J | 32 1 | | ng/kg | 03SS170002 | 5/11 | 0 17 - 0 71 | 32 1 | NA | 390 C | NA | NA | No | BSL |
| 55673-89-7 | 1,2,3,4,7,8,9-HPCDF | 0 7 | J | 2 1 | J | ng/kg | 03SS170002 | 4/11 | 0 1 - 0 4 | 2 1 | NA | 390 C | NA | NA | No | BSL |
| 39227-28-6 | 1,2,3,4,7,8-HXCDD | 0 58 | J | 2 1 | J | ng/kg | 03SS170002 | 4/11 | 0 17 - 0 74 | 2 1 | NA | 39 C | NA | NA | No | BSL |
| 70648-26-9 | 1,2,3,4,7,8-HXCDF | 3 1 | | 3 9 | | ng/kg | 03SS170002 | 2/11 | 0 08 - 2 1 | 3 9 | NA | 39 C | NA | NA | No | BSL |
| 57653-85-7 | 1,2,3,6,7,8-HXCDD | 0 33 | J | 10 1 | | ng/kg | 03SS170002 | 5/11 | 0 1 - 0 76 | 10 1 | NA | 39 C | NA | NA | No | BSL |
| 57117-44-9 | 1,2,3,6,7,8-HXCDF | 0 19 | J | 2 4 | J | ng/kg | 03SS170002 | 6/11 | 0 06 - 0 2 | 2 4 | NA | 39 C | NA | NA | No | BSL |
| 19408-74-3 | 1,2,3,7,8,9-HXCDD | 0 35 | J | 6 5 | | ng/kg | 03SS170002 | 5/11 | 0 32 - 0 76 | 6 5 | NA | 39 C | NA | NA | No | BSL |
| 72918-21-9 | 1,2,3,7,8,9-HXCDF | 0 22 | J | 0 22 | J | ng/kg | 03SS230002 | 1/11 | 0 08 - 0 65 | 0 22 | NA | 39 C | NA | NA | No | BSL |
| 40321-76-4 | 1,2,3,7,8-PECDD | 0 4 | J | 1 3 | J | ng/kg | 03SS170002 | 5/11 | 0 08 - 0 2 | 1 3 | NA | 3 9 C | NA | NA | No | BSL |
| 57117-41-6 | 1,2,3,7,8-PECDF | 0 37 | J | 1 1 | J | ng/kg | 03SS260002 | 3/11 | 0 06 - 0 38 | 1 1 | NA | 78 C | NA | NA | No | BSL |
| 60851-34-5 | 2,3,4,6,7,8-HXCDF | 0 43 | J | 2 7 | J | ng/kg | 03SS170002 | 5/11 | 0 07 - 0 13 | 2 7 | NA | 39 C | NA | NA | No | BSL |
| 57117-31-4 | 2,3,4,7,8-PECDF | 0 39 | J | 1 4 | J | ng/kg | 03SS230002 | 4/11 | 0 06 - 0 67 | 1 4 | NA | 7 8 C | NA | NA | No | BSL |
| 1746-01-6 | 2,3,7,8-TCDD | 0 19 | J | 3 9 | | ng/kg | 03SS260002 | 5/11 | 0 08 - 0 2 | 3 9 | NA | 3 9 C | NA | NA | No | BSL |
| 51207-31-9 | 2,3,7,8-TCDF | 0 5 | J | 0 78 | J | ng/kg | 03SS470002 | 4/11 | 0 06 - 0 85 | 0 78 | NA | 39 C | NA | NA | No | BSL |
| 3268-87-9 | **2,3,7,8-TCDD Equivalents** | 0 12 | | 7 4 | | ng/kg | 03SS170002 | 11/11 | NA | 7 4 | NA | **3.9 C** | NA | NA | **Yes** | ASL |
| 37871-00-4 | **TOTAL HPCDD** | 6 7 | J | 419 | | ng/kg | 03SS170002 | 10/11 | 6 9 | 419 | NA | **390 C** | NA | NA | **Yes** | ASL |
| 38998-75-3 | TOTAL HPCDF | 0 19 | | 19 | | ng/kg | 03SS230002 | 5/11 | 0 17 - 93 9 | 19 | NA | 39 C | NA | NA | No | BSL |
| 34465-46-8 | TOTAL HXCDD | 2 | | 4 | | ng/kg | 03SS290002 | 2/11 | 1 4 - 59 1 | 4 | NA | 39 C | NA | NA | No | BSL |
| 55684-94-1 | TOTAL HXCDF | 3 2 | | 17 8 | | ng/kg | 03SS230002 | 2/11 | 0 07 - 61 2 | 17 8 | NA | 39 C | NA | NA | No | BSL |
| 36088-22-9 | TOTAL PECDD | 0 45 | J | 0 45 | J | ng/kg | 03SS320002 | 1/11 | 0 08 - 10 4 | 0 45 | NA | 3 9 C | NA | NA | No | BSL |
| 41903-57-5 | TOTAL TCDD | 1 | | 1 | | ng/kg | 03SS170002 | 1/11 | 0 08 - 7 5 | 1 | NA | 3 9 C | NA | NA | No | BSL |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 71-55-6 | 1,1,1-TRICHLOROETHANE | 2 | J | 19 | J | µg/kg | 03SS280002 | 4/15 | 0 93 - 11 | 19 | NA | 63000 N | 1800000 | IDEM | No | BSL |
| 591-78-6 | 2-HEXANONE | 5 | J | 5 | J | µg/kg | 03SS460002 | 1/15 | 0 93 - 12 | 5 | NA | 310000 (7) N | NA | NA | No | BSL |
| 108-10-1 | 4-METHYL-2-PENTANONE | 4 | J | 4 | J | µg/kg | 03SS460002 | 1/15 | 0 93 - 12 | 4 | NA | 79000 N | 1000000 | IDEM | No | BSL |
| 127-18-4 | TETRACHLOROETHENE | 1 | J | 3 | J | µg/kg | 03SS230002 | 2/15 | 0 93 - 12 | 3 | NA | 5700 C | 48000 | IDEM | No | BSL |
| 1330-20-7 | TOTAL XYLENES | 82 | | 82 | | µg/kg | 03SS470002 | 1/15 | 0 93 - 12 | 82 | NA | 210000 sat | 4800000 | IDEM | No | BSL |
| 79-01-6 | TRICHLOROETHENE | 3 | J | 14 | J | µg/kg | 03SS230002 | 3/15 | 0 93 - 12 | 14 | NA | 2800 C | 45000 | IDEM | No | BSL |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 106-50-3 | 1,4-PHENYLENEDIAMINE | 210 | J | 210 | J | µg/kg | 03SS340002 | 1/29 | 67 - 98 | 210 | NA | 1200000 N | NA | NA | No | BSL |
| 91-57-6 | 2-METHYLNAPHTHALENE | 24 | | 290 | | µg/kg | 03SS240002 | 2/45 | 1 3 - 55 | 290 | NA | 5600 (8) N | NA | NA | No | BSL |
| 83-32-9 | ACENAPHTHENE | 18 | | 18 | | µg/kg | 03SS240002 | 1/45 | 1 3 - 55 | 18 | NA | 370000 N | 9500000 | IDEM | No | BSL |
| 208-96-8 | ACENAPHTHYLENE | 11 | | 14 | | µg/kg | 03SS110002 | 2/45 | 1 3 - 55 | 14 | NA | 370000 (9) N | 9500000 (9) | IDEM | No | BSL |
| 120-12-7 | ANTHRACENE | 12 | | 12 | | µg/kg | 03SS110002 | 1/45 | 1 3 - 380 | 12 | NA | 2200000 N | 47000000 | IDEM | No | BSL |
| 56-55-3 | BENZO(A)ANTHRACENE | 8 | | 37 | | µg/kg | 03SS180002 | 3/45 | 1 3 - 380 | 37 | NA | 620 C | 5000 | IDEM | No | BSL |
| 50-32-8 | BENZO(A)PYRENE | 1 5 | | 54 | | µg/kg | 03SS240002 | 5/45 | 1 3 - 55 | 54 | NA | 62 C | 500 | IDEM | No | BSL |
| 205-99-2 | BENZO(B)FLUORANTHENE | 9 | | 160 | | µg/kg | 03SS180002, 03SS240002 | 13/45 | 1 3 - 55 | 160 | NA | 620 C | 5000 | IDEM | No | BSL |
| 191-24-2 | BENZO(G,H,I)PERYLENE | 8 | | 67 | | µg/kg | 03SS180002 | 7/45 | 1 3 - 55 | 67 | NA | 230000 (10) N | 5500000 (10) | IDEM | No | BSL |
| 117-81-7 | BIS(2-ETHYLHEXYL)PHTHALATE | 84 | J | 870 | | µg/kg | 03SS180002 | 7/45 | 67 - 170 | 870 | NA | 35000 C | 300000 | IDEM | No | BSL |
| 218-01-9 | CHRYSENE | 8 | | 68 | | µg/kg | 03SS180002 | 7/45 | 1 3 - 380 | 68 | NA | 62000 C | 500000 | IDEM | No | BSL |
| 84-74-2 | DI-N-BUTYL PHTHALATE | 110 | J | 4500 | | µg/kg | 03SS180002 | 9/45 | 67 - 98 | 4500 | NA | 610000 N | 18000000 | IDEM | No | BSL |
| 117-84-0 | DI-N-OCTYL PHTHALATE | 270 | J | 270 | J | µg/kg | 03SS250002 | 1/39 | 67 - 98 | 270 | NA | 120000 N | 3700000 | IDEM | No | BSL |
| 53-70-3 | DIBENZO(A,H)ANTHRACENE | 8 | | 8 | | µg/kg | 03SS240002 | 1/45 | 1 3 - 55 | 8 | NA | 62 C | 500 | IDEM | No | BSL |
| 206-44-0 | FLUORANTHENE | 8 | | 250 | | µg/kg | 03SS240002 | 8/45 | 1 3 - 55 | 250 | NA | 230000 N | 6300000 | IDEM | No | BSL |
| 86-73-7 | FLUORENE | 15 | | 15 | | µg/kg | 03SS240002 | 1/45 | 1 3 - 55 | 15 | NA | 260000 N | 6300000 | IDEM | No | BSL |
| 193-39-5 | INDENO(1,2,3-CD)PYRENE | 8 | | 49 | J | µg/kg | 03SS180002 | 5/45 | 1 3 - 55 | 49 | NA | 620 C | 5000 | IDEM | No | BSL |
| 91-20-3 | NAPHTHALENE | 11 | | 130 | | µg/kg | 03SS240002 | 4/45 | 1 3 - 55 | 130 | NA | 5600 N | 3200000 | IDEM | No | BSL |

TABLE 4-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Soil
Exposure Medium Surface Soil (0 to 2 feet)
Exposure Point. SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects[2] | Concentration Used for Screening[3] | Site Above Background?[4] | U S EPA Region 9 PRG-Residential[5] | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semivolatile Organic Compounds (Continued)** | | | | | | | | | | | | | | | | |
| 85-01-8 | PHENANTHRENE | 8 | | 320 | | µg/kg | 03SS240002 | 5/45 | 1 3 - 55 | 320 | NA | 230000 (10) N | 5500000 (10) | IDEM | No | BSL |
| 129-00-0 | PYRENE | 8 | | 250 | | µg/kg | 03SS240002 | 9/45 | 1 3 - 55 | 250 | NA | 230000 N | 5500000 | IDEM | No | BSL |
| | **Energetics** | | | | | | | | | | | | | | | |
| 99-35-4 | 1,3,5-TRINITROBENZENE | 0 72 | | 11 | J | mg/kg | 03SS240002 | 3/48 | 0 25 | 11 | NA | 180 N | NA | NA | No | BSL |
| 118-96-7 | 2,4,6-TRINITROTOLUENE | 0 39 | J | 1700 | J | mg/kg | 03SS240002 | 4/48 | 0 25 | 1700 | NA | 16 C | NA | NA | Yes | ASL |
| 121-14-2 | 2,4-DINITROTOLUENE | 1 | J | 1 | J | mg/kg | 03SS240002 | 1/48 | 0 25 | 1 | NA | 12 N | NA | NA | No | BSL |
| 35572-78-2 | 2-AMINO-4,6-DINITROTOLUENE | 0 56 | | 30 | J | mg/kg | 03SS240002 | 7/48 | 0 25 | 30 | NA | 0.47 (7) N | NA | NA | Yes | ASL |
| 88-72-2 | 2-NITROTOLUENE | 0 28 | J | 0 28 | J | mg/kg | 03SS330002 | 1/48 | 0 25 | 0 28 | NA | 37 N | NA | NA | No | BSL |
| 19406-51-0 | 4-AMINO-2,6-DINITROTOLUENE | 0 35 | J | 15 | J | mg/kg | 03SS240002 | 7/48 | 0 25 | 15 | NA | 0.47 (7) N | NA | NA | Yes | ASL |
| 2691-41-0 | HMX | 0 34 | | 1600 | J | mg/kg | 03SS240002 | 9/47 | 0 25 - 0 34 | 1600 | NA | 310 N | NA | NA | Yes | ASL |
| 121-82-4 | RDX | 0 93 | | 2400 | J | mg/kg | 03SS240002 | 6/48 | 0 25 | 2400 | NA | 4.4 C | NA | NA | Yes | ASL |
| | **Herbicides** | | | | | | | | | | | | | | | |
| 93-76-5 | 2,4,5-T | 6 4 | | 6 4 | | µg/kg | 03SS320002 | 1/5 | 1 6 - 1 7 | 6 4 | NA | 61000 N | NA | NA | No | BSL |
| 94-75-7 | 2,4-D | 6 7 | | 8 3 | J | µg/kg | 03SS320002 | 3/5 | 1 6 - 1 7 | 8 3 | NA | 69000 N | NA | NA | No | BSL |
| 88-85-7 | DINOSEB | 11 | | 11 | | µg/kg | 03SS290002 | 1/3 | 1 6 - 1 7 | 11 | NA | 6100 N | NA | NA | No | BSL |
| | **Inorganics** | | | | | | | | | | | | | | | |
| 7429-90-5 | ALUMINUM | 2350 | J | 14900 | J | mg/kg | 03SS270002 | 32/32 | NA | 14900 | No | 7600 N | NA | NA | No | BKG |
| 7440-36-0 | ANTIMONY | 0 49 | J | 4 4 | J | mg/kg | 03SS240002 | 8/32 | 0 19 - 2 8 | 4 4 | No | 3.1 N | 140 | IDEM | No | BKG |
| 7440-38-2 | ARSENIC | 3 | J | 28 4 | J | mg/kg | 03SS330002 | 30/32 | 2 8 - 4 4 | 28 4 | No | 0.39 C | 3.9 | IDEM | No | BKG |
| 7440-39-3 | BARIUM | 66 2 | J | 2040 | J | mg/kg | 03SS480002 | 32/32 | NA | 2040 | Yes | 540 N | 23000 | IDEM | Yes | ASL |
| 7440-41-7 | BERYLLIUM | 0 33 | J | 1 4 | | mg/kg | 03SS180002 | 31/32 | 0 2 | 1 4 | Yes | 15 N | 680 | IDEM | No | BSL |
| 7440-43-9 | CADMIUM | 0 35 | | 4 4 | | mg/kg | 03SS240002 | 29/32 | 0 31 - 0 32 | 4 4 | Yes | 3.7 N | 12 | IDEM | Yes | ASL |
| 7440-70-2 | CALCIUM | 1180 | J | 244000 | J | mg/kg | 03SS330002 | 32/32 | NA | 244000 | Yes | NA | NA | NA | No | NUT |
| 7440-47-3 | CHROMIUM | 7 7 | J | 288 | J | mg/kg | 03SS270002 | 32/32 | NA | 288 | Yes | 30 (11) C | 430 | IDEM | Yes | ASL |
| 7440-48-4 | COBALT | 3 | J | 19 9 | J | mg/kg | 03SS340002 | 32/32 | NA | 19 9 | No | 470 N | NA | NA | No | BSL, BKG |
| 7440-50-8 | COPPER | 5 4 | J | 63 9 | J | mg/kg | 03SS270002 | 32/32 | NA | 63 9 | Yes | 290 N | 13000 | IDEM | No | BSL |
| 7439-89-6 | IRON | 8280 | J | 51600 | J | mg/kg | 03SS340002 | 32/32 | NA | 51600 | Yes | 2300 N | NA | NA | Yes | ASL |
| 7439-92-1 | LEAD | 9 2 | J | 10200 | J | mg/kg | 03SS240002 | 32/32 | NA | 10200 | Yes | 400 | 400 | IDEM | Yes | ASL |
| 7439-95-4 | MAGNESIUM | 556 | J | 15000 | J | mg/kg | 03SS330002 | 32/32 | NA | 15000 | No | NA | NA | NA | No | NUT, BKG |
| 7439-96-5 | MANGANESE | 260 | J | 1760 | J | mg/kg | 03SS390002 | 32/32 | NA | 1760 | No | 180 N | NA | NA | No | BSL, BKG |
| 7439-97-6 | MERCURY | 0 017 | J | 0 26 | J | mg/kg | 03SS280002 | 31/32 | 0 02 | 0 26 | Yes | 2 3 N | 55 | IDEM | No | BSL |
| 7440-02-0 | NICKEL | 8 9 | J | 32 6 | J | mg/kg | 03SS180002 | 32/32 | NA | 32 6 | Yes | 160 N | 6900 | IDEM | No | BSL |
| 7440-09-7 | POTASSIUM | 330 | J | 2180 | J | mg/kg | 03SS180002 | 32/32 | NA | 2180 | No | NA | NA | NA | No | NUT, BKG |
| 7782-49-2 | SELENIUM | 0 17 | J | 0 42 | | mg/kg | 03SS270002, 03SS290002 | 29/32 | 0 16 - 0 18 | 0 42 | No | 39 N | 1700 | IDEM | No | BSL, BKG |
| 7440-22-4 | SILVER | 0 32 | J | 0 72 | | mg/kg | 03SS380002 | 5/32 | 0 04 - 0 8 | 0 72 | Yes | 39 N | 1700 | IDEM | No | BSL |
| 7440-23-5 | SODIUM | 87 1 | J | 598 | J | mg/kg | 03SS170002 | 9/32 | 21 - 237 | 598 | Yes | NA | NA | NA | No | NUT |
| 7440-28-0 | THALLIUM | 0 05 | | 0 21 | | mg/kg | 03SS270002 | 32/32 | NA | 0 21 | No | 0 52 N | 31 | IDEM | No | BSL, BKG |
| 7440-62-2 | VANADIUM | 10 8 | | 29 1 | | mg/kg | 03SS270002 | 32/32 | NA | 29 1 | No | 55 N | NA | NA | No | BSL, BKG |
| 7440-66-6 | ZINC | 19 5 | J | 739 | J | mg/kg | 03SS280002 | 32/32 | NA | 739 | Yes | 2300 N | 100000 | IDEM | No | BSL |

TABLE 4-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
NSWC CRANE
CRANE, INDIANA


**Scenario Timeframe Current/Future**
**Medium Surface Soil**
**Exposure Medium Surface Soil (0 to 2 feet)**
**Exposure Point· SWMU 3 - Old Jeep Trail / Little Sulphur Creek**

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects(2) | Concentration Used for Screening(3) | Site Above Background?(4) | U S EPA Region 9 PRG-Residential(5) | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection(6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| 14797-55-8 | NITRATE | 0 8 | | 49 | | mg/kg | 03SS240002 | 46/48 | 0 6 - 1 1 | 49 | NA | 13000 (7) N | NA | NA | No | BSL |
| 14797-65-0 | NITRITE | 2 4 | J | 5 6 | J | mg/kg | 03SS010002 | 2/39 | 2 - 44 | 5 6 | NA | 780 (7) N | NA | NA | No | BSL |
| TTNUS029 | NITRITE/NITRATE | 0 8 | | 49 | J | mg/kg | 03SS240002 | 46/48 | 0 6 - 1 1 | 49 | NA | NA | NA | NA | No | NTX |
| TTNUS288 | PERCENT MOISTURE | 6 4 | | 25 6 | | | 03SS270002 | 48/48 | NA | 25 6 | NA | NA | NA | NA | No | NTX |
| 14797-73-0 | PERCHLORATE | 24 | J | 470 | J | µg/kg | 03SS220002 | 3/48 | 20 - 27 | 470 | NA | 3900 | NA | NA | No | BSL |

Notes
1 Only the original of duplicate samples was considered 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 significantly different from background that chemical was not selected as a COPC
5 U S EPA Region 9 Preliminary Remediation Goals Table November 1 2000 (PRGs for noncarcinogens are divided by 10 )
6 - Rationale Codes Selection Reason Above Screening Levels (ASL)
Deletion Reason No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)
Below Background Value (BKG)
7 No U S EPA Region 9 PRG available value is from U S EPA Region 3 Risk Based Concentration table, September 25, 2001
8 - Value is for naphthalene
9 Value is for acenaphthene
10 Value is for pyrene
11 - Value is for hexavalent chromium

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

Definitions
NA Not applicable
SQL Sample quantitation limit
COPC Chemical of potential concern
ARAR/TBC - Applicable or Relevant and Appropriate Requirement/To Be Considered
J - Estimated value
C Carcinogenic
N Noncarcinogenic
IDEM - Indiana Department of Environmental Management Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM July 2001)
sat Soil saturation limit

ASSOCIATED SAMPLES

| | | |
|---|---|---|
| 03SS010002 | 03SS170002 | 03SS330002 |
| 03SS020002 | 03SS180002 | 03SS340002 |
| 03SS030002 | 03SS190002 | 03SS350002 |
| 03SS040002 | 03SS200002 | 03SS360002 |
| 03SS050002 | 03SS210002 | 03SS370002 |
| 03SS060002 | 03SS220002 | 03SS380002 |
| 03SS070002 | 03SS230002 | 03SS390002 |
| 03SS080002 | 03SS240002 | 03SS400002 |
| 03SS090002 | 03SS250002 | 03SS410002 |
| 03SS100002 | 03SS260002 | 03SS420002 |
| 03SS110002 | 03SS270002 | 03SS430002 |
| 03SS120002 | 03SS280002 | 03SS440002 |
| 03SS130002 | 03SS290002 | 03SS450002 |
| 03SS140002 | 03SS300002 | 03SS460002 |
| 03SS150002 | 03SS310002 | 03SS470002 |
| 03SS160002 | 03SS320002 | 03SS480002 |

TABLE 4-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Soil
Exposure Medium Surface Soil (0 to 2 feet)
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects(2) | Concentration Used for Screening(3) | Site Above Background? (4) | U S EPA Generic SSL for Soil to Air(5) | U S EPA Generic SSL for Migration to Ground Water(5) | IDEM SSL for Migration to Ground Water(6) | COPC Flag | Rationale for Contaminant Deletion or Selection(7) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dioxins** | | | | | | | | | | | | | | | | |
| 3268-87-9 | 1,2,3,4,6,7,8,9-OCDD | 176 | J | 3440 | J | ng/kg | 03SS470002 | 11/11 | NA | 3440 | NA | 4 30E+11 | 2.87E+03 | NA | Yes | ASL |
| 39001-02-0 | 1,2,3,4,6,7,8,9-OCDF | 7 6 | J | 62 2 | J | ng/kg | 03SS170002 | 3/11 | 0 3 - 2 1 | 62 2 | NA | 4 30E+11 | 2 87E+03 | NA | No | BSL |
| 35822-46-9 | 1,2,3,4,6,7,8-HPCDD | 3 2 | | 233 | | ng/kg | 03SS170002 | 11/11 | NA | 233 | NA | 4 30E+09 | 2.87E+01 | NA | Yes | ASL |
| 67562-39-4 | 1,2,3,4,6,7,8-HPCDF | 0 19 | J | 32 1 | | ng/kg | 03SS170002 | 5/11 | 0 17 - 0 71 | 32 1 | NA | 4 30E+09 | 2.87E+01 | NA | Yes | ASL |
| 55673-89-7 | 1,2,3,4,7,8,9-HPCDF | 0 7 | J | 2 1 | J | ng/kg | 03SS170002 | 4/11 | 0 1 - 0 4 | 2 1 | NA | 4 30E+09 | 2 87E+01 | NA | No | BSL |
| 39227-28-6 | 1,2,3,4 7 8-HXCDD | 0 58 | J | 2 1 | J | ng/kg | 03SS170002 | 4/11 | 0 17 - 0 74 | 2 1 | NA | 4 30E+08 | 2 87E+00 | NA | No | BSL |
| 70648-26-9 | 1,2,3,4,7,8-HXCDF | 3 1 | | 3 9 | | ng/kg | 03SS170002 | 2/11 | 0 08 - 2 1 | 3 9 | NA | 4 30E+08 | 2.87E+00 | NA | Yes | ASL |
| 57653-85-7 | 1,2,3,6,7,8-HXCDD | 0 33 | J | 10 1 | | ng/kg | 03SS170002 | 5/11 | 0 1 0 76 | 10 1 | NA | 4 30E+08 | 2.87E+00 | NA | Yes | ASL |
| 57117-44-9 | 1,2,3,6,7,8-HXCDF | 0 19 | J | 2 4 | J | ng/kg | 03SS170002 | 6/11 | 0 06 - 0 2 | 2 4 | NA | 4 30E+08 | 2 87E+00 | NA | No | BSL |
| 19408-74-3 | 1,2,3,7,8,9-HXCDD | 0 35 | J | 6 5 | | ng/kg | 03SS170002 | 5/11 | 0 32 - 0 76 | 6 5 | NA | 4 30E+08 | 2.87E+00 | NA | Yes | ASL |
| 72918-21-9 | 1 2 3 7,8,9-HXCDF | 0 22 | J | 0 22 | J | ng/kg | 03SS230002 | 1/11 | 0 08 - 0 65 | 0 22 | NA | 4 30E+08 | 2 87E+00 | NA | No | BSL |
| 40321-76-4 | 1,2,3,7,8-PECDD | 0 4 | J | 1 3 | J | ng/kg | 03SS170002 | 5/11 | 0 08 - 0 2 | 1 3 | NA | 4 30E+07 | 2.87E-01 | NA | Yes | ASL |
| 57117-41-6 | 1,2,3,7,8-PECDF | 0 37 | J | 1 1 | J | ng/kg | 03SS260002 | 3/11 | 0 06 - 0 38 | 1 1 | NA | 8 60E+08 | 5 74E+00 | NA | No | BSL |
| 60851-34-5 | 2,3 4 6 7,8-HXCDF | 0 43 | J | 2 7 | J | ng/kg | 03SS170002 | 5/11 | 0 07 - 0 13 | 2 7 | NA | 4 30E+08 | 2 87E+00 | NA | No | BSL |
| 57117-31-4 | 2,3,4,7,8-PECDF | 0 39 | J | 1 4 | J | ng/kg | 03SS230002 | 4/11 | 0 06 - 0 67 | 1 4 | NA | 8 60E+07 | 5.74E-01 | NA | Yes | ASL |
| 1746-01-6 | 2,3,7,8-TCDD | 0 19 | J | 3 9 | | ng/kg | 03SS260002 | 5/11 | 0 08 - 0 2 | 3 9 | NA | 4 30E+07 | 2.87E-01 | NA | Yes | ASL |
| 51207-31-9 | 2,3,7 8-TCDF | 0 5 | J | 0 78 | J | ng/kg | 03SS470002 | 4/11 | 0 06 - 0 85 | 0 78 | NA | 4 30E+08 | 2 87E+00 | NA | No | BSL |
| 3268-87-9 | 2,3,7,8-TCDD Equivalents | 0 12 | | 7 4 | | ng/kg | 03SS170002 | 11/11 | NA | 7 4 | NA | 4 30E+07 | 2.87E-01 | NA | Yes | ASL |
| 37871-00-4 | TOTAL HPCDD | 6 7 | J | 419 | | ng/kg | 03SS170002 | 10/11 | 6 9 | 419 | NA | 4 30E+09 | 2.87E+01 | NA | Yes | ASL |
| 38998-75-3 | TOTAL HPCDF | 0 19 | | 19 | | ng/kg | 03SS230002 | 5/11 | 0 17 - 93 9 | 19 | NA | 4 30E+09 | 2 87E+03 | NA | No | BSL |
| 34465-46-8 | TOTAL HXCDD | 2 | | 4 | | ng/kg | 03SS290002 | 2/11 | 1 4 - 59 1 | 4 | NA | 4 30E+08 | 2.87E+00 | NA | Yes | ASL |
| 55684-94-1 | TOTAL HXCDF | 3 2 | | 17 8 | | ng/kg | 03SS230002 | 2/11 | 0 07 - 61 2 | 17 8 | NA | 4 30E+08 | 2.87E+00 | NA | Yes | ASL |
| 36088-22-9 | TOTAL PECDD | 0 45 | J | 0 45 | J | ng/kg | 03SS320002 | 1/11 | 0 08 - 10 4 | 0 45 | NA | 4 30E+07 | 2.87E-01 | NA | Yes | ASL |
| 41903-57-5 | TOTAL TCDD | 1 | | 1 | | ng/kg | 03SS170002 | 1/11 | 0 08 - 7 5 | 1 | NA | 4 30E+07 | 2.87E-01 | NA | Yes | ASL |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 71-55-6 | 1,1,1-TRICHLOROETHANE | 2 | J | 19 | J | µg/kg | 03SS280002 | 4/15 | 0 93 - 11 | 19 | NA | 1200000 | 100 | 1900 | No | BSL |
| 591-78-6 | 2-HEXANONE | 5 | J | 5 | J | µg/kg | 03SS460002 | 1/15 | 0 93 - 12 | 5 | NA | NA | NA | NA | No | NTX |
| 108-10-1 | 4-METHYL-2-PENTANONE | 4 | J | 4 | J | µg/kg | 03SS460002 | 1/15 | 0 93 - 12 | 4 | NA | NA | NA | NA | No | NTX |
| 127-18 4 | TETRACHLOROETHENE | 1 | J | 3 | J | µg/kg | 03SS230002 | 2/15 | 0 93 - 12 | 3 | NA | 11000 | 3 | 58 | No | BSL |
| 1330-20-7 | TOTAL XYLENES | 82 | | 82 | | µg/kg | 03SS470002 | 1/15 | 0 93 - 12 | 82 | NA | 410000 | 9000 | 190000 | No | BSL |
| 79-01-6 | TRICHLOROETHENE | 3 | J | 14 | J | µg/kg | 03SS230002 | 3/15 | 0 93 - 12 | 14 | NA | 5000 | 3 | 57 | Yes | ASL |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 106-50-3 | 1,4-PHENYLENEDIAMINE | 210 | J | 210 | J | µg/kg | 03SS340002 | 1/29 | 67 - 98 | 210 | NA | NA | NA | NA | No | NTX |
| 91-57-6 | 2-METHYLNAPHTHALENE | 24 | | 290 | | µg/kg | 03SS240002 | 2/45 | 1 3 - 55 | 290 | NA | NA | NA | NA | No | NTX |
| 83-32-9 | ACENAPHTHENE | 18 | | 18 | | µg/kg | 03SS240002 | 1/45 | 1 3 - 55 | 18 | NA | NA | NA | 130000 | No | BSL |
| 208-96-8 | ACENAPHTHYLENE | 11 | | 14 | | µg/kg | 03SS110002 | 2/45 | 1 3 - 55 | 14 | NA | NA | NA | NA | No | NTX |
| 120-12-7 | ANTHRACENE | 12 | | 12 | | µg/kg | 03SS110002 | 1/45 | 1 3 380 | 12 | NA | NA | 590000 | 51000 | No | BSL |
| 56-55-3 | BENZO(A)ANTHRACENE | 8 | | 37 | | µg/kg | 03SS180002 | 3/45 | 1 3 - 380 | 37 | NA | NA | 80 | 19000 | No | BSL |
| 50-32-8 | BENZO(A)PYRENE | 1 5 | | 54 | | µg/kg | 03SS240002 | 5/45 | 1 3 - 55 | 54 | NA | NA | 400 | 8200 | No | BSL |
| 205-99-2 | BENZO(B)FLUORANTHENE | 9 | | 160 | | µg/kg | 03SS180002, 03SS240002 | 13/45 | 1 3 - 55 | 160 | NA | NA | 200 | 57000 | No | BSL |
| 191-24-2 | BENZO(G,H,I)PERYLENE | 8 | | 67 | | µg/kg | 03SS180002 | 7/45 | 1 3 - 55 | 67 | NA | NA | NA | NA | No | NTX |
| 117-81-7 | BIS(2-ETHYLHEXYL)PHTHALAT | 84 | J | 870 | | µg/kg | 03SS180002 | 7/45 | 67 - 170 | 870 | NA | 31000000 | 180000 | 3600000 | No | BSL |
| 218-01-9 | CHRYSENE | 8 | | 68 | | µg/kg | 03SS180002 | 7/45 | 1 3 - 380 | 68 | NA | NA | 8000 | 25000 | No | BSL |
| 84-74-2 | DI-N-BUTYL PHTHALATE | 110 | J | 4500 | | µg/kg | 03SS180002 | 9/45 | 67 - 98 | 4500 | NA | 2300000 | 270000 | 500000 | No | BSL |
| 117-84-0 | DI-N-OCTYL PHTHALATE | 270 | J | 270 | J | µg/kg | 03SS250002 | 1/39 | 67 - 98 | 270 | NA | 10000000 | 10000000 | 6700000 | No | BSL |
| 53-70-3 | DIBENZO(A,H)ANTHRACENE | 8 | | 8 | | µg/kg | 03SS240002 | 1/45 | 1 3 - 55 | 8 | NA | NA | 80 | 18000 | No | BSL |
| 206-44-0 | FLUORANTHENE | 8 | | 250 | | µg/kg | 03SS240002 | 8/45 | 1 3 - 55 | 250 | NA | NA | 210000 | 880000 | No | BSL |
| 86-73-7 | FLUORENE | 15 | | 15 | | µg/kg | 03SS240002 | 1/45 | 1 3 - 55 | 15 | NA | NA | 28000 | 170000 | No | BSL |
| 193-39-5 | INDENO(1,2,3-CD)PYRENE | 8 | | 49 | J | µg/kg | 03SS180002 | 5/45 | 1 3 - 55 | 49 | NA | NA | 700 | 3100 | No | BSL |
| 91-20-3 | NAPHTHALENE | 11 | | 130 | | µg/kg | 03SS240002 | 4/45 | 1 3 - 55 | 130 | NA | NA | 4000 | 700 | No | BSL |
| 85-01-8 | PHENANTHRENE | 8 | | 320 | | µg/kg | 03SS240002 | 5/45 | 1 3 - 55 | 320 | NA | NA | NA | NA | No | NTX |
| 129-00-0 | PYRENE | 8 | | 250 | | µg/kg | 03SS240002 | 9/45 | 1 3 - 55 | 250 | NA | NA | 210000 | 570000 | No | BSL |

TABLE 4-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Soil
Exposure Medium Surface Soil (0 to 2 feet)
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects[2] | Concentration Used for Screening[3] | Site Above Background? [4] | U S EPA Generic SSL for Soil to Air[5] | U S EPA Generic SSL for Migration to Ground Water[5] | IDEM SSL for Migration to Ground Water[6] | COPC Flag | Rationale for Contaminant Deletion or Selection[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Energetics** | | | | | | | | | | | | | | | | |
| 99-35-4 | 1,3,5-TRINITROBENZENE | 0 72 | | 11 | J | mg/kg | 03SS240002 | 3/48 | 0 25 | 11 | NA | NA | NA | NA | No | NTX |
| 118-96-7 | 2,4,6-TRINITROTOLUENE | 0 39 | J | 1700 | J | mg/kg | 03SS240002 | 4/48 | 0 25 | 1700 | NA | NA | NA | NA | No | NTX |
| 121-14-2 | 2,4-DINITROTOLUENE | 1 | J | 1 | J | mg/kg | 03SS240002 | 1/48 | 0 25 | 1 | NA | NA | 0.00004 | NA | Yes | ASL |
| 35572-78-2 | 2-AMINO-4 6-DINITROTOLUENE | 0 56 | | 30 | J | mg/kg | 03SS240002 | 7/48 | 0 25 | 30 | NA | NA | NA | NA | No | NTX |
| 88-72-2 | 2-NITROTOLUENE | 0 28 | J | 0 28 | J | mg/kg | 03SS330002 | 1/48 | 0 25 | 0 28 | NA | NA | NA | NA | No | NTX |
| 19406-51-0 | 4-AMINO-2,6-DINITROTOLUENE | 0 35 | J | 15 | J | mg/kg | 03SS240002 | 7/48 | 0 25 | 15 | NA | NA | NA | NA | No | NTX |
| 2691 41-0 | HMX | 0 34 | | 1600 | J | mg/kg | 03SS240002 | 9/47 | 0 25 - 0 34 | 1600 | NA | NA | NA | NA | No | NTX |
| 121-82-4 | RDX | 0 93 | | 2400 | J | mg/kg | 03SS240002 | 6/48 | 0 25 | 2400 | NA | NA | NA | NA | No | NTX |
| **Herbicides** | | | | | | | | | | | | | | | | |
| 93-76-5 | 2,4,5-T | 6 4 | | 6 4 | | µg/kg | 03SS320002 | 1/5 | 1 6 - 1 7 | 6 4 | NA | NA | NA | NA | No | NTX |
| 94-75 7 | 2 4-D | 6 7 | | 8 3 | J | µg/kg | 03SS320002 | 3/5 | 1 6 - 1 7 | 8 3 | NA | NA | NA | NA | No | NTX |
| 88-85-7 | DINOSEB | 11 | | 11 | | µg/kg | 03SS290002 | 1/3 | 1 6 - 1 7 | 11 | NA | NA | NA | NA | No | NTX |
| **Inorganics** | | | | | | | | | | | | | | | | |
| 7429 90-5 | ALUMINUM | 2350 | J | 14900 | J | mg/kg | 03SS270002 | 32/32 | NA | 14900 | No | NA | NA | NA | No | BKG |
| 7440-36-0 | ANTIMONY | 0 49 | J | 4 4 | J | mg/kg | 03SS240002 | 8/32 | 0 19 - 2 8 | 4 4 | No | NA | 3 | 5 4 | No | BKG |
| 7440-38-2 | ARSENIC | 3 | J | 28 4 | J | mg/kg | 03SS330002 | 30/32 | 2 8 - 4 4 | 28 4 | No | 750 | 1 | 29 | No | BKG |
| 7440-39-3 | BARIUM | 66 2 | J | 2040 | J | mg/kg | 03SS480002 | 32/32 | NA | 2040 | Yes | 690000 | 82 | 1600 | Yes | ASL |
| 7440-41-7 | BERYLLIUM | 0 33 | J | 1 4 | | mg/kg | 03SS180002 | 31/32 | 0 2 | 1 4 | Yes | 1300 | 3 | 63 | No | BSL |
| 7440 43-9 | CADMIUM | 0 35 | | 4 4 | | mg/kg | 03SS240002 | 29/32 | 0 31 - 0 32 | 4 4 | Yes | 1800 | 0.4 | 7 5 | Yes | ASL |
| 7440-70-2 | CALCIUM | 1180 | J | 244000 | J | mg/kg | 03SS330002 | 32/32 | NA | 244000 | Yes | NA | NA | NA | No | NUT, BKG |
| 7440 47-3 | CHROMIUM | 7 7 | J | 288 | J | mg/kg | 03SS270002 | 32/32 | NA | 288 | Yes | 270 (9) | 2 (9) | 38 (9) | No | * |
| 7440-48-4 | COBALT | 3 | J | 19 9 | J | mg/kg | 03SS340002 | 32/32 | NA | 19 9 | No | NA | NA | NA | No | BKG |
| 7440-50-8 | COPPER | 5 4 | J | 63 9 | J | mg/kg | 03SS270002 | 32/32 | NA | 63 9 | Yes | NA | NA | 580 | No | BSL |
| 7439-89-6 | IRON | 8280 | J | 51600 | J | mg/kg | 03SS340002 | 32/32 | NA | 51600 | Yes | NA | NA | NA | No | NTX |
| 7439-92-1 | LEAD | 9 2 | J | 10200 | J | mg/kg | 03SS240002 | 32/32 | NA | 10200 | Yes | NA | NA | 81 | Yes | ASL |
| 7439 95-4 | MAGNESIUM | 556 | J | 15000 | J | mg/kg | 03SS330002 | 32/32 | NA | 15000 | No | NA | NA | NA | No | BKG |
| 7439-96-5 | MANGANESE | 260 | J | 1760 | J | mg/kg | 03SS390002 | 32/32 | NA | 1760 | No | NA | NA | NA | No | BKG |
| 7439-97-6 | MERCURY | 0 017 | J | 0 26 | J | mg/kg | 03SS280002 | 31/32 | 0 02 | 0 26 | Yes | 10 | 0.1 | 2 1 | Yes | ASL |
| 7440-02-0 | NICKEL | 8 9 | J | 32 6 | J | mg/kg | 03SS180002 | 32/32 | NA | 32 6 | Yes | 13000 | 7 | 950 | Yes | ASL |
| 7440-09-7 | POTASSIUM | 330 | J | 2180 | J | mg/kg | 03SS180002 | 32/32 | NA | 2180 | No | NA | NA | NA | No | NUT, BKG |
| 7782-49-2 | SELENIUM | 0 17 | J | 0 42 | | mg/kg | 03SS270002, 03SS290002 | 29/32 | 0 16 - 0 18 | 0 42 | No | NA | 0.3 | 5 2 | No | BKG |
| 7440-22-4 | SILVER | 0 32 | J | 0 72 | | mg/kg | 03SS380002 | 5/32 | 0 04 - 0 8 | 0 72 | Yes | NA | 2 | 31 | No | BSL |
| 7440-23-5 | SODIUM | 87 1 | J | 598 | J | mg/kg | 03SS170002 | 9/32 | 21 - 237 | 598 | Yes | NA | NA | NA | No | NUT |
| 7440-28-0 | THALLIUM | 0 05 | | 0 21 | | mg/kg | 03SS270002 | 32/32 | NA | 0 21 | No | NA | 0.04 | 2 8 | No | BKG |
| 7440-62-2 | VANADIUM | 10 8 | | 29 1 | | mg/kg | 03SS270002 | 32/32 | NA | 29 1 | No | NA | 300 | NA | No | BSL, BKG |
| 7440-66-6 | ZINC | 19 5 | J | 739 | J | mg/kg | 03SS280002 | 32/32 | NA | 739 | Yes | NA | 620 | 14000 | Yes | ASL |

TABLE 4-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Soil
Exposure Medium Surface Soil (0 to 2 feet)
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects(2) | Concentration Used for Screening(3) | Site Above Background? (4) | U S EPA Generic SSL for Soil to Air(5) | U S EPA Generic SSL for Migration to Ground Water(5) | IDEM SSL for Migration to Ground Water(6) | COPC Flag | Rationale for Contaminant Deletion or Selection(7) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Miscellaneous Parameters | | | | | | | | | | | | | | | | |
| 14797-55-8 | NITRATE | 0 8 | | 49 | | mg/kg | 03SS240002 | 46/48 | 0 6 - 1 1 | 49 | NA | NA | NA | NA | No | NTX |
| 14797-65-0 | NITRITE | 2 4 | J | 5 6 | J | mg/kg | 03SS010002 | 2/39 | 2 - 44 | 5 6 | NA | NA | NA | NA | No | NTX |
| TTNUS029 | NITRITE/NITRATE | 0 8 | | 49 | J | mg/kg | 03SS240002 | 46/48 | 0 6 - 1 1 | 49 | NA | NA | NA | NA | No | NTX |
| TTNUS288 | PERCENT MOISTURE | 6 4 | | 25 6 | | | 03SS270002 | 48/48 | NA | 25 6 | NA | NA | NA | NA | No | NTX |
| 14797-73 0 | PERCHLORATE | 24 | J | 470 | J | µg/kg | 03SS220002 | 3/48 | 20 - 27 | 470 | NA | NA | NA | NA | No | NTX |

Notes
1 - Only the original of duplicate samples was considered 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 significantly 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 Rationale Codes
Selection Reason Above Screening Levels (ASL)
Deletion Reason No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)
Below Background Value (BKG)
8 Value is for hexavalent chromium

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

Definitions
NA Not applicable
SQL Sample quantitation limit
COPC Chemical of potential concern
ARAR/TBC Applicable or Relevant and Appropriate Requirement/To Be Considered
J - Estimated value
IDEM Indiana Department of Environmental Management Risk Integrated System of Closure (RISC) residential levels for migration from soil to ground water (IDEM July 2001)

See Section 4 2 2 for explanation

ASSOCIATED SAMPLES

| | | |
|---|---|---|
| 03SS010002 | 03SS170002 | 03SS330002 |
| 03SS020002 | 03SS180002 | 03SS340002 |
| 03SS030002 | 03SS190002 | 03SS350002 |
| 03SS040002 | 03SS200002 | 03SS360002 |
| 03SS050002 | 03SS210002 | 03SS370002 |
| 03SS060002 | 03SS220002 | 03SS380002 |
| 03SS070002 | 03SS230002 | 03SS390002 |
| 03SS080002 | 03SS240002 | 03SS400002 |
| 03SS090002 | 03SS250002 | 03SS410002 |
| 03SS100002 | 03SS260002 | 03SS420002 |
| 03SS110002 | 03SS270002 | 03SS430002 |
| 03SS120002 | 03SS280002 | 03SS440002 |
| 03SS130002 | 03SS290002 | 03SS450002 |
| 03SS140002 | 03SS300002 | 03SS460002 |
| 03SS150002 | 03SS310002 | 03SS470002 |
| 03SS160002 | 03SS320002 | 03SS480002 |

TABLE 4-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Subsurface Soil
Exposure Medium Subsurface Soil (Greater than 2 feet)
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects[2] | Concentration Used for Screening[3] | Site Above Background?[4] | U S EPA Region 9 PRG-Residential[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 | 174 | J | 970 | J | ng/kg | 03SB241215 | 2/2 | NA | 970 | NA | 39000 C | NA | NA | No | BSL |
| 35822-46-9 | 1,2,3,4,6,7,8-HPCDD | 1 2 | J | 7 6 | | ng/kg | 03SB241215 | 2/2 | NA | 7 6 | NA | 390 C | NA | NA | No | BSL |
| 57653-85-7 | 1,2,3,6,7,8-HXCDD | 0 35 | J | 0 35 | J | ng/kg | 03SB241215 | 1/2 | 0 1 | 0 35 | NA | 39 C | NA | NA | No | BSL |
| 3268-87-9 | 2,3,7,8-TCDD Equivalents | 0 029 | | 0 21 | | ng/kg | 03SB241215 | 2/2 | NA | 0 21 | NA | 3 9 C | NA | NA | No | BSL |
| 37871-00-4 | TOTAL HPCDD | 18 4 | | 18 4 | | ng/kg | 03SB241215 | 1/2 | 2 5 | 18 4 | NA | 39 C | NA | NA | No | BSL |
| 36088-22-9 | TOTAL PECDD | 0 27 | | 0 27 | | ng/kg | 03SB191215 | 1/2 | 0 14 | 0 27 | NA | 3 9 C | NA | NA | No | BSL |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 71-55-6 | 1,1,1-TRICHLOROETHANE | 1 | J | 21 | J | µg/kg | 03SB270607 | 5/25 | 0 9 - 13 | 21 | NA | 63000 N | 1800000 | IDEM | No | BSL |
| 79-34-5 | 1,1,2,2-TETRACHLOROETHANE | 1 | J | 2 | J | µg/kg | 03SB460610 | 2/25 | 0 9 - 13 | 2 | NA | 380 C | 5000 | IDEM | No | BSL |
| 591-78-6 | 2-HEXANONE | 2 | J | 13 | J | µg/kg | 03SB220204 | 4/25 | 0 9 - 13 | 13 | NA | 310000 (7) N | NA | NA | No | BSL |
| 108-10-1 | 4-METHYL-2-PENTANONE | 10 | J | 10 | J | µg/kg | 03SB250608 | 1/25 | 0 9 - 13 | 10 | NA | 79000 N | 1000000 | IDEM | No | BSL |
| 156-59-2 | CIS-1,2-DICHLOROETHENE | 1 | J | 18 | J | µg/kg | 03SB480610 | 3/25 | 0 9 - 13 | 18 | NA | 4300 N | 110000 | IDEM | No | BSL |
| 79-01-6 | TRICHLOROETHENE | 6 | J | 33 | J | µg/kg | 03SB480610 | 6/25 | 0 9 - 13 | 33 | NA | 2800 C | 45000 | IDEM | No | BSL |
| 75-69-4 | TRICHLOROFLUOROMETHANE | 1 | J | 5 | | µg/kg | 03SB211215 | 2/25 | 0 9 - 13 | 5 | NA | 39000 N | NA | NA | No | BSL |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 91-57-6 | 2-METHYLNAPHTHALENE | 23 | | 260 | | µg/kg | 03SB240406 | 5/62 | 1 3 - 5 7 | 260 | NA | 5600 (8) N | NA | NA | No | BSL |
| 95-48-7 | 2-METHYLPHENOL | 83 | J | 83 | J | µg/kg | 03SB220204 | 1/62 | 67 - 92 | 83 | NA | 310000 N | 7500000 | IDEM | No | BSL |
| | 3&4-METHYLPHENOL | 130 | J | 130 | J | µg/kg | 03SB220204 | 1/62 | 67 - 92 | 130 | NA | 310000 (9) N | 910000 (9) | NA | No | BSL |
| 83-32-9 | ACENAPHTHENE | 15 | | 15 | | µg/kg | 03SB240406 | 1/62 | 1 3 - 6 3 | 15 | NA | 370000 N | 9500000 | IDEM | No | BSL |
| 208-96-8 | ACENAPHTHYLENE | 20 | | 20 | | µg/kg | 03SB240406 | 1/62 | 1 3 - 6 3 | 20 | NA | 370000 (10) N | 9500000 (10) | IDEM | No | BSL |
| 98-86-2 | ACETOPHENONE | 81 | J | 120 | J | µg/kg | 03SB240406 | 2/62 | 67 - 92 | 120 | NA | 49 N | NA | NA | Yes | ASL |
| 120-12-7 | ANTHRACENE | 12 | | 25 | | µg/kg | 03SB230610 | 3/62 | 1 3 - 6 3 | 25 | NA | 2200000 N | 47000000 | IDEM | No | BSL |
| 56-55-3 | BENZO(A)ANTHRACENE | 9 | | 72 | | µg/kg | 03SB180204 | 2/62 | 1 3 - 6 3 | 72 | NA | 620 C | 5000 | IDEM | No | BSL |
| 50-32-8 | BENZO(A)PYRENE | 11 | | 110 | | µg/kg | 03SB180204 | 2/62 | 1 3 - 6 3 | 110 | NA | 62 C | 500 | IDEM | Yes | ASL |
| 205-99-2 | BENZO(B)FLUORANTHENE | 14 | | 290 | | µg/kg | 03SB180204 | 2/62 | 1 3 - 6 3 | 290 | NA | 620 C | 5000 | IDEM | No | BSL |
| 191-24-2 | BENZO(G,H,I)PERYLENE | 100 | | 100 | | µg/kg | 03SB180204 | 1/62 | 1 3 - 6 3 | 100 | NA | 230000 (11) N | 5500000 (11) | IDEM | No | BSL |
| 207-08-9 | BENZO(K)FLUORANTHENE | 32 | | 32 | | µg/kg | 03SB220204 | 1/62 | 1 3 - 6 1 | 32 | NA | 6200 C | 50000 | IDEM | No | BSL |
| 117-81-7 | BIS(2-ETHYLHEXYL)PHTHALATE | 79 | J | 3300 | J | µg/kg | 03SB070610 | 7/61 | 67 - 92 | 3300 | NA | 35000 C | 300000 | IDEM | No | BSL |
| 218-01-9 | CHRYSENE | 16 | | 140 | | µg/kg | 03SB180204 | 2/62 | 1 3 - 6 3 | 140 | NA | 62000 C | 500000 | IDEM | No | BSL |
| 84-74-2 | DI-N-BUTYL PHTHALATE | 100 | J | 2700 | | µg/kg | 03SB480206 | 6/61 | 67 - 92 | 2700 | NA | 610000 N | 18000000 | IDEM | No | BSL |
| 117-84-0 | DI-N-OCTYL PHTHALATE | 110 | J | 110 | J | µg/kg | 03SB070610 | 1/49 | 67 - 92 | 110 | NA | 120000 N | 3700000 | IDEM | No | BSL |
| 206-44-0 | FLUORANTHENE | 24 | | 100 | | µg/kg | 03SB180204 | 3/62 | 1 3 - 6 3 | 100 | NA | 230000 N | 6300000 | IDEM | No | BSL |
| 86-73-7 | FLUORENE | 19 | | 19 | | µg/kg | 03SB240406 | 1/62 | 1 3 - 6 3 | 19 | NA | 260000 N | 6300000 | IDEM | No | BSL |
| 193-39-5 | INDENO(1,2,3-CD)PYRENE | 77 | J | 77 | J | µg/kg | 03SB180204 | 1/62 | 1 3 - 6 3 | 77 | NA | 620 C | 5000 | IDEM | No | BSL |
| 91-20-3 | NAPHTHALENE | 8 | | 270 | | µg/kg | 03SB240406 | 6/62 | 1 3 - 5 7 | 270 | NA | 5600 N | 3200000 | IDEM | No | BSL |
| 85-01-8 | PHENANTHRENE | 45 | | 85 | | µg/kg | 03SB180204 | 3/62 | 1 3 - 5 7 | 85 | NA | 230000 (11) N | 5500000 (11) | IDEM | No | BSL |
| 108-95-2 | PHENOL | 100 | J | 100 | J | µg/kg | 03SB240406 | 1/62 | 67 - 92 | 100 | NA | 3700000 N | 88000000 | IDEM | No | BSL |
| 129-00-0 | PYRENE | 14 | | 150 | | µg/kg | 03SB180204 | 5/62 | 1 3 - 1 8 | 150 | NA | 230000 N | 5500000 | IDEM | No | BSL |
| **Energetics** | | | | | | | | | | | | | | | | |
| 118-96-7 | 2,4,6-TRINITROTOLUENE | 0 76 | | 2 1 | | mg/kg | 03SB190204 | 4/62 | 0 25 | 2 1 | NA | 16 C | NA | NA | No | BSL |
| 121-14-2 | 2,4-DINITROTOLUENE | 0 63 | J | 0 63 | J | mg/kg | 03SB180204 | 1/62 | 0 25 | 0 63 | NA | 12 N | NA | NA | No | BSL |
| 35572-78-2 | 2-AMINO-4,6-DINITROTOLUENE | 0 42 | J | 1 7 | | mg/kg | 03SB180204 | 4/62 | 0 25 | 1 7 | NA | 0.47 (7) N | NA | NA | Yes | ASL |
| 19406-51-0 | 4-AMINO-2,6-DINITROTOLUENE | 0 55 | | 1 1 | | mg/kg | 03SB180204 | 3/62 | 0 25 | 1 1 | NA | 0.47 (7) N | NA | NA | Yes | ASL |
| 2691-41-0 | HMX | 0 28 | J | 8 8 | | mg/kg | 03SB241215 | 7/60 | 0 25 | 8 8 | NA | 310 N | NA | NA | No | BSL |
| 121-82-4 | RDX | 0 92 | | 4 4 | | mg/kg | 03SB241215 | 5/62 | 0 25 | 4 4 | NA | 4.4 C | NA | NA | Yes | ASL |

TABLE 4-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Subsurface Soil
Exposure Medium· Subsurface Soil (Greater than 2 feet)
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects[2] | Concentration Used for Screening[3] | Site Above Background?[4] | U S EPA Region 9 PRG-Residential[5] | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inorganics | | | | | | | | | | | | | | | | |
| 7429-90-5 | ALUMINUM | 391 | J | 11500 | J | mg/kg | 03SB270607 | 37/37 | NA | 11500 | No | 7600 N | NA | NA | No | BKG |
| 7440-36-0 | ANTIMONY | 0 64 | J | 30 | J | mg/kg | 03SB480206 | 7/37 | 0 08 - 3 5 | 30 | No | 3.1 N | 140 | IDEM | No | BKG |
| 7440-38-2 | ARSENIC | 0 53 | J | 12 6 | J | mg/kg | 03SB241215 | 37/37 | NA | 12 6 | No | 0.39 C | 3.9 | IDEM | No | BKG |
| 7440-39-3 | BARIUM | 10 8 | J | 1340 | J | mg/kg | 03SB240406 | 37/37 | NA | 1340 | Yes | 540 N | 23000 | IDEM | Yes | ASL |
| 7440-41-7 | BERYLLIUM | 0 11 | J | 1 4 | | mg/kg | 03SB440206 | 37/37 | NA | 1 4 | Yes | 15 N | 680 | IDEM | No | BSL |
| 7440-43-9 | CADMIUM | 0 32 | | 12 1 | | mg/kg | 03SB240406 | 32/37 | 0 28 - 0 3 | 12 1 | Yes | 3.7 N | 12 | IDEM | Yes | ASL |
| 7440-70-2 | CALCIUM | 226 | J | 113000 | J | mg/kg | 03SB180204 | 37/37 | NA | 113000 | Yes | NA | NA | NA | No | NUT |
| 7440-47-3 | CHROMIUM | 3 | J | 34 5 | J | mg/kg | 03SB240406 | 37/37 | NA | 34 5 | No | 30 (12) C | 430 (12) | IDEM | No | BKG |
| 7440-48-4 | COBALT | 3 4 | J | 740 | J | mg/kg | 03SB480206 | 37/37 | NA | 740 | Yes | 470 N | NA | NA | Yes | ASL |
| 7440-50-8 | COPPER | 1 4 | J | 22500 | J | mg/kg | 03SB480206 | 37/37 | NA | 22500 | Yes | 290 N | 13000 | IDEM | Yes | ASL |
| 7439-89-6 | IRON | 2620 | J | 56400 | J | mg/kg | 03SB440610 | 37/37 | NA | 56400 | Yes | 2300 N | NA | NA | Yes | ASL |
| 7439-92-1 | LEAD | 3 | J | 3590 | J | mg/kg | 03SB480206 | 37/37 | NA | 3590 | Yes | 400 | 400 | IDEM | Yes | ASL |
| 7439-95-4 | MAGNESIUM | 146 | J | 7670 | J | mg/kg | 03SB180204 | 37/37 | NA | 7670 | No | NA | NA | NA | No | NUT, BKG |
| 7439-96-5 | MANGANESE | 130 | J | 1790 | J | mg/kg | 03SB460206 | 37/37 | NA | 1790 | Yes | 180 N | NA | NA | Yes | ASL |
| 7439-97-6 | MERCURY | 0 016 | | 0 57 | J | mg/kg | 03SB230610 | 31/37 | 0 015 - 0 019 | 0 57 | No | 2 3 N | 55 | IDEM | No | BSL, BKG |
| 7440-02-0 | NICKEL | 3 | J | 79100 | J | mg/kg | 03SB480206 | 37/37 | NA | 79100 | Yes | 160 N | 6900 | IDEM | Yes | ASL |
| 7440-09-7 | POTASSIUM | 227 | J | 1790 | J | mg/kg | 03SB270607 | 37/37 | NA | 1790 | No | NA | NA | NA | No | NUT, BKG |
| 7782-49-2 | SELENIUM | 0 16 | J | 0 43 | J | mg/kg | 03SB460206 | 28/37 | 0 16 - 0 19 | 0 43 | No | 39 N | 1700 | IDEM | No | BSL, BKG |
| 7440-22-4 | SILVER | 0 05 | | 33 9 | J | mg/kg | 03SB480206 | 6/37 | 0 04 - 0 92 | 33 9 | Yes | 39 N | 1700 | IDEM | No | BSL |
| 7440-23-5 | SODIUM | 80 6 | J | 668 | J | mg/kg | 03SB220204 | 14/37 | 18 8 - 182 | 668 | Yes | NA | NA | NA | No | NUT |
| 7440-28-0 | THALLIUM | 0 05 | | 0 21 | | mg/kg | 03SB230610 | 33/37 | 0 04 | 0 21 | No | 0 52 N | 31 | IDEM | No | BSL, BKG |
| 7440-31-5 | TIN | 7 1 | J | 1630 | J | mg/kg | 03SB480206 | 4/37 | 0 07 - 3 8 | 1630 | Yes | 4700 N | NA | NA | No | BSL |
| 7440-62-2 | VANADIUM | 2 6 | J | 28 3 | J | mg/kg | 03SB440206 | 37/37 | NA | 28 3 | No | 55 N | NA | NA | No | BSL, BKG |
| 7440-66-6 | ZINC | 7 2 | J | 1100 | J | mg/kg | 03SB240406 | 37/37 | NA | 1100 | Yes | 2300 N | 100000 | IDEM | No | BSL |

TABLE 4-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
NSWC CRANE
CRANE, INDIANA


**Scenario Timeframe Current/Future**
**Medium Subsurface Soil**
**Exposure Medium Subsurface Soil (Greater than 2 feet)**
**Exposure Point· SWMU 3 - Old Jeep Trail / Little Sulphur Creek**

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects[2] | Concentration Used for Screening[3] | Site Above Background?[4] | U S EPA Region 9 PRG-Residential[5] | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| 14797-55-8 | NITRATE | 1 1 | | 38 | | mg/kg | 03SB390206 | 58/62 | 1 - 1 1 | 38 | NA | 13000 (7) N | NA | NA | No | BSL |
| 14797-65-0 | NITRITE | 2 3 | J | 15 | J | mg/kg | 03SB250608 | 6/46 | 2 - 110 | 15 | NA | 780 (7) N | NA | NA | No | BSL |
| | NITRITE/NITRATE | 1 2 | J | 38 | J | mg/kg | 03SB390206 | 60/62 | 1 - 1 1 | 38 | NA | NA | NA | NA | No | NTX |
| | PERCENT MOISTURE | 8 4 | | 27 3 | | | 03SB241215 | 62/62 | NA | 27 3 | NA | NA | NA | NA | No | NTX |
| 14797-73-0 | PERCHLORATE | 32 | J | 43 | J | µg/kg | 03SB390206 | 2/62 | 20 - 28 | 43 | NA | 3900 N | NA | NA | No | BSL |

Notes
1 - Only the original of duplicate samples was considered 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 significantly different from background that chemical was not selected as a COPC
5 - U S EPA Region 9 Preliminary Remediation Goals Table November 1 2000 (PRGs for noncarcinogens are divided by 10 )
6 - Rationale Codes Selection Reason Above Screening Levels (ASL)
Deletion Reason No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)
Below Background Value (BKG)
7 - No U S EPA Region 9 PRG available value is from U S EPA Region 3 Risk Based Concentration table April 2 2002
8 - Value is for naphthalene
9 - Value is for 4-methylphenol
10 - Value is for acenaphthene
11 Value is for pyrene
12 - Value is for hexavalent chromium
Shaded cells indicate that the specified criterion has been exceeded or that the chemical has been selected as a COPC

**ASSOCIATED SAMPLES**

| | | | |
|---|---|---|---|
| 03SB020206 | 03SB110610 | 03SB211012 | 03SB390206 |
| 03SB020610 | 03SB130206 | 03SB211215 | 03SB390610 |
| 03SB040206 | 03SB130610 | 03SB220204 | 03SB400206 |
| 03SB040610 | 03SB140206 | 03SB221215 | 03SB400610 |
| 03SB050206 | 03SB140610 | 03SB230610 | 03SB420206 |
| 03SB050610 | 03SB150206 | 03SB240406 | 03SB420610 |
| 03SB060206 | 03SB150610 | 03SB241215 | 03SB440206 |
| 03SB060610 | 03SB160206 | 03SB250608 | 03SB440610 |
| 03SB070206 | 03SB160610 | 03SB260610 | 03SB460206 |
| 03SB070610 | 03SB170406 | 03SB270206 | 03SB460610 |
| 03SB080206 | 03SB171214 | 03SB270607 | 03SB470206 |
| 03SB080610 | 03SB180204 | 03SB280204 | 03SB470610 |
| 03SB090204 | 03SB190204 | 03SB340206 | 03SB480206 |
| 03SB100206 | 03SB191215 | 03SB340610 | 03SB480610 |
| 03SB100610 | 03SB200810 | 03SB360206 | |
| 03SB110206 | 03SB201215 | 03SB360610 | |

Definitions
NA Not applicable
SQL - Sample quantitation limit
COPC - Chemical of potential concern
ARAR/TBC - Applicable or Relevant and Appropriate Requirement/To Be Considered
J - Estimated value
C - Carcinogenic
N - Noncarcinogenic
IDEM - Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001)

TABLE 4-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SUBSURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Subsurface Soil
Exposure Medium Subsurface Soil (Greater than 2 feet)
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects(2) | Concentration Used for Screening(3) | Site Above Background?(4) | U S EPA Generic SSL for Soil to Air(5) | U S EPA Generic SSL for Migration to Ground water(6) | IDEM SSL for Migration to Ground water(6) | COPC Flag | Rationale for Contaminant Deletion or Selection(7) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dioxins/Furans** | | | | | | | | | | | | | | | | |
| 3268-87-9 | 1,2,3,4,6,7,8,9-OCDD | 174 | J | 970 | J | ng/kg | 03SB241215 | 2/2 | NA | 970 | NA | 4 30E+05 | 2.87E-03 | NA | Yes | ASL |
| 35822-46-9 | 1,2,3,4,6,7,8-HPCDD | 1 2 | J | 7 6 | | ng/kg | 03SB241215 | 2/2 | NA | 7 6 | NA | 4 30E+03 | 2.87E-05 | NA | Yes | ASL |
| 57653-85-7 | 1,2,3,6,7,8-HXCDD | 0 35 | J | 0 35 | J | ng/kg | 03SB241215 | 1/2 | 0 1 | 0 35 | NA | 4 30E+08 | 2 87E+00 | NA | No | BSL |
| 3268-87-9 | 2,3,7,8-TCDD Equivalents | 0 029 | | 0 21 | | ng/kg | 03SB241215 | 2/2 | NA | 0 21 | NA | 4 30E+05 | 2.87E-03 | NA | Yes | ASL |
| 37871-00-4 | TOTAL HPCDD | 18 4 | | 18 4 | | ng/kg | 03SB241215 | 1/2 | 2 5 | 18 4 | NA | 4 30E+09 | 2 87E+01 | NA | No | BSL |
| 36088-22-9 | TOTAL PECDD | 0 27 | | 0 27 | | ng/kg | 03SB191215 | 1/2 | 0 14 | 0 27 | NA | 4 30E+07 | 2 87E-01 | NA | No | BSL |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 71-55-6 | 1,1,1-TRICHLOROETHANE | 1 | J | 21 | J | µg/kg | 03SB270607 | 5/25 | 0 9 - 13 | 21 | NA | 1200000 | 100 | 1900 | No | BSL |
| 79-34-5 | 1,1,2,2-TETRACHLOROETHANE | 1 | J | 2 | J | µg/kg | 03SB460610 | 2/25 | 0 9 - 13 | 2 | NA | 600 | 0.2 | 7 | Yes | ASL |
| 591-78-6 | 2-HEXANONE | 2 | J | 13 | J | µg/kg | 03SB220204 | 4/25 | 0 9 - 13 | 13 | NA | NA | NA | NA | No | NTX |
| 108-10-1 | 4-METHYL-2-PENTANONE | 10 | J | 10 | J | µg/kg | 03SB250608 | 1/25 | 0 9 - 13 | 10 | NA | NA | NA | NA | No | NTX |
| 156-59-2 | CIS-1,2-DICHLOROETHENE | 1 | J | 18 | J | µg/kg | 03SB480610 | 3/25 | 0 9 - 13 | 18 | NA | 1200000 | 20 | 400 | No | BSL |
| 79-01-6 | TRICHLOROETHENE | 6 | J | 33 | J | µg/kg | 03SB480610 | 6/25 | 0 9 - 13 | 33 | NA | 5000 | 3 | 57 | Yes | ASL |
| 75-69-4 | TRICHLOROFLUOROMETHANE | 1 | J | 5 | | µg/kg | 03SB211215 | 2/25 | 0 9 - 13 | 5 | NA | NA | NA | NA | No | NTX |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 91-57-6 | 2-METHYLNAPHTHALENE | 23 | | 260 | | µg/kg | 03SB240406 | 5/62 | 1 3 - 5 7 | 260 | NA | NA | NA | NA | No | NTX |
| 95-48-7 | 2-METHYLPHENOL | 83 | J | 83 | J | µg/kg | 03SB220204 | 1/62 | 67 - 92 | 83 | NA | NA | 800 | 14000 | No | BSL |
| | 3&4-METHYLPHENOL | 130 | J | 130 | J | µg/kg | 03SB220204 | 1/62 | 67 - 92 | 130 | NA | NA | NA | 1100 (8) | No | BSL |
| 83-32-9 | ACENAPHTHENE | 15 | | 15 | | µg/kg | 03SB240406 | 1/62 | 1 3 - 6 3 | 15 | NA | NA | NA | 130000 | No | BSL |
| 208-96-8 | ACENAPHTHYLENE | 20 | | 20 | | µg/kg | 03SB240406 | 1/62 | 1 3 - 6 3 | 20 | NA | NA | NA | NA | No | NTX |
| 98-86-2 | ACETOPHENONE | 81 | J | 120 | J | µg/kg | 03SB240406 | 2/62 | 67 - 92 | 120 | NA | NA | NA | NA | No | NTX |
| 120-12-7 | ANTHRACENE | 12 | | 25 | | µg/kg | 03SB230610 | 3/62 | 1 3 - 6 3 | 25 | NA | NA | 590000 | 51000 | No | BSL |
| 56-55-3 | BENZO(A)ANTHRACENE | 9 | | 72 | | µg/kg | 03SB180204 | 2/62 | 1 3 - 6 3 | 72 | NA | NA | 80 | 19000 | No | BSL |
| 50-32-8 | BENZO(A)PYRENE | 11 | | 110 | | µg/kg | 03SB180204 | 2/62 | 1 3 - 6 3 | 110 | NA | NA | 400 | 8200 | No | BSL |
| 205-99-2 | BENZO(B)FLUORANTHENE | 14 | | 290 | | µg/kg | 03SB180204 | 2/62 | 1 3 - 6 3 | 290 | NA | NA | 200 | 57000 | Yes | ASL |
| 191-24-2 | BENZO(G,H,I)PERYLENE | 100 | | 100 | | µg/kg | 03SB180204 | 1/62 | 1 3 - 6 3 | 100 | NA | NA | NA | NA | No | NTX |
| 207-08-9 | BENZO(K)FLUORANTHENE | 32 | | 32 | | µg/kg | 03SB220204 | 1/62 | 1 3 - 6 1 | 32 | NA | NA | 2000 | 39000 | No | BSL |
| 117-81-7 | BIS(2-ETHYLHEXYL)PHTHALATE | 79 | J | 3300 | J | µg/kg | 03SB070610 | 7/61 | 67 - 92 | 3300 | NA | 31000000 | 180000 | 3600000 | No | BSL |
| 218-01-9 | CHRYSENE | 16 | | 140 | | µg/kg | 03SB180204 | 2/62 | 1 3 - 6 3 | 140 | NA | NA | 8000 | 25000 | No | BSL |
| 84-74-2 | DI-N-BUTYL PHTHALATE | 100 | J | 2700 | | µg/kg | 03SB480206 | 6/61 | 67 - 92 | 2700 | NA | 2300000 | 270000 | 500000 | No | BSL |
| 117-84-0 | DI-N-OCTYL PHTHALATE | 110 | J | 110 | J | µg/kg | 03SB070610 | 1/49 | 67 - 92 | 110 | NA | 10000000 | 10000000 | 6700000 | No | BSL |
| 206-44-0 | FLUORANTHENE | 24 | | 100 | | µg/kg | 03SB180204 | 3/62 | 1 3 - 6 3 | 100 | NA | NA | 210000 | 880000 | No | BSL |
| 86-73-7 | FLUORENE | 19 | | 19 | | µg/kg | 03SB240406 | 1/62 | 1 3 - 6 3 | 19 | NA | NA | 28000 | 170000 | No | BSL |
| 193-39-5 | INDENO(1,2,3-CD)PYRENE | 77 | J | 77 | J | µg/kg | 03SB180204 | 1/62 | 1 3 - 6 3 | 77 | NA | NA | 700 | 3100 | No | BSL |
| 91-20-3 | NAPHTHALENE | 8 | | 270 | | µg/kg | 03SB240406 | 6/62 | 1 3 - 5 7 | 270 | NA | NA | 4000 | 700 | No | BSL |
| 85-01-8 | PHENANTHRENE | 45 | | 85 | | µg/kg | 03SB180204 | 3/62 | 1 3 - 5 7 | 85 | NA | NA | NA | NA | No | NTX |
| 108-95-2 | PHENOL | 100 | J | 100 | J | µg/kg | 03SB240406 | 1/62 | 67 - 92 | 100 | NA | NA | 5000 | 110000 | No | BSL |
| 129-00-0 | PYRENE | 14 | | 150 | | µg/kg | 03SB180204 | 5/62 | 1 3 - 1 8 | 150 | NA | NA | 210000 | 570000 | No | BSL |
| **Energetics** | | | | | | | | | | | | | | | | |
| 118-96-7 | 2,4,6-TRINITROTOLUENE | 0 76 | | 2 1 | | mg/kg | 03SB190204 | 4/62 | 0 25 | 2 1 | NA | NA | NA | NA | No | NTX |
| 121-14-2 | 2,4-DINITROTOLUENE | 0 63 | J | 0 63 | J | mg/kg | 03SB180204 | 1/62 | 0 25 | 0 63 | NA | NA | 0.00004 | NA | Yes | ASL |
| 35572-78-2 | 2-AMINO-4,6-DINITROTOLUENE | 0 42 | J | 1 7 | | mg/kg | 03SB180204 | 4/62 | 0 25 | 1 7 | NA | NA | NA | NA | No | NTX |
| 19406-51-0 | 4-AMINO-2,6-DINITROTOLUENE | 0 55 | | 1 1 | | mg/kg | 03SB180204 | 3/62 | 0 25 | 1 1 | NA | NA | NA | NA | No | NTX |
| 2691-41-0 | HMX | 0 28 | J | 8 8 | | mg/kg | 03SB241215 | 7/60 | 0 25 | 8 8 | NA | NA | NA | NA | No | NTX |
| 121-82-4 | RDX | 0 92 | | 4 4 | | mg/kg | 03SB241215 | 5/62 | 0 25 | 4 4 | NA | NA | NA | NA | No | NTX |

TABLE 4-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SUBSURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium: Subsurface Soil
Exposure Medium Subsurface Soil (Greater than 2 feet)
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects(2) | Concentration Used for Screening(3) | Site Above Background?(4) | U S EPA Generic SSL for Soil to Air(5) | U S EPA Generic SSL for Migration to Ground water(5) | IDEM SSL for Migration to Ground water(6) | COPC Flag | Rationale for Contaminant Deletion or Selection(7) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inorganics | | | | | | | | | | | | | | | | |
| 7429-90-5 | ALUMINUM | 391 | J | 11500 | J | mg/kg | 03SB270607 | 37/37 | NA | 11500 | No | NA | NA | NA | No | BKG |
| 7440-36-0 | ANTIMONY | 0 64 | J | 30 | J | mg/kg | 03SB480206 | 7/37 | 0 08 - 3 5 | 30 | No | NA | 3 | 5.4 | No | BKG |
| 7440-38-2 | ARSENIC | 0 53 | J | 12 6 | J | mg/kg | 03SB241215 | 37/37 | NA | 12 6 | No | 750 | 1 | 29 | No | BKG |
| 7440-39-3 | BARIUM | 10 8 | J | 1340 | J | mg/kg | 03SB240406 | 37/37 | NA | 1340 | Yes | 690000 | 82 | 1600 | Yes | ASL |
| 7440-41-7 | BERYLLIUM | 0 11 | J | 1 4 | | mg/kg | 03SB440206 | 37/37 | NA | 1 4 | Yes | 1300 | 3 | 63 | No | BSL |
| 7440-43-9 | CADMIUM | 0 32 | | 12 1 | | mg/kg | 03SB240406 | 32/37 | 0 28 - 0 3 | 12 1 | Yes | 1800 | 0.4 | 7.5 | Yes | ASL |
| 7440-70-2 | CALCIUM | 226 | J | 113000 | J | mg/kg | 03SB180204 | 37/37 | NA | 113000 | Yes | NA | NA | NA | No | NUT |
| 7440-47-3 | CHROMIUM | 3 | J | 34 5 | J | mg/kg | 03SB240406 | 37/37 | NA | 34 5 | No | 270 (9) | 2 (9) | 38 (9) | No | BKG |
| 7440-48-4 | COBALT | 3 4 | J | 740 | J | mg/kg | 03SB480206 | 37/37 | NA | 740 | Yes | NA | NA | NA | No | NTX |
| 7440-50-8 | COPPER | 1 4 | J | 22500 | J | mg/kg | 03SB480206 | 37/37 | NA | 22500 | Yes | NA | NA | 580 | Yes | ASL |
| 7439-89-6 | IRON | 2620 | J | 56400 | J | mg/kg | 03SB440610 | 37/37 | NA | 56400 | Yes | NA | NA | NA | No | NTX |
| 7439-92-1 | LEAD | 3 | J | 3590 | J | mg/kg | 03SB480206 | 37/37 | NA | 3590 | Yes | NA | NA | 81 | Yes | ASL |
| 7439-95-4 | MAGNESIUM | 146 | J | 7670 | J | mg/kg | 03SB180204 | 37/37 | NA | 7670 | No | NA | NA | NA | No | NUT, BKG |
| 7439-96-5 | MANGANESE | 130 | J | 1790 | J | mg/kg | 03SB460206 | 37/37 | NA | 1790 | Yes | NA | NA | NA | No | NTX |
| 7439-97-6 | MERCURY | 0 016 | | 0 57 | J | mg/kg | 03SB230610 | 31/37 | 0 015 - 0 019 | 0 57 | No | 10 | 0.1 | 2 1 | No | BKG |
| 7440-02-0 | NICKEL | 3 | J | 79100 | J | mg/kg | 03SB480206 | 37/37 | NA | 79100 | Yes | 13000 | 7 | 950 | Yes | ASL |
| 7440-09-7 | POTASSIUM | 227 | J | 1790 | J | mg/kg | 03SB270607 | 37/37 | NA | 1790 | No | NA | NA | NA | No | NUT, BKG |
| 7782-49-2 | SELENIUM | 0 16 | J | 0 43 | J | mg/kg | 03SB460206 | 28/37 | 0 16 - 0 19 | 0 43 | No | NA | 0.3 | 5 2 | No | BKG |
| 7440-22-4 | SILVER | 0 05 | | 33 9 | J | mg/kg | 03SB480206 | 6/37 | 0 04 - 0 92 | 33 9 | Yes | NA | 2 | 31 | Yes | ASL |
| 7440-23-5 | SODIUM | 80 6 | J | 668 | J | mg/kg | 03SB220204 | 14/37 | 18 8 - 182 | 668 | Yes | NA | NA | NA | No | NUT |
| 7440-28-0 | THALLIUM | 0 05 | | 0 21 | | mg/kg | 03SB230610 | 33/37 | 0 04 | 0 21 | No | NA | 0.04 | 2 8 | No | BKG |
| 7440-31-5 | TIN | 7 1 | J | 1630 | J | mg/kg | 03SB480206 | 4/37 | 0 07 - 3 8 | 1630 | No | NA | NA | NA | No | NTX |
| 7440-62-2 | VANADIUM | 2 6 | J | 28 3 | J | mg/kg | 03SB440206 | 37/37 | NA | 28 3 | No | NA | 300 | NA | No | BKG |
| 7440-66-6 | ZINC | 7 2 | J | 1100 | J | mg/kg | 03SB240406 | 37/37 | NA | 1100 | Yes | NA | 620 | 14000 | Yes | ASL |

TABLE 4-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SUBSURFACE SOIL
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium· Subsurface Soil
Exposure Medium· Subsurface Soil (Greater than 2 feet)
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects(2) | Concentration Used for Screening(3) | Site Above Background?(4) | U S EPA Generic SSL for Soil to Air(5) | U S EPA Generic SSL for Migration to Ground water(5) | IDEM SSL for Migration to Ground water(6) | COPC Flag | Rationale for Contaminant Deletion or Selection(7) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| 14797-55-8 | NITRATE | 1 1 | | 38 | | mg/kg | 03SB390206 | 58/62 | 1 - 1 1 | 38 | NA | NA | NA | NA | No | NTX |
| 14797-65-0 | NITRITE | 2 3 | J | 15 | J | mg/kg | 03SB250608 | 6/46 | 2 - 110 | 15 | NA | NA | NA | NA | No | NTX |
| | NITRITE/NITRATE | 1 2 | J | 38 | J | mg/kg | 03SB390206 | 60/62 | 1 - 1 1 | 38 | NA | NA | NA | NA | No | NTX |
| | PERCENT MOISTURE | 8 4 | | 27 3 | | | 03SB241215 | 62/62 | NA | 27 3 | NA | NA | NA | NA | No | NTX |
| 14797-73-0 | PERCHLORATE | 32 | J | 43 | J | µg/kg | 03SB390206 | 2/62 | 20 - 28 | 43 | NA | NA | NA | NA | No | NTX |

Notes
1 - Only the original of duplicate samples was considered 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 significantly 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 Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX); Essential Nutrient (NUT); Below Screening Level (BSL); Below Background Value (BKG)
8 Value is for 4-methylphenol
9 - Value is for hexavalent chromium
Shaded cells indicate that the specified criterion has been exceeded or that the chemical has been selected as a COPC

Definitions
NA Not applicable
SQL Sample quantitation limit
COPC Chemical of potential concern
ARAR/TBC Applicable or Relevant and Appropriate Requirement/To Be Considered
J - Estimated value
IDEM - Indiana Department of Environmental Management Risk Integrated System of Closure (RISC) residential levels for migration from soil to ground water (IDEM, July 2001)

ASSOCIATED SAMPLES

| | | | |
|---|---|---|---|
| 03SB020206 | 03SB110610 | 03SB211012 | 03SB390206 |
| 03SB020610 | 03SB130206 | 03SB211215 | 03SB390610 |
| 03SB040206 | 03SB130610 | 03SB220204 | 03SB400206 |
| 03SB040610 | 03SB140206 | 03SB221215 | 03SB400610 |
| 03SB050206 | 03SB140610 | 03SB230610 | 03SB420206 |
| 03SB050610 | 03SB150206 | 03SB240406 | 03SB420610 |
| 03SB060206 | 03SB150610 | 03SB241215 | 03SB440206 |
| 03SB060610 | 03SB160206 | 03SB250608 | 03SB440610 |
| 03SB070206 | 03SB160610 | 03SB260610 | 03SB460206 |
| 03SB070610 | 03SB170406 | 03SB270206 | 03SB460610 |
| 03SB080206 | 03SB171214 | 03SB270607 | 03SB470206 |
| 03SB080610 | 03SB180204 | 03SB280204 | 03SB470610 |
| 03SB090204 | 03SB190204 | 03SB340206 | 03SB480206 |
| 03SB100206 | 03SB191215 | 03SB340610 | 03SB480610 |
| 03SB100610 | 03SB200810 | 03SB360206 | |
| 03SB110206 | 03SB201215 | 03SB360610 | |

TABLE 4-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH GROUND WATER
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Ground Water
Exposure Medium Ground Water
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration (1) | Minimum Qualifier | Maximum Concentration (1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits (2) | Concentration Used for Screening (3) | Site Above Background? (4) | Screening Toxicity Value R9TAP(5) | Potential ARAR/TBC Value (MCL/IDEM) | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection (6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 79-34-5 | 1,1,2,2-TETRACHLOROETHANE | 3 9 | J | 530 | | µg/L | 03GW0701 | 4/15 | 0 3 | 530 | NA | 0.055 C | NA<br>0.9 | NA<br>IDEM | Yes | ASL |
| 79-00-5 | 1,1,2-TRICHLOROETHANE | 0 5 | J | 12 | | µg/L | 03GW0701 | 3/15 | 0 3 | 12 | NA | 0.20 C | 5<br>5 | FED-MCL<br>IDEM | Yes | ASL |
| 75-35-4 | 1,1-DICHLOROETHENE | 1 1 | J | 1 1 | J | µg/L | 03GW0701 | 1/15 | 0 3 | 1 1 | NA | 0.046 C | 7<br>7 | FED-MCL<br>IDEM | Yes | ASL |
| 74-83-9 | BROMOMETHANE | 0 3 | J | 0 6 | | µg/L | 03GW2001 | 4/15 | 0 5 | 0 6 | NA | 0 87 N | NA<br>11 | NA<br>IDEM | No | BSL |
| 156-59-2 | cis-1,2-DICHLOROETHENE | 0 3 | J | 150 | | µg/L | 03GW0701 | 5/15 | 0 5 | 150 | NA | 6.1 N | 70<br>70 | FED-MCL<br>IDEM | Yes | ASL |
| 97-63-2 | ETHYL METHACRYLATE | 0 5 | J | 0 5 | J | µg/L | 03GW1101 | 1/15 | 0 5 | 0 5 | NA | 55 N | NA<br>NA | NA<br>NA | No | BSL |
| 127-18-4 | TETRACHLOROETHENE | 0 3 | J | 5 7 | | µg/L | 03GW0701 | 2/15 | 0 5 | 5 7 | NA | 1.1 C | 5<br>5 | FED-MCL<br>IDEM | Yes | ASL |
| 156-60-5 | TRANS-1,2-DICHLOROETHENE | 1 2 | J | 37 | | µg/L | 03GW0701 | 3/15 | 0 5 | 37 | NA | 12 N | 100<br>100 | FED-MCL<br>IDEM | Yes | ASL |
| 79-01-6 | TRICHLOROETHENE | 0 3 | J | 640 | | µg/L | 03GW0701 | 6/15 | 0 5 1 6 | 640 | NA | 1.6 C | 5<br>5 | FED-MCL<br>IDEM | Yes | ASL |
| 75-01-4 | VINYL CHLORIDE | 3 9 | | 3 9 | | µg/L | 03GW0701 | 1/15 | 0 3 | 3 9 | NA | 0.041 C | 2<br>2 | FED-MCL<br>IDEM | Yes | ASL |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 117-81-7 | BIS(2 ETHYLHEXYL)PHTHALATE | 2 | J | 2 | J | µg/L | 03GW2301 | 1/15 | 0 94 - 1 1 | 2 | NA | 4 8 C | 6<br>6 | FED-MCL<br>IDEM | No | BSL |
| **Energetics** | | | | | | | | | | | | | | | | |
| 99-35-4 | 1 3,5-TRINITROBENZENE | 0 61 | | 0 61 | | µg/L | 03GW2101 | 1/15 | 0 35 | 0 61 | NA | 110 N | NA<br>NA | NA<br>NA | No | BSL |
| 118-96-7 | 2,4,6-TRINITROTOLUENE | 17 | | 17 | | µg/L | 03GW2101 | 1/15 | 0 35 | 17 | NA | 2.2 C | NA<br>NA | NA<br>NA | Yes | ASL |
| 35572-78-2 | 2-AMINO-4,6-DINITROTOLUENE | 0 55 | J | 2 6 | | µg/L | 03GW2101 | 3/14 | 0 12 - 0 35 | 2 6 | NA | 0.22 N | NA<br>NA | NA<br>NA | Yes | ASL |
| 19406-51-0 | 4-AMINO-2,6-DINITROTOLUENE | 0 62 | J | 10 | | µg/L | 03GW2101 | 5/15 | 0 35 | 10 | NA | 0.22 N | NA<br>NA | NA<br>NA | Yes | ASL |
| 2691-41-0 | HMX | 1 3 | | 170 | J | µg/L | 03GW2101 | 8/15 | 0 35 | 170 | NA | 180 N | NA<br>NA | NA<br>NA | No | BSL |
| 121-82-4 | RDX | 1 5 | J | 280 | J | µg/L | 03GW2101 | 12/15 | 0 35 | 280 | NA | 0.61 C | NA<br>NA | NA<br>NA | Yes | ASL |
| **Total Metals** | | | | | | | | | | | | | | | | |
| 7429 90-5 | ALUMINUM | 7 5 | | 372 | | µg/L | 03GW2501 | 10/15 | 4 - 29 5 | 372 | Yes | 3600 N | 50 to 200<br>NA | FED-SMCL<br>NA | Yes | ASL |
| 7440-36 0 | ANTIMONY | 0 1 | | 0 12 | | µg/L | 03GW1501 | 2/15 | 0 1 - 0 5 | 0 12 | No | 1 5 N | 6<br>6 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440-38 2 | ARSENIC | 0 21 | | 0 3 | | µg/L | 03GW2201 | 3/15 | 0 2 1 | 0 3 | No | 0.045 C | 10<br>50 | FED-MCL<br>IDEM | No | BKG |
| 7440-39-3 | BARIUM | 19 4 | J | 275 | J | µg/L | 03GW2101 | 15/15 | NA | 275 | Yes | 260 N | 2000<br>2000 | FED-MCL<br>IDEM | Yes | ASL |
| 7440-43-9 | CADMIUM | 12 | | 12 | | µg/L | 03GW1801 | 1/15 | 0 7 - 3 5 | 12 | Yes | 1.8 N | 5<br>5 | FED-MCL<br>IDEM | Yes | ASL |
| 7440 70-2 | CALCIUM | 13400 | J | 149000 | J | µg/L | 03GW2201 | 15/15 | NA | 149000 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7440-47-3 | CHROMIUM | 0 24 | | 90 8 | J | µg/L | 03GW1201 | 12/15 | 0 34 - 0 47 | 90 8 | Yes | 11 (7)N | 100<br>100(7) | FED-MCL<br>IDEM | Yes | ASL |
| 7440-48-4 | COBALT | 0 12 | | 2 2 | | µg/L | 03GW1201 | 6/15 | 0 1 - 0 5 | 2 2 | Yes | 220 N | NA<br>NA | NA<br>NA | No | BSL |
| 7440-50-8 | COPPER | 0 95 | J | 3 | J | µg/L | 03GW1701<br>03GW1101 | 7/15 | 0 19 - 0 87 | 3 | Yes | 140 N | 1300<br>1300 | FED-MCL<br>IDEM | No | BSL |
| 7439-89-6 | IRON | 103 | J | 1650 | J | µg/L | 03GW1301 | 15/15 | NA | 1650 | Yes | 1100 N | 300<br>NA | FED-SMCL<br>IDEM | Yes | ASL |
| **Total Metals (Continued)** | | | | | | | | | | | | | | | | |

TABLE 4-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH GROUND WATER
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Ground Water
Exposure Medium Ground Water
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration (1) | Minimum Qualifier | Maximum Concentration (1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits (2) | Concentration Used for Screening (3) | Site Above Background? (4) | Screening Toxicity Value R9TAP(5) | Potential ARAR/TBC Value (MCL/IDEM) | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection (6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7439-92-1 | LEAD | 0 17 | | 0 95 | | µg/L | 03GW1301 | 5/15 | 0 1 - 0 5 | 0 95 | Yes | NA | 15<br>15 | FED-MCL<br>IDEM | No | BSL |
| 7439-95-4 | MAGNESIUM | 1230 | | 33400 | J | µg/L | 03GW2201 | 15/15 | | NA | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7439-96-5 | MANGANESE | 2 1 | J | 445 | J | µg/L | 03GW1301 | 13/15 | 0 54 - 0 55 | 445 | Yes | 88 N | 50<br>NA | FED-SMCL<br>NA | Yes | ASL |
| 7440-02-0 | NICKEL | 1 3 | J | 91 2 | J | µg/L | 03GW1201 | 15/15 | NA | 91 2 | Yes | 73 N | NA<br>730 | NA<br>IDEM | Yes | ASL |
| 7440-09-7 | POTASSIUM | 923 | J | 9440 | J | µg/L | 03GW0701 | 15/15 | NA | 9440 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7782-49 2 | SELENIUM | 0 41 | J | 0 79 | J | µg/L | 03GW2201 | 4/15 | 0 4 - 2 | 0 79 | Yes | 18 N | 50<br>50 | FED-MCL<br>IDEM | No | BSL |
| 7440 23-5 | SODIUM | 952 | J | 8930 | J | µg/L | 03GW2401 | 15/15 | NA | 8930 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7440-28-0 | THALLIUM | 0 5 | | 0 5 | | µg/L | 03GW2501 | 1/15 | 0 1 - 0 5 | 0 5 | Yes | 0.24 N | 2<br>2 | FED-MCL<br>IDEM | Yes | ASL |
| 7440-62-2 | VANADIUM | 0 6 | | 1 2 | | µg/L | 03GW2501 | 5/15 | 0 1 - 0 78 | 1 2 | Yes | 26 N | NA<br>NA | NA<br>NA | No | BSL |
| 7440-66 6 | ZINC | 3 2 | | 20 4 | J | µg/L | 03GW2201 | 10/15 | 0 5 - 2 7 | 20 4 | Yes | 1100 N | 5000<br>11000 | FED-SMCL<br>IDEM | No | BSL |
| **Dissolved Metals** | | | | | | | | | | | | | | | | |
| 7429-90-5 | ALUMINUM, DISSOLVED | 23 7 | | 23 7 | | µg/L | 03GW2501-F | 1/1 | NA | 23 7 | NA | 3600 N | 50 to 200<br>NA | FED-SMCL<br>NA | No | BSL |
| 7440-39-3 | BARIUM, DISSOLVED | 18 1 | J | 18 1 | J | µg/L | 03GW2501-F | 1/1 | NA | 18 1 | NA | 260 N | 2000<br>2000 | FED-MCL<br>IDEM | No | BSL |
| 7440-70-2 | CALCIUM DISSOLVED | 24400 | J | 24400 | J | µg/L | 03GW2501-F | 1/1 | NA | 24400 | NA | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7440-47-3 | CHROMIUM, DISSOLVED | 2 6 | J | 2 6 | J | µg/L | 03GW2501-F | 1/1 | NA | 2 6 | NA | 11 (7)N | 100<br>100(7) | FED-MCL<br>IDEM | No | BSL |
| 7440-50-8 | COPPER, DISSOLVED | 0 95 | J | 0 95 | J | µg/L | 03GW2501-F | 1/1 | NA | 0 95 | NA | 140 N | 1300<br>1300 | FED-MCL<br>IDEM | No | BSL |
| 7439-89 6 | IRON DISSOLVED | 98 8 | J | 98 8 | J | µg/L | 03GW2501-F | 1/1 | NA | 98 8 | NA | 1100 N | 300<br>NA | FED-MCL<br>NA | No | BSL |
| 7439-95-4 | MAGNESIUM, DISSOLVED | 1190 | | 1190 | | µg/L | 03GW2501-F | 1/1 | NA | 1190 | NA | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7439-96-5 | MANGANESE, DISSOLVED | 1 | J | 1 | J | µg/L | 03GW2501-F | 1/1 | NA | 1 | NA | 88 N | 50<br>NA | FED-SMCL<br>NA | No | BSL |
| 7440-02-0 | NICKEL, DISSOLVED | 0 85 | J | 0 85 | J | µg/L | 03GW2501-F | 1/1 | NA | 0 85 | NA | 73 N | NA<br>730 | NA<br>IDEM | No | BSL |
| 7440-09-7 | POTASSIUM, DISSOLVED | 950 | J | 950 | J | µg/L | 03GW2501-F | 1/1 | NA | 950 | NA | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7440-23 5 | SODIUM, DISSOLVED | 2460 | J | 2460 | J | µg/L | 03GW2501-F | 1/1 | NA | 2460 | NA | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7440-31-5 | TIN, DISSOLVED | 4 9 | J | 4 9 | J | µg/L | 03GW2501-F | 1/1 | NA | 4 9 | NA | 2200 N | NA<br>NA | NA<br>NA | No | BSL |

TABLE 4-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH GROUND WATER
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Ground Water
Exposure Medium Ground Water
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration (1) | Minimum Qualifier | Maximum Concentration (1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits (2) | Concentration Used for Screening (3) | Site Above Background? (4) | Screening Toxicity Value R9TAP(5) | Potential ARAR/TBC Value (MCL/IDEM) | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection (6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Field Parameters | | | | | | | | | | | | | | | | |
| | DISSOLVED OXYGEN | 0 77 | | 19 32 | | mg/L | 03GW2501 | 15/15 | NA | 19 32 | NA | NA | NA | NA | No | NTX |
| 14797-55-8 | NITRATE | 0 01 | | 1 65 | | mg/L | 03GW1001 | 15/15 | NA | 1 65 | NA | 1 N | NA | NA | Yes | ASL |
| 14797-65-0 | NITRITE | 0 001 | | 0 03 | | mg/L | 03GW2201 | 15/15 | NA | 0 03 | NA | 0 1 N | NA | NA | No | BSL |
| | OXIDATION REDUCTION POTENTIAL | 49 | | 733 | | MV | 03GW1501 | 15/15 | NA | 733 | NA | NA | NA | NA | No | NTX |
| | pH | 3 2 | | 7 39 | | SU | 03GW2501 | 15/15 | NA | 7 39 | NA | NA | NA | NA | No | NTX |
| | SPECIFIC CONDUCTANCE | 0 149 | | 0 874 | | MS/CM | 03GW2201 | 15/15 | NA | 0 874 | NA | NA | NA | NA | No | NTX |
| | TEMPERATURE | 12 6 | | 16 4 | | (C) | 03GW2201, 03GW1101 | 15/15 | NA | 16 4 | NA | NA | NA | NA | No | NTX |
| | TURBIDITY | 0 4 | | 25 | | NTU | 03GW2501 | 15/15 | NA | 25 | NA | NA | NA | NA | No | NTX |

Notes

1 - Only the original of duplicate samples was considered 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 groundwater concentrations were statistically compared to concentrations in upgradient groundwater samples If the site groundwater concentrations were less than the upgradient concentrations that metal was not selected as a COPC See Section 4

5 U S EPA Region 9 Preliminary Remediation Goals Table November 1 2000 (PRGs for noncarcinogens are divided by 10 )

6 Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX); Essential Nutrient (NUT); Below Screening Level (BSL); Below Background Value (BKG)

7 Value is for hexavalent chromium

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

Definitions
NA = Not applicable
SQL = Sample quantitation limit
COPC = Chemical of potential concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
J = Estimated value
C = Carcinogenic
N = Non Carcinogenic
FED MCL = Federal Maximum Contaminant Level (U S EPA Summer 2000)
SMCL = Federal Secondary Maximum Contaminant Level based on aesthetic FED water quality (U S EPA Summer 2000)
IDEM = Indiana Department of Environmental Management Risk Integrated System of Closure (RISC) residential closure levels for ground water (IDEM July 2001)

Associated Samples

| | | |
|---|---|---|
| 03GW0701 | 03GW1401 | 03GW2201 |
| 03GW1001 | 03GW1501 | 03GW2301 |
| 03GW1101 | 03GW1701 | 03GW2401 |
| 03GW1201 | 03GW1801 | 03GW2501 |
| 03GW1301 | 03GW2001 | 03GW2501 F |
| | 03GW2101 | |

TABLE 4-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SHALLOW SEDIMENTS
NSWC CRANE
CRANE, INDIANA


**Scenario Timeframe Current/Future**
**Medium Sediment**
**Exposure Medium Shallow Sediments (0" - 6")**
**Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek**

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Sample with Maximum Concentration | Detection Frequency | Range of Nondetects(2) | Concentration Used for Screening(3) | Site Above Background? (4) | U S EPA Region 9 PRG-Residential(5) | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection(6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 71-55-6 | 1,1,1-TRICHLOROETHANE | 2 | J | 2 | J | µg/kg | 03SD180006 | 1/15 | 1 - 13 | 2 | NA | 63000 N | 1800000 | IDEM | No | BSL |
| 78-93-3 | 2-BUTANONE | 18 | J | 18 | J | µg/kg | 03SD170006 | 1/15 | 1 - 13 | 18 | NA | 730000 N | 20000000 | IDEM | No | BSL |
| 108-10-1 | 4-METHYL-2-PENTANONE | 2 | J | 2 | J | µg/kg | 03SD190006 | 1/15 | 1 - 13 | 2 | NA | 79000 N | 1000000 | IDEM | No | BSL |
| 67-64-1 | ACETONE | 36 | J | 160 | J | µg/kg | 03SD050006 | 2/15 | 1 - 240 | 160 | NA | 160000 N | 3900000 | IDEM | No | BSL |
| 75-15-0 | CARBON DISULFIDE | 1 4 | J | 2 | J | µg/kg | 03SD180006 | 2/15 | 1 - 13 | 2 | NA | 360000 N | 3300 | IDEM | No | BSL |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 83-32-9 | ACENAPHTHENE | 25 | | 25 | | µg/kg | 03SD180006 | 1/15 | 1 4 - 2 1 | 25 | NA | 370000 N | 9500000 | IDEM | No | BSL |
| 84-74-2 | DI-N-BUTYL PHTHALATE | 77 | J | 590 | | µg/kg | 03SD110006 | 2/15 | 75 - 490 | 590 | NA | 610000 N | 18000000 | IDEM | No | BSL |
| 122-39-4 | DIPHENYLAMINE | 96 | J | 420 | J | µg/kg | 03SD150006 | 3/15 | 74 - 96 | 420 | NA | 150000 N | NA | NA | No | BSL |
| 206-44-0 | FLUORANTHENE | 11 | | 12 | J | µg/kg | 03SD140006 | 2/15 | 1 4 - 2 1 | 12 | NA | 230000 N | 6300000 | IDEM | No | BSL |
| 85-01-8 | PHENANTHRENE | 14 | J | 14 | J | µg/kg | 03SD140006 | 1/15 | 1 4 - 2 1 | 14 | NA | 230000 (8) N | 5500000(8) | IDEM | No | BSL |
| 129-00-0 | PYRENE | 11 | | 11 | | µg/kg | 03SD110006 | 1/15 | 1 4 - 26 | 11 | NA | 230000 N | 5500000 | IDEM | No | BSL |
| **Energetics** | | | | | | | | | | | | | | | | |
| 118-96-7 | 2,4,6-TRINITROTOLUENE | 0 29 | J | 0 69 | | mg/kg | 03SD110006 | 4/15 | 0 25 | 0 69 | NA | 16 C | NA | NA | No | BSL |
| 121-14-2 | 2,4-DINITROTOLUENE | 1 1 | | 1 1 | | mg/kg | 03SD060006 | 1/15 | 0 25 - 0 33 | 1 1 | NA | 12 N | NA | NA | No | BSL |
| 35572-78-2 | 2-AMINO-4,6-DINITROTOLUENE | 0 37 | J | 0 37 | J | mg/kg | 03SD110006 | 1/15 | 0 25 | 0 37 | NA | 0 47 (7) N | NA | NA | No | BSL |
| 2691-41-0 | HMX | 1 1 | | 130 | | mg/kg | 03SD110006 | 3/15 | 0 25 | 130 | NA | 310 N | NA | NA | No | BSL |
| **Pesticides/PCB's** | | | | | | | | | | | | | | | | |
| 72-43-5 | METHOXYCHLOR | 17 | J | 17 | J | µg/kg | 03SD180006 | 1/15 | 10 - 15 | 17 | NA | 31000 N | 910000 | IDEM | No | BSL |
| **Herbicides** | | | | | | | | | | | | | | | | |
| 93-76-5 | 2,4,5-T | 2 7 | J | 4 8 | J | µg/kg | 03SD190006 | 4/15 | 1 6 - 2 3 | 4 8 | NA | 61000 N | NA | NA | No | BSL |
| 93-72-1 | 2,4,5-TP (SILVEX) | 2 4 | J | 4 5 | J | µg/kg | 03SD180006 | 5/14 | 1 6 - 2 | 4 5 | NA | 49000 N | NA | NA | No | BSL |
| 94-75-7 | 2,4-D | 4 9 | J | 20 | J | µg/kg | 03SD080006 | 7/10 | 1 7 - 1 8 | 20 | NA | 69000 N | NA | NA | No | BSL |
| 88-85-7 | DINOSEB | 3 1 | J | 8 2 | J | µg/kg | 03SD080006 | 3/14 | 1 6 - 2 3 | 8 2 | NA | 6100 N | NA | NA | No | BSL |
| 70-30-4 | HEXACHLOROPHENE | 3 5 | J | 3 5 | J | µg/kg | 03SD080006 | 1/15 | 7 4 - 11 | 3 5 | NA | 1800 N | NA | NA | No | BSL |
| **Inorganics** | | | | | | | | | | | | | | | | |
| 7429-90-5 | ALUMINUM | 4590 | J | 23200 | J | mg/kg | 03SD150006 | 15/15 | NA | 23200 | Yes | 7600 N | NA | NA | Yes | ASL |
| 7440-36-0 | ANTIMONY | 1 1 | J | 7 6 | J | mg/kg | 03SD150006 | 8/15 | 0 38 - 2 1 | 7 6 | Yes | 3.1 N | 140 | IDEM | Yes | ASL |
| 7440-38-2 | ARSENIC | 4 3 | | 22 | | mg/kg | 03SD150006 | 15/15 | NA | 22 | No | 0.39 C | 3.9 | IDEM | No | BKG |
| 7440-39-3 | BARIUM | 91 6 | J | 853 | J | mg/kg | 03SD050006 | 15/15 | NA | 853 | Yes | 540 N | 23000 | IDEM | Yes | ASL |
| 7440-41-7 | BERYLLIUM | 0 09 | | 1 7 | | mg/kg | 03SD150006 | 15/15 | NA | 1 7 | No | 15 N | 680 | IDEM | No | BSL,BKG |
| 7440-43-9 | CADMIUM | 0 37 | | 3 5 | J | mg/kg | 03SD110006 | 15/15 | NA | 3 5 | Yes | 3 7 N | 12 | IDEM | No | BSL |
| 7440-70-2 | CALCIUM | 833 | J | 37500 | J | mg/kg | 03SD090006 | 15/15 | NA | 37500 | Yes | NA | NA | NA | No | NUT |
| 7440-47-3 | CHROMIUM | 8 4 | J | 40 8 | J | mg/kg | 03SD150006 | 15/15 | NA | 40 8 | No | 30 (9) C | 430 | IDEM | No | BKG |
| 7440-48-4 | COBALT | 7 9 | J | 31 2 | J | mg/kg | 03SD150006 | 15/15 | NA | 31 2 | No | 470 N | NA | NA | No | BSL,BKG |
| 7440-50-8 | COPPER | 8 1 | | 198 | | mg/kg | 03SD150006 | 15/15 | NA | 198 | Yes | 290 N | 13000 | IDEM | No | BSL |
| 7439-89-6 | IRON | 12900 | J | 68600 | J | mg/kg | 03SD150006 | 15/15 | NA | 68600 | No | 2300 N | NA | NA | No | BKG |
| 7439-92-1 | LEAD | 13 3 | | 653 | J | mg/kg | 03SD060006 | 15/15 | NA | 653 | Yes | 400 | 400 | IDEM | Yes | ASL |
| 7439-95-4 | MAGNESIUM | 489 | J | 14700 | J | mg/kg | 03SD090006 | 15/15 | NA | 14700 | No | NA | NA | NA | No | NUT,BKG |
| 7439-96-5 | MANGANESE | 444 | J | 2780 | J | mg/kg | 03SD150006 | 15/15 | NA | 2780 | No | 180 N | NA | NA | No | BKG |
| 7439-97-6 | MERCURY | 0 02 | | 0 31 | | mg/kg | 03SD150006 | 15/15 | NA | 0 31 | No | 2 3 N | 55 | IDEM | No | BSL,BKG |
| 7440-02-0 | NICKEL | 10 3 | J | 36 3 | J | mg/kg | 03SD100006 | 15/15 | NA | 36 3 | No | 160 N | 6900 | IDEM | No | BSL |
| 7440-09-7 | POTASSIUM | 294 | J | 1260 | J | mg/kg | 03SD060006 | 15/15 | NA | 1260 | No | NA | NA | NA | No | NUT,BKG |
| 7782-49-2 | SELENIUM | 0 2 | | 0 26 | | mg/kg | 03SD150006 | 3/15 | 0 16 - 0 8 | 0 26 | No | 39 N | 1700 | IDEM | No | BSL |
| 7440-22-4 | SILVER | 0 46 | J | 0 71 | J | mg/kg | 03SD110006 | 3/15 | 0 04 - 0 15 | 0 71 | No | 39 N | 1700 | IDEM | No | BSL,BKG |
| 7440-23-5 | SODIUM | 94 7 | J | 138 | J | mg/kg | 03SD060006 | 2/15 | 3 4 - 55 5 | 138 | No | NA | NA | NA | No | NUT,BKG |
| 7440-28-0 | THALLIUM | 0 06 | | 0 12 | | mg/kg | 03SD150006 | 15/15 | NA | 0 12 | No | 0 52 N | 31 | IDEM | No | BSL,BKG |
| 7440-31-5 | TIN | 4 4 | J | 13 8 | J | mg/kg | 03SD120006 | 2/15 | 0 35 - 4 5 | 13 8 | Yes | 4700 N | NA | NA | No | BSL |
| 7440-62-2 | VANADIUM | 12 2 | J | 44 1 | J | mg/kg | 03SD150006 | 15/15 | NA | 44 1 | No | 55 N | NA | NA | No | BSL, BKG |
| 7440-66-6 | ZINC | 27 5 | J | 385 | J | mg/kg | 03SD160006 | 15/15 | NA | 385 | Yes | 2300 N | 100000 | IDEM | No | BSL |

TABLE 4-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SHALLOW SEDIMENTS
NSWC CRANE
CRANE, INDIANA


**Scenario Timeframe Current/Future**
**Medium Sediment**
**Exposure Medium Shallow Sediments (0" - 6")**
**Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek**

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Sample with Maximum Concentration | Detection Frequency | Range of Nondetects(2) | Concentration Used for Screening(3) | Site Above Background? (4) | U S EPA Region 9 PRG-Residential(5) | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection(6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| 14797-55-8 | NITRATE | 2 2 | | 8 4 | | mg/kg | 03SD080006 | 13/15 | 1 1 - 1 3 | 8 4 | NA | 13000 (7) N | NA | NA | No | BSL |
| 14797-65-0 | NITRITE | 3 4 | J | 3 5 | J | mg/kg | 03SD170006 | 2/11 | 2 3 - 17 | 3 5 | NA | 780 (7) N | NA | NA | No | BSL |
| TTNUS029 | NITRITE/NITRATE | 2 2 | J | 8 4 | | mg/kg | 03SD080006 | 15/15 | NA | 8 4 | NA | NA | NA | NA | No | NTX |
| TTNUS003 | TOTAL ORGANIC CARBON | 4600 | | 28000 | | mg/kg | 03SD080006 | 14/15 | 1000 | 28000 | NA | NA | NA | NA | No | NTX |
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| TTNUS288 | PERCENT MOISTURE | 7 4 | | 34 9 | | & | 03SD080006 | 15/15 | NA | 34 9 | NA | NA | NA | NA | No | NTX |
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| TTNUS002 | pH | 7 | J | 8 1 | J | S U | 03SD070006 | 15/15 | NA | 8 1 | NA | NA | NA | NA | No | NTX |

Notes
1 - Only the original of duplicate samples was considered 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 significantly different from background that chemical was not selected as a COPC
5 - U S EPA Region 9 Preliminary Remediation Goals Table November 1 2000 (PRGs for noncarcinogens are divided by 10 )
6 Rationale Codes Selection Reason Above Screening Levels (ASL)
Deletion Reason No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)
Below Background Value (BKG)
7 - No U S EPA Region 9 PRG available value is from U S EPA Region 3 Risk-Based Concentration Table April 2 2002
8 - Value is for pyrene
9 - Value is for hexavalent chromium
Shaded cells indicate that the specified criterion has been exceeded or that the chemical has been selected as a COPC

Definitions
NA = Not applicable
SQL = Sample quantitation limit
COPC = Chemical of potential concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
J = Estimated value
C = Carcinogenic
N = Noncarcinogenic
IDEM = Indiana Department of Environmental Management, Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM July 2001)
sat = Soil saturation limit

ASSOCIATED SAMPLES

| | | |
|---|---|---|
| 03SD050006 | 03SD100006 | 03SD150006 |
| 03SD060006 | 03SD110006 | 03SD160006 |
| 03SD070006 | 03SD120006 | 03SD170006 |
| 03SD080006 | 03SD130006 | 03SD180006 |
| 03SD090006 | 03SD140006 | 03SD190006 |

TABLE 4-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH DEEP SEDIMENTS
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Sediment
Exposure Medium Deep Sediments (6"-12")
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects[2] | Concentration Used for Screening[3] | Site Above Background?[4] | U S EPA Region 9 PRG-Residential[5] | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 71-55-6 | 1,1,1-TRICHLOROETHANE | 1 | J | 4 | | µg/kg | 03SD190612 | 5/15 | 1 1 - 4 3 | 4 | NA | 63000 N | 1800000 | IDEM | No | BSL |
| 78-93-3 | 2-BUTANONE | 10 | | 60 | | µg/kg | 03SD180612 | 3/15 | 0 96 - 4 3 | 60 | NA | 730000 N | 20000000 | IDEM | No | BSL |
| 67-64-1 | ACETONE | 29 | J | 220 | J | µg/kg | 03SD180612 | 4/15 | 1 1 - 72 | 220 | NA | 160000 N | 3900000 | IDEM | No | BSL |
| 75-15-0 | CARBON DISULFIDE | 1 | J | 1 1 | J | µg/kg | 03SD060612 | 3/15 | 0 96 - 5 | 1 1 | NA | 360000 N | 3300 | IDEM | No | BSL |
| 108-88-3 | TOLUENE | 54 | | 54 | | µg/kg | 03SD180612 | 1/15 | 0 96 - 4 3 | 54 | NA | 520000 sat | 1700000 | IDEM | No | BSL |
| 75-69-4 | TRICHLOROFLUOROMETHANE | 2 | J | 2 | J | µg/kg | 03SD090612 | 1/15 | 0 96 - 4 3 | 2 | NA | 39000 N | NA | NA | No | BSL |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 56-55-3 | BENZO(A)ANTHRACENE | 11 | | 11 | | µg/kg | 03SD160612 | 1/15 | 1 4 - 2 1 | 11 | NA | 620 C | 5000 | IDEM | No | BSL |
| 205-99-2 | BENZO(B)FLUORANTHENE | 11 | | 15 | | µg/kg | 03SD160612 | 2/15 | 1 4 - 2 1 | 15 | NA | 620 C | 5000 | IDEM | No | BSL |
| 218-01-9 | CHRYSENE | 10 | | 10 | | µg/kg | 03SD160612 | 1/15 | 1 4 - 2 1 | 10 | NA | 62000 C | 500000 | IDEM | No | BSL |
| 84-74-2 | DI-N-BUTYL PHTHALATE | 110 | J | 880 | | µg/kg | 03SD110612 | 2/15 | 73 - 330 | 880 | NA | 610000 N | 18000000 | IDEM | No | BSL |
| 206-44-0 | FLUORANTHENE | 27 | | 27 | | µg/kg | 03SD160612 | 1/15 | 1 4 - 2 1 | 27 | NA | 230000 N | 6300000 | IDEM | No | BSL |
| 85-01-8 | PHENANTHRENE | 23 | | 23 | | µg/kg | 03SD160612 | 1/15 | 1 4 - 2 1 | 23 | NA | 230000 (8) N | 5500000 (8) | IDEM | No | BSL |
| 129-00-0 | PYRENE | 19 | | 19 | | µg/kg | 03SD160612 | 1/15 | 1 4 - 2 1 | 19 | NA | 230000 N | 5500000 | IDEM | No | BSL |
| **Energetics** | | | | | | | | | | | | | | | | |
| 118-96-7 | 2,4,6-TRINITROTOLUENE | 0 34999 | J | 2 2 | | mg/kg | 03SD120612 | 5/15 | 0 25 | 2 2 | NA | 16 C | NA | NA | No | BSL |
| 35572-78-2 | 2-AMINO-4,6-DINITROTOLUENE | 0 35 | J | 0 73 | | mg/kg | 03SD110612 | 2/15 | 0 25 | 0 73 | NA | 0.47 (7) N | NA | NA | Yes | ASL |
| 19406-51-0 | 4-AMINO-2,6-DINITROTOLUENE | 0 4 | J | 0 4 | J | mg/kg | 03SD120612 | 1/15 | 0 25 - 1 | 0 4 | NA | 0 47 (7) N | NA | NA | No | BSL |
| 2691-41-0 | HMX | 0 37 | J | 19 | | mg/kg | 03SD110612 | 4/15 | 0 25 | 19 | NA | 310 N | NA | NA | No | BSL |
| 121-82-4 | RDX | 0 44999 | J | 0 45 | J | mg/kg | 03SD110612 | 2/15 | 0 25 | 0 45 | NA | 4 4 C | NA | NA | No | BSL |
| **Herbicides** | | | | | | | | | | | | | | | | |
| 93-76-5 | 2,4,5-T | 2 5 | J | 4 5 | | µg/kg | 03SD110612 | 5/15 | 1 5 - 2 3 | 4 5 | NA | 61000 N | NA | NA | No | BSL |
| 93-72-1 | 2,4,5-TP (SILVEX) | 2 3 | J | 2 9 | J | µg/kg | 03SD060612 | 2/15 | 1 5 - 2 3 | 2 9 | NA | 49000 N | NA | NA | No | BSL |
| 94-75-7 | 2,4-D | 6 9 | J | 28 | J | µg/kg | 03SD050612 | 5/12 | 1 5 - 2 | 28 | NA | 69000 N | NA | NA | No | BSL |
| 88-85-7 | DINOSEB | 3 5 | J | 3 5 | J | µg/kg | 03SD170612, 03SD140612 | 2/15 | 1 5 - 2 3 | 3 5 | NA | 6100 N | NA | NA | No | BSL |
| 70-30-4 | HEXACHLOROPHENE | 2 8 | J | 7 6 | J | µg/kg | 03SD080612 | 2/15 | 7 3 - 9 8 | 7 6 | NA | 1800 N | NA | NA | No | BSL |
| 87-86-5 | PENTACHLOROPHENOL | 2 1 | | 3 7 | J | µg/kg | 03SD050612 | 2/11 | 0 37 - 0 48 | 3 7 | NA | 3000 C | 20000 | IDEM | No | BSL |
| **Inorganics** | | | | | | | | | | | | | | | | |
| 7429-90-5 | ALUMINUM | 3150 | | 56900 | | mg/kg | 03SD110612 | 15/15 | NA | 56900 | Yes | 7600 N | NA | NA | Yes | ASL |
| 7440-36-0 | ANTIMONY | 0 85 | J | 6 7 | J | mg/kg | 03SD110612 | 8/15 | 0 36 - 1 3 | 6 7 | Yes | 3.1 N | 140 | IDEM | Yes | ASL |
| 7440-38-2 | ARSENIC | 3 5 | | 17 5 | | mg/kg | 03SD150612 | 15/15 | NA | 17 5 | No | 0.39 C | 3.9 | IDEM | No | BKG |
| 7440-39-3 | BARIUM | 47 5 | J | 981 | J | mg/kg | 03SD110612 | 15/15 | NA | 981 | Yes | 540 N | 23000 | IDEM | Yes | ASL |
| 7440-41-7 | BERYLLIUM | 0 43 | | 1 5 | | mg/kg | 03SD150612, 03SD110612 | 15/15 | NA | 1 5 | No | 15 N | 680 | IDEM | No | BSL, BKG |
| 7440-43-9 | CADMIUM | 0 39 | J | 4 | | mg/kg | 03SD120612 | 14/15 | 0 31 | 4 | Yes | 3.7 N | 12 | IDEM | Yes | ASL |
| 7440-70-2 | CALCIUM | 676 | J | 32300 | | mg/kg | 03SD060612 | 15/15 | NA | 32300 | Yes | NA | NA | NA | No | NUT |
| 7440-47-3 | CHROMIUM | 8 | J | 48 9 | J | mg/kg | 03SD110612 | 15/15 | NA | 48 9 | No | 30 (9) C | 430 | IDEM | No | BKG |
| 7440-48-4 | COBALT | 7 9 | | 29 1 | J | mg/kg | 03SD150612 | 15/15 | NA | 29 1 | No | 470 N | NA | NA | No | BSL,BKG |
| 7440-50-8 | COPPER | 7 9 | | 273 | | mg/kg | 03SD110612 | 15/15 | NA | 273 | Yes | 290 N | 13000 | IDEM | No | BSL |
| 7439-89-6 | IRON | 12500 | J | 87700 | J | mg/kg | 03SD060612 | 15/15 | NA | 87700 | No | 2300 N | NA | NA | No | BKG |
| 7439-92-1 | LEAD | 11 8 | | 445 | | mg/kg | 03SD110612 | 15/15 | NA | 445 | Yes | 400 | 400 | IDEM | Yes | ASL |
| 7439-95-4 | MAGNESIUM | 368 | J | 4980 | J | mg/kg | 03SD060612 | 15/15 | NA | 4980 | No | NA | NA | NA | No | NUT,BKG |
| 7439-96-5 | MANGANESE | 316 | J | 2320 | J | mg/kg | 03SD150612 | 15/15 | NA | 2320 | No | 180 N | NA | NA | No | BKG |
| 7439-97-6 | MERCURY | 0 02 | | 0 13 | | mg/kg | 03SD120612, 03SD140612 | 13/15 | 0 01999 - 0 03 | 0 13 | Yes | 2 3 N | 55 | IDEM | No | BSL |
| 7440-02-0 | NICKEL | 10 1 | J | 36 1 | J | mg/kg | 03SD110612 | 15/15 | NA | 36 1 | No | 160 N | 6900 | IDEM | No | BSL,BKG |
| 7440-09-7 | POTASSIUM | 236 | J | 802 | J | mg/kg | 03SD050612 | 15/15 | NA | 802 | No | NA | NA | NA | No | NUT,BKG |
| 7782-49-2 | SELENIUM | 0 36 | | 0 36 | | mg/kg | 03SD130612 | 1/15 | 0 16 - 0 78 | 0 36 | No | 39 N | 1700 | IDEM | No | BSL, BKG |
| 7440-22-4 | SILVER | 0 23 | J | 0 43 | J | mg/kg | 03SD110612 | 4/15 | 0 04 - 0 28 | 0 43 | Yes | 39 N | 1700 | IDEM | No | BSL |
| 7440-23-5 | SODIUM | 88 5 | J | 88 5 | J | mg/kg | 03SD060612 | 1/15 | 3 4 - 48 5 | 88 5 | No | NA | NA | NA | No | NUT,BKG |
| 7440-28-0 | THALLIUM | 0 05 | | 0 12 | | mg/kg | 03SD090612, 03SD150612 | 15/15 | NA | 0 12 | No | 0 52 N | 31 | IDEM | No | BSL,BKG |
| 7440-31-5 | TIN | 1 5 | J | 4 1 | J | mg/kg | 03SD100612 | 3/15 | 0 39 - 3 8 | 4 1 | Yes | 4700 N | NA | NA | No | BSL |
| 7440-62-2 | VANADIUM | 10 2 | | 47 1 | | mg/kg | 03SD110612 | 15/15 | NA | 47 1 | No | 55 N | NA | NA | No | BSL,BKG |
| 7440-66-6 | ZINC | 21 4 | J | 1120 | J | mg/kg | 03SD110612 | 15/15 | NA | 1120 | Yes | 2300 N | 100000 | IDEM | No | BSL |

TABLE 4-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH DEEP SEDIMENTS
NSWC CRANE
CRANE, INDIANA


**Scenario Timeframe Current/Future**
**Medium Sediment**
**Exposure Medium Deep Sediments (6"-12")**
**Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek**

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Nondetects(2) | Concentration Used for Screening(3) | Site Above Background?(4) | U S EPA Region 9 PRG-Residential(5) | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection(6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| 14797-55-8 | NITRATE | 1 6 | | 6 5 | | mg/kg | 03SD120612 | 14/15 | 1 1 | 6 5 | NA | 13000 (7) N | NA | NA | No | BSL |
| 14797-65-0 | NITRITE | 2 6 | J | 2 7 | J | mg/kg | 03SD130612 | 2/10 | 2 3 - 52 | 2 7 | NA | 780 (7) N | NA | NA | No | BSL |
| TTNUS029 | NITRITE/NITRATE | 2 6 | | 6 5 | | mg/kg | 03SD120612 | 15/15 | NA | 6 5 | NA | NA | NA | NA | No | NTX |
| TTNUS003 | TOTAL ORGANIC CARBON | 2300 | J | 34000 | | mg/kg | 03SD080612 | 15/15 | NA | 34000 | NA | NA | NA | NA | No | NTX |
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| TTNUS288 | PERCENT MOISTURE | 8 2 | | 38 8 | | % | 03SD180612 | 15/15 | NA | 38 8 | NA | NA | NA | NA | No | NTX |
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| TTNUS002 | pH | 6 8 | J | 8 | J | S U | 03SD110612 | 15/15 | NA | 8 | NA | NA | NA | NA | No | NTX |

Notes
1 Only the original of duplicate samples was considered 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 significantly different from background that chemical was not selected as a COPC
5 U S EPA Region 9 Preliminary Remediation Goals Table November 1 2000 (PRGs for noncarcinogens are divided by 10 )
6 Rationale Codes Selection Reason Above Screening Levels (ASL)
Deletion Reason No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)
Below Background Value (BKG)
7 - No U S EPA Region 9 PRG available, value is from U S EPA Region 3 Risk Based Concentration Table April 2 2002
8 - Value is for pyrene
9 Value is for hexavalent chromium
Shaded cells indicate that the specified criterion has been exceeded or that the chemical has been selected as a COPC

Definitions
NA = Not applicable
SQL = Sample quantitation limit
COPC = Chemical of potential concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
J = Estimated value
C = Carcinogenic
N = Noncarcinogenic
IDEM = Indiana Department of Environmental Management Risk Integrated System of Closure (RISC) residential levels for direct contact with soil (IDEM, July 2001)
sat = Soil saturation limit

ASSOCIATED SAMPLES

| | | |
|---|---|---|
| 03SD050612 | 03SD100612 | 03SD150612 |
| 03SD060612 | 03SD110612 | 03SD160612 |
| 03SD070612 | 03SD120612 | 03SD170612 |
| 03SD080612 | 03SD130612 | 03SD180612 |
| 03SD090612 | 03SD140612 | 03SD190612 |

TABLE 4-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER - LOW-FLOW CONDITIONS
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Water
Exposure Medium Little Sulfur Creek - Low Flow
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits[2] | Concentration Used for Screening[3] | Site Above Background?[4] | Screening Toxicity Value[5] | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 78 93-3 | 2-BUTANONE | 0 6 | J | 0 6 | J | µg/L | 03SW1701 | 1/5 | 0 5 | 0 6 | NA | 190 N | NA<br>2500 | NA<br>IDEM | No | BSL |
| 74-83 9 | BROMOMETHANE | 0 8 | | 1 6 | | µg/L | 03SW1701 | 3/6 | 0 5 | 1 6 | NA | 0.87 N | NA<br>11 | NA<br>IDEM | Yes | ASL |
| 79-01-6 | TRICHLOROETHENE | 0 4 | J | 0 4 | J | µg/L | 03SW1701 | 1/6 | 0 5 | 0 4 | NA | 1 6 C | 5<br>5 | FED-MCL<br>IDEM | No | BSL |
| **Energetics** | | | | | | | | | | | | | | | | |
| 118-96-7 | 2,4 6-TRINITROTOLUENE | 0 56 | | 0 56 | | µg/L | 03SW1701 | 1/6 | 0 35 | 0 56 | NA | 2 2 C | NA<br>NA | NA<br>NA | No | BSL |
| 35572-78 2 | 2-AMINO-4,6-DINITROTOLUENE | 0 37 | J | 0 75 | J | µg/L | 03SW0601 | 2/6 | 0 35 | 0 75 | NA | 0.22 (7) N | NA<br>NA | NA<br>NA | Yes | ASL |
| 19406-51-0 | 4-AMINO-2,6-DINITROTOLUENE | 0 54 | J | 1 7 | | µg/L | 03SW0601 | 4/6 | 0 35 | 1 7 | NA | 0.22 (7) N | NA<br>NA | NA<br>NA | Yes | ASL |
| 2691-41-0 | HMX | 3 1 | J | 12 | | µg/L | 03SW0601 | 6/6 | NA | 12 | NA | 180 N | NA<br>NA | NA<br>NA | No | BSL |
| 121-82-4 | RDX | 2 3 | | 11 | | µg/L | 03SW1701 | 6/6 | NA | 11 | NA | 0.61 C | NA<br>NA | NA<br>NA | Yes | ASL |
| **Herbicides** | | | | | | | | | | | | | | | | |
| 93-76-5 | 2 4,5-T | 0 064 | J | 0 064 | J | µg/L | 03SW0601 | 1/5 | 0 04 | 0 064 | NA | 36 N | NA<br>NA | NA<br>NA | No | BSL |
| **Total Metals** | | | | | | | | | | | | | | | | |
| 7429-90-5 | ALUMINUM | 24 | | 213 | J | µg/L | 03SW0601 | 6/6 | NA | 213 | No | 3600 N | 50 to 200<br>NA | FED-SMCL<br>NA | No | BKG |
| 7440-38-2 | ARSENIC | 0 23 | | 0 56 | | µg/L | 03SW0601 | 6/6 | NA | 0 56 | No | 0.045 C | 10<br>50 | FED-MCL<br>IDEM | No | BKG |
| 7440-39-3 | BARIUM | 61 6 | | 120 | J | µg/L | 03SW0601 | 6/6 | NA | 120 | No | 260 N | 2000<br>2000 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440-70-2 | CALCIUM | 26400 | J | 31600 | | µg/L | 03SW0601 | 6/6 | NA | 31600 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7440-47-3 | CHROMIUM | 0 6 | J | 0 6 | J | µg/L | 03SW0601 | 1/6 | 0 33 - 0 49 | 0 6 | Yes | 11 (8) N | 100<br>100 (8) | FED-MCL<br>IDEM | No | BSL |
| 7440-48-4 | COBALT | 0 12 | | 0 31 | | µg/L | 03SW0601 | 5/6 | 0 1 | 0 31 | No | 220 N | NA<br>NA | NA<br>NA | No | BSL, BKG |
| 7440-50-8 | COPPER | 0 75 | | 2 5 | | µg/L | 03SW0601 | 6/6 | NA | 2 5 | No | 140 N | 1300<br>1300 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7439-89-6 | IRON | 114 | J | 373 | | µg/L | 03SW0601 | 6/6 | NA | 373 | No | 1100 N | 300<br>NA | FED-SMCL<br>NA | No | BKG |
| 7439-92-1 | LEAD | 0 2 | | 20 | | µg/L | 03SW0601 | 6/6 | NA | 20 | Yes | NA | 15<br>15 | FED-MCL<br>IDEM | Yes | ASL |
| 7439-95-4 | MAGNESIUM | 6290 | J | 10300 | J | µg/L | 03SW0601 | 6/6 | NA | 10300 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7439-96-5 | MANGANESE | 7 4 | J | 34 8 | J | µg/L | 03SW1901 | 6/6 | NA | 34 8 | No | 88 N | 50<br>NA | FED-SMCL<br>NA | No | BSL, BKG |
| 7440-02-0 | NICKEL | 1 | | 1 9 | J | µg/L | 03SW0601 | 6/6 | NA | 1 9 | No | 73 N | NA<br>730 | NA<br>IDEM | No | BSL, BKG |
| 7440-09-7 | POTASSIUM | 1170 | J | 5100 | | µg/L | 03SW0601 | 6/6 | NA | 5100 | No | NA | NA<br>NA | NA<br>NA | No | NUT, BKG |
| 7440-23-5 | SODIUM | 3730 | | 5850 | | µg/L | 03SW0601 | 6/6 | NA | 5850 | No | NA | NA<br>NA | NA<br>NA | No | NUT, BKG |
| 7440-31-5 | TIN | 2 8 | J | 4 9 | J | µg/L | 03SW1901, 03SW1601 | 5/6 | 2 6 | 4 9 | Yes | 2200 N | NA<br>NA | NA<br>NA | No | BSL |
| 7440-62-2 | VANADIUM | 0 12 | | 0 54 | | µg/L | 03SW0601 | 4/6 | 0 1 | 0 54 | No | 26 N | NA<br>NA | NA<br>NA | No | BSL, BKG |
| 7440-66-6 | ZINC | 1 8 | | 3 4 | | µg/L | 03SW1701 | 5/6 | 6 3 | 3 4 | No | 1100 N | 5000<br>11000 | FED-SMCL<br>IDEM | No | BSL, BKG |

TABLE 4-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER - LOW-FLOW CONDITIONS
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Water
Exposure Medium Little Sulfur Creek - Low Flow
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits [2] | Concentration Used for Screening[3] | Site Above Background?[4] | Screening Toxicity Value[5] | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dissolved Metals** | | | | | | | | | | | | | | | | |
| 7429-90-5 | ALUMINUM, DISSOLVED | 5 6 | | 10 6 | | µg/L | 03SW1501-F | 2/6 | 2 6 19 3 | 10 6 | No | 3600 N | 50 to 200<br>NA | FED-SMCL<br>NA | No | BSL, BKG |
| 7440-36-0 | ANTIMONY, DISSOLVED | 1 2 | J | 1 2 | J | µg/L | 03SW0601-F | 1/6 | 0 14 - 0 36 | 1 2 | No | 1 5 N | 6<br>6 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440-38-2 | ARSENIC, DISSOLVED | 0 21 | | 0 42 | | µg/L | 03SW0601-F | 5/6 | 0 2 | 0 42 | BKG | 0 045 C | 10<br>50 | FED-MCL<br>IDEM | No | BKG |
| 7440-39-3 | BARIUM, DISSOLVED | 63 1 | | 114 | J | µg/L | 03SW0601-F | 6/6 | NA | 114 | Yes | 260 N | 2000<br>2000 | FED-MCL<br>IDEM | No | BSL |
| 7440-70 2 | CALCIUM, DISSOLVED | 26900 | J | 31200 | | µg/L | 03SW0601-F | 6/6 | NA | 31200 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7440-47-3 | CHROMIUM, DISSOLVED | 0 53 | J | 0 53 | J | µg/L | 03SW1701-F | 1/6 | 0 19 - 0 43 | 0 53 | Yes | 11 (8) N | 100<br>100 (8) | FED-MCL<br>IDEM | No | BSL |
| 7440-48-4 | COBALT, DISSOLVED | 0 11 | | 0 73 | | µg/L | 03SW1601-F | 6/6 | NA | 0 73 | No | 220 N | NA<br>NA | NA<br>NA | No | BSL, BKG |
| 7440-50-8 | COPPER, DISSOLVED | 0 54 | | 1 5 | | µg/L | 03SW0601-F | 6/6 | NA | 1 5 | Yes | 140 N | 1300<br>1300 | FED-MCL<br>IDEM | No | BSL |
| 7439-89-6 | IRON, DISSOLVED | 97 6 | | 154 | J | µg/L | 03SW0601-F | 6/6 | NA | 154 | Yes | 1100 N | 300<br>NA | FED-SMCL<br>NA | No | BSL |
| 7439-92-1 | LEAD DISSOLVED | 1 1 | | 1 1 | | µg/L | 03SW0601-F | 1/6 | 0 1 | 1 1 | No | NA | 15<br>15 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7439-95-4 | MAGNESIUM, DISSOLVED | 6000 | J | 10400 | J | µg/L | 03SW0601-F | 6/6 | NA | 10400 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7439-96-5 | MANGANESE, DISSOLVED | 3 4 | J | 35 6 | J | µg/L | 03SW1901-F | 6/6 | NA | 35 6 | No | 88 N | 50<br>NA | FED-SMCL<br>NA | No | BSL, BKG |
| 7440-02-0 | NICKEL, DISSOLVED | 1 1 | | 1 4 | | µg/L | 03SW1701-F | 6/6 | NA | 1 4 | No | 73 N | NA<br>730 | NA<br>IDEM | No | BSL, BKG |
| 7440 09-7 | POTASSIUM, DISSOLVED | 1150 | J | 5010 | | µg/L | 03SW0601-F | 6/6 | NA | 5010 | No | NA | NA<br>NA | NA<br>NA | No | NUT, BKG |
| 7782-49-2 | SELENIUM, DISSOLVED | 0 52 | J | 0 52 | J | µg/L | 03SW0601-F | 1/6 | 0 4 | 0 52 | Yes | 18 N | 50<br>50 | FED-MCL<br>IDEM | No | BSL |
| 7440-23 5 | SODIUM, DISSOLVED | 3540 | | 6020 | | µg/L | 03SW0601-F | 6/6 | NA | 6020 | No | NA | NA<br>NA | NA<br>NA | No | NUT, BKG |
| 7440-31-5 | TIN, DISSOLVED | 4 6 | J | 5 6 | J | µg/L | 03SW1701-F | 5/6 | 4 4 | 5 6 | Yes | 2200 N | NA<br>NA | NA<br>NA | No | BSL |
| 7440-62-2 | VANADIUM, DISSOLVED | 0 18 | | 0 18 | | µg/L | 03SW0601-F | 1/6 | 0 1 | 0 18 | No | 26 N | NA<br>NA | NA<br>NA | No | BSL, BKG |
| 7440-66-6 | ZINC, DISSOLVED | 1 5 | | 2 8 | | µg/L | 03SW1701-F | 5/6 | 0 5 | 2 8 | Yes | 1100 N | 5000<br>11000 | FED-SMCL<br>IDEM | No | BSL |
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| | TOTAL SUSPENDED SOLIDS | 9 | | 20 | J | mg/L | 03SW0601 | 2/6 | 2 | 20 | NA | NA | NA | NA | No | NTX |

TABLE 4-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER - LOW-FLOW CONDITIONS
NSWC CRANE
CRANE, INDIANA


**Scenario Timeframe Current/Future**
**Medium Surface Water**
**Exposure Medium Little Sulfur Creek - Low Flow**
**Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek**

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits (2) | Concentration Used for Screening(3) | Site Above Background?(4) | Screening Toxicity Value(5) | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection(6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Field Parameters** | | | | | | | | | | | | | | | | |
| | DISSOLVED OXYGEN | 7 9 | | 10 92 | | mg/L | 03SW1501 | 6/6 | NA | 10 92 | NA | NA | NA | NA | No | NTX |
| 14797-55-8 | NITRATE | 0 1 | | 0 2 | | mg/L | 03SW1701 | 6/6 | NA | 0 2 | NA | 1 N | NA | NA | No | BSL |
| 14797-65-0 | NITRITE | 0 | | 0 004 | | mg/L | 03SW1701 | 6/6 | NA | 0 004 | NA | 0 1 N | NA | NA | No | BSL |
| | OXIDATION REDUCTION POTENTIAL | 316 4 | | 396 | | MV | 03SW1801 | 6/6 | NA | 396 | NA | NA | NA | NA | No | NTX |
| | pH | 6 62 | | 8 25 | | S U | 03SW0601 | 6/6 | NA | 8 25 | NA | NA | NA | NA | No | NTX |
| | SPECIFIC CONDUCTANCE | 0 261 | | 0 312 | | MS/CM | 03SW0601 | 6/6 | NA | 0 312 | NA | NA | NA | NA | No | NTX |
| | TEMPERATURE | 14 5 | | 25 45 | | C | 03SW0601 | 6/6 | NA | 25 45 | NA | NA | NA | NA | No | NTX |
| | TURBIDITY | 0 | | 8 4 | | NTU | 03SW0601 | 6/6 | NA | 8 4 | NA | NA | NA | NA | No | NTX |

Notes

1 Only the original of duplicate samples was considered 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 surface water concentrations were statistically compared to concentrations in upgradient surface water samples If the site surface water concentrations were less than the upgradient concentrations that metal was not selected as a COPC See Section 4

5 U S EPA Region 9 Preliminary Remediation Goals Table November 1 2000 (PRGs for noncarcinogens are divided by 10 )

6 Rationale Codes

| | |
|---|---|
| Selection Reason | Above Screening Levels (ASL) |
| Deletion Reason | No Toxicity Information (NTX) |
| | Essential Nutrient (NUT) |
| | Below Screening Level (BSL) |
| | Below Background Value (BKG) |

7 No U S EPA Region 9 PRG available value is from U S EPA Region 3 Risk Based Concentration Table April 2 2002

8 Value is for hexavalent chromium

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

Definitions

NA = Not applicable
SQL = Sample quantitation limit
COPC = Chemical of potential concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
J = Estimated value
C = Carcinogenic
N = Non Carcinogenic
FED MCL = Federal Maximum Contaminant Level (U S EPA Summer 2000)
SMCL = Federal Secondary Maximum Contaminant Level based on aesthetic FED water quality (U S EPA Summer 2000)
IDEM = Indiana Department of Environmental Management Risk Integrated System of Closure (RISC) residential closure levels for groundwater (IDEM July 2001)

Associated Samples

| | |
|---|---|
| 03SW0601 | 03SW1701 |
| 03SW0601 F | 03SW1701 F |
| 03SW1501 | 03SW1801 |
| 03SW1501 F | 03SW1801-F |
| 03SW1601 | 03SW1901 |
| 03SW1601-F | 03SW1901 F |

TABLE 4-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER - HIGH-FLOW CONDITIONS
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Water
Exposure Medium Little Sulfur Creek - High Flow
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits [2] | Concentration Used for Screening[3] | Site Above Background?[4] | Screening Toxicity Value[5] | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 75-09-2 | METHYLENE CHLORIDE | 9 5 | J | 13 | | µg/L | 03SW0802 | 2/11 | 0 5 - 5 3 | 13 | NA | 4.3 C | 5<br>5 | FED-MCL<br>IDEM | Yes | ASL |
| 67-64-1 | ACETONE | 64 | | 64 | | µg/L | 03SW0902 | 1/3 | 23 - 26 | 64 | NA | 61 N | NA<br>770 | NA<br>IDEM | Yes | ASL |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | | | | | |
| 208-96-8 | ACENAPHTHYLENE | 0 22 | | 0 22 | | µg/L | 03SW0902 | 1/11 | 0 019 - 0 02 | 0 22 | NA | 37 (7) N | NA<br>NA | NA<br>NA | No | BSL |
| 117-81-7 | bis(2-ETHYLHEXYL) PHTHALATE | 4 | | 6 | | µg/L | 03SW1402 | 2/11 | 0 94 - 1 | 6 | NA | 4.8 C | 6<br>6 | FED-MCL<br>IDEM | Yes | ASL |
| **Energetics** | | | | | | | | | | | | | | | | |
| 35572-78-2 | 2-AMINO-4,6-DINITROTOLUENE | 1 5 | J | 1 5 | J | µg/L | 03SW1702 | 1/11 | 0 35 | 1 5 | NA | 0.22 (8) N | NA<br>NA | NA<br>NA | Yes | ASL |
| 19406-51-0 | 4-AMINO-2,6-DINITROTOLUENE | 1 4 | J | 2 9 | | µg/L | 03SW1702 | 2/11 | 0 35 | 2 9 | NA | 0.22 (8) N | NA<br>NA | NA<br>NA | Yes | ASL |
| 2691-41-0 | HMX | 1 1 | J | 90 | | µg/L | 03SW0902 | 10/11 | 0 35 | 90 | NA | 180 N | NA<br>NA | NA<br>NA | No | BSL |
| 9004-70-0 | NITROCELLULOSE | 3200 | | 3200 | | µg/L | 03SW1502 | 1/11 | 1000 | 3200 | NA | NA | NA<br>NA | NA<br>NA | No | NTX |
| 121-82-4 | RDX | 0 62 | | 63 | | µg/L | 03SW1702 | 9/11 | 0 35 | 63 | NA | 0.61 C | NA<br>NA | NA<br>NA | Yes | ASL |
| **Herbicides`** | | | | | | | | | | | | | | | | |
| 93-76-5 | 2,4,5-T | 0 23 | J | 0 63 | J | µg/L | 03SW0902 | 3/10 | 0 04 | 0 63 | NA | 36 N | NA<br>NA | NA<br>NA | No | BSL |
| 94-75-7 | 2 4-D | 0 28 | J | 0 36 | J | µg/L | 03SW0902 | 2/11 | 0 04 | 0 36 | NA | 36 N | 70<br>NA | FED-MCL<br>NA | No | BSL |
| 87-86-5 | PENTACHLOROPHENOL | 0 71 | J | 0 71 | J | µg/L | 03SW1102 | 1/8 | 0 01 | 0 71 | NA | 0.56 C | 1<br>1 | FED-MCL<br>IDEM | Yes | ASL |
| **Total Metals** | | | | | | | | | | | | | | | | |
| 7429 90-5 | ALUMINUM | 211 | | 2010 | | µg/L | 03SW1102 | 7/11 | 200 | 2010 | No | 3600 N | 50 to 200<br>NA | FED SMCL<br>NA | No | BKG |
| 7440-36-0 | ANTIMONY | 2 | J | 3 | J | µg/L | 03SW0602 | 2/11 | 0 1 - 0 96 | 3 | Yes | 1.5 N | 6<br>6 | FED-MCL<br>IDEM | Yes | ASL |
| 7440 38-2 | ARSENIC | 0 29 | | 2 5 | | µg/L | 03SW1102 | 11/11 | NA | 2 5 | No | 0.045 C | 10<br>50 | FED-MCL<br>IDEM | No | BKG |
| 7440-39-3 | BARIUM | 45 6 | J | 156 | J | µg/L | 03SW1802 | 11/11 | NA | 156 | No | 260 N | 2000<br>2000 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440 41-7 | BERYLLIUM | 0 12 | | 0 13 | | µg/L | 03SW0902, 03SW1302 | 4/11 | 0 1 | 0 13 | No | 7 3 N | 4<br>4 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440-43-9 | CADMIUM | 0 83 | | 1 4 | | µg/L | 03SW1402 | 3/11 | 0 7 | 1 4 | Yes | 1 8 N | 5<br>5 | FED-MCL<br>IDEM | No | BSL |
| 7440-70-2 | CALCIUM | 6890 | | 58900 | | µg/L | 03SW1702 | 11/11 | NA | 58900 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7440 47-3 | CHROMIUM | 0 67 | J | 4 5 | J | µg/L | 03SW1102 | 9/11 | 0 46 - 0 47 | 4 5 | No | 11 (9) N | 100<br>100 (9) | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440-48-4 | COBALT | 0 12 | | 1 9 | | µg/L | 03SW0902 | 11/11 | NA | 1 9 | No | 220 N | NA<br>NA | NA<br>NA | No | BSL, BKG |
| 7440-50-8 | COPPER | 0 94 | | 18 4 | | µg/L | 03SW1102 | 11/11 | NA | 18 4 | Yes | 140 N | 1300<br>1300 | FED-MCL<br>IDEM | No | BSL |
| 7439-89-6 | IRON | 115 | J | 2550 | J | µg/L | 03SW1102 | 10/11 | 100 | 2550 | No | 1100 N | 300<br>NA | FED-SMCL<br>NA | No | BKG |
| 7439-92-1 | LEAD | 0 25 | | 285 | | µg/L | 03SW1102 | 11/11 | NA | 285 | Yes | NA | 15<br>15 | FED-MCL<br>IDEM | Yes | ASL |
| 7439-95-4 | MAGNESIUM | 6460 | | 14300 | | µg/L | 03SW0602 | 8/11 | 5000 | 14300 | No | NA | NA<br>NA | NA<br>NA | No | NUT, BKG |
| 7439-96-5 | MANGANESE | 33 1 | | 201 | | µg/L | 03SW1902 | 10/11 | 15 | 201 | No | 88 N | 50<br>NA | FED-SMCL<br>NA | No | BKG |
| **Total Metals (Continued)** | | | | | | | | | | | | | | | | |

TABLE 4-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER - HIGH-FLOW CONDITIONS
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Water
Exposure Medium Little Sulfur Creek - High Flow
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration[1] | Minimum Qualifier | Maximum Concentration[1] | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits [2] | Concentration Used for Screening[3] | Site Above Background?[4] | Screening Toxicity Value[5] | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7440-02-0 | NICKEL | 1 5 | | 5 3 | | µg/L | 03SW0902 | 11/11 | NA | 5 3 | No | 73 N | NA<br>730 | NA<br>IDEM | No | BSL, BKG |
| 7440-09-7 | POTASSIUM | 5300 | J | 21600 | J | µg/L | 03SW0602 | 4/11 | 5000 | 21600 | No | NA | NA<br>NA | NA<br>NA | No | NUT, BKG |
| 7782-49-2 | SELENIUM | 0 43 | | 0 62 | | µg/L | 03SW0602 | 3/11 | 0 4 | 0 62 | Yes | 18 N | 50<br>50 | FED-MCL<br>IDEM | No | BSL |
| 7440-23-5 | SODIUM | 5090 | | 8070 | | µg/L | 03SW1102 | 6/11 | 5000 | 8070 | No | NA | NA<br>NA | NA<br>NA | No | NUT, BKG |
| 7440-31-5 | TIN | 3 | J | 4 7 | J | µg/L | 03SW1602 03SW1702 | 6/11 | 0 1 - 0 9 | 4 7 | Yes | 2200 N | NA<br>NA | NA<br>NA | No | BSL |
| 7440-62-2 | VANADIUM | 0 22 | | 3 9 | | µg/L | 03SW1102 | 11/11 | NA | 3 9 | No | 26 N | NA<br>NA | NA<br>NA | No | BSL, BKG |
| 7440-66-6 | ZINC | 2 5 | | 111 | | µg/L | 03SW1102 | 11/11 | NA | 111 | Yes | 1100 N | 5000<br>11000 | FED-SMCL<br>IDEM | No | BSL |
| **Dissolved Metals** | | | | | | | | | | | | | | | | |
| 7429-90-5 | ALUMINUM, DISSOLVED | 260 | | 332 | | µg/L | 03SW1302-F | 5/11 | 200 | 332 | No | 3600 N | 50 to 200<br>NA | FED-SMCL<br>NA | No | BKG |
| 7440-36-0 | ANTIMONY, DISSOLVED | 1 | J | 2 4 | J | µg/L | 03SW0602-F | 3/11 | 0 13 - 0 57 | 2 4 | Yes | 1.5 N | 6<br>6 | FED-MCL<br>IDEM | Yes | ASL |
| 7440-38-2 | ARSENIC, DISSOLVED | 0 25 | | 1 | | µg/L | 03SW1102-F | 11/11 | NA | 1 | No | 0 045 C | 10<br>50 | FED-MCL<br>IDEM | No | BKG |
| 7440-39-3 | BARIUM, DISSOLVED | 37 7 | J | 147 | J | µg/L | 03SW1802-F | 11/11 | NA | 147 | No | 260 N | 2000<br>2000 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440-43-9 | CADMIUM, DISSOLVED | 1 2 | | 1 2 | | µg/L | 03SW1602-F | 1/11 | 0 7 | 1 2 | No | 1 8 N | 5<br>5 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440-70-2 | CALCIUM, DISSOLVED | 7550 | | 61200 | | µg/L | 03SW1702-F | 11/11 | NA | 61200 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7440-47-3 | CHROMIUM DISSOLVED | 0 51 | J | 1 4 | J | µg/L | 03SW0902-F | 9/11 | 0 36 - 0 41 | 1 4 | No | 11 (9) N | 100<br>100 (9) | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440-48-4 | COBALT, DISSOLVED | 0 11 | | 0 72 | | µg/L | 03SW1902-F | 11/11 | NA | 0 72 | No | 220 N | NA<br>NA | NA<br>NA | No | BSL, BKG |
| 7440 50-8 | COPPER, DISSOLVED | 0 84 | | 7 6 | | µg/L | 03SW0902-F | 11/11 | NA | 7 6 | Yes | 140 N | 1300<br>1300 | FED-MCL<br>IDEM | No | BSL |
| 7439-89-6 | IRON, DISSOLVED | 109 | | 171 | | µg/L | 03SW1302-F | 2/11 | 100 | 171 | No | 1100 N | 300<br>NA | FED-SMCL<br>NA | No | BSL, BKG |
| 7439 92-1 | LEAD, DISSOLVED | 0 12 | J | 22 6 | J | µg/L | 03SW1102-F | 9/11 | 0 1 | 22 6 | Yes | NA | 15<br>15 | FED-MCL<br>IDEM | Yes | ASL |
| 7439-95-4 | MAGNESIUM, DISSOLVED | 6000 | | 14000 | | µg/L | 03SW0602-F | 8/11 | 5000 | 14000 | No | NA | NA<br>NA | NA<br>NA | No | NUT, BKG |
| 7439-96-5 | MANGANESE, DISSOLVED | 17 4 | | 100 | | µg/L | 03SW1902-F | 6/11 | 15 | 100 | No | 88 N | 50<br>NA | FED-SMCL<br>NA | No | BKG |
| 7440-02-0 | NICKEL, DISSOLVED | 0 88 | | 2 4 | | µg/L | 03SW0902-F | 11/11 | NA | 2 4 | No | 73 N | NA<br>730 | NA<br>IDEM | No | BSL, BKG |
| 7440-09-7 | POTASSIUM, DISSOLVED | 5220 | | 22900 | | µg/L | 03SW0602-F | 4/11 | 5000 | 22900 | Yes | NA | NA<br>NA | NA<br>NA | No | NUT |
| 7782-49-2 | SELENIUM, DISSOLVED | 0 43 | | 0 51 | | µg/L | 03SW0602-F | 2/11 | 0 4 | 0 51 | No | 18 N | 50<br>50 | FED-MCL<br>IDEM | No | BSL, BKG |
| 7440-23-5 | SODIUM, DISSOLVED | 5000 | | 9830 | | µg/L | 03SW1702-F | 7/11 | 5000 | 9830 | No | NA | NA<br>NA | NA<br>NA | No | NUT, BKG |
| 7440-31-5 | TIN, DISSOLVED | 3 5 | J | 7 3 | J | µg/L | 03SW0602-F | 11/11 | NA | 7 3 | No | 2200 N | NA<br>NA | NA<br>NA | No | BSL, BKG |
| 7440-62-2 | VANADIUM, DISSOLVED | 0 18 | | 0 61 | | µg/L | 03SW1102-F | 11/11 | NA | 0 61 | No | 26 N | NA<br>NA | NA<br>NA | No | BSL, BKG |
| 7440-66-6 | ZINC, DISSOLVED | 2 2 | | 21 7 | | µg/L | 03SW1902-F | 11/11 | NA | 21 7 | No | 1100 N | 5000<br>11000 | FED-SMCL<br>IDEM | No | BSL, BKG |
| **Miscellaneous Parameters** | | | | | | | | | | | | | | | | |
| | TOTAL SUSPENDED SOLIDS | 2 | | 100 | | mg/L | 03SW1102 | 8/11 | 2 | 100 | NA | NA | NA | NA | No | NTX |

TABLE 4-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER - HIGH-FLOW CONDITIONS
NSWC CRANE
CRANE, INDIANA


Scenario Timeframe Current/Future
Medium Surface Water
Exposure Medium Little Sulfur Creek - High Flow
Exposure Point SWMU 3 - Old Jeep Trail / Little Sulphur Creek

| CAS Number | Chemical | Minimum Concentration(1) | Minimum Qualifier | Maximum Concentration(1) | Maximum Qualifier | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits (2) | Concentration Used for Screening(3) | Site Above Background?(4) | Screening Toxicity Value(5) | Potential ARAR/TBC Value | Potential ARAR/TBC Source | COPC Flag | Rationale for Contaminant Deletion or Selection(6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Field Parameters | | | | | | | | | | | | | | | | |
| | DISSOLVED OXYGEN | 2 39 | | 13 94 | | mg/L | 03SW1102 | 11/11 | NA | 13 94 | NA | NA | NA | NA | No | NTX |
| 14797-55-8 | NITRATE | 0 02 | | 1 44 | | mg/L | 03SW0602 | 10/10 | NA | 1 44 | NA | 1 N | NA | NA | No | BKG |
| 14797-65-0 | NITRITE | 0 | | 0 023 | | mg/L | 03SW0602 | 10/10 | NA | 0 023 | NA | 0 1 N | NA | NA | No | BSL |
| | OXIDATION REDUCTION POTENTIAL | 150 | | 320 7 | | MV | 03SW1902 | 11/11 | NA | 320 7 | NA | NA | NA | NA | No | NTX |
| | pH | 7 2 | | 8 73 | | S U | 03SW0902 | 11/11 | NA | 8 73 | NA | NA | NA | NA | No | NTX |
| | SPECIFIC CONDUCTANCE | 0 058 | | 0 427 | | MS/CM | 03SW1702 | 11/11 | NA | 0 427 | NA | NA | NA | NA | No | NTX |
| | TEMPERATURE | 16 73 | | 23 5 | | C | 03SW1102 | 11/11 | NA | 23 5 | NA | NA | NA | NA | No | NTX |
| | TURBIDITY | 0 75 | | 190 | | NTU | 03SW1102 | 11/11 | NA | 190 | NA | NA | NA | NA | No | NTX |

Notes

1 Only the original of duplicate samples was considered 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 surface water concentrations were statistically compared to concentrations in upgradient surface water samples If the site surface water concentrations were less than the upgradient concentrations that metal was not selected as a COPC See Section 4

5 U S EPA Region 9 Preliminary Remediation Goals Table November 1 2000 (PRGs for noncarcinogens are divided by 10 )

6 Rationale Codes

Selection Reason
- Above Screening Levels (ASL)

Deletion Reason
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)
- Below Background Value (BKG)

7 - Value is for acenaphthene

8 - No U S EPA Region 9 PRG available value is from U S EPA Region 3 Risk Based Concentration Table April 2 2002

9 Value is for hexavalent chromium

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

Associated Samples

| | | |
|---|---|---|
| 03SW0602 | 03SW1102 F | 03SW1602 F |
| 03SW0602 F | 03SW1302 | 03SW1702 |
| 03SW0802 | 03SW1302 F | 03SW1702 F |
| 03SW0802 F | 03SW1402 | 03SW1802 |
| 03SW0902 | 03SW1402-F | 03SW1802 F |
| 03SW0902 F | 03SW1502 | 03SW1902 |
| 03SW1102 | 03SW1502 F | 03SW1902 F |

Definitions

NA = Not applicable
SQL = Sample quantitation limit
COPC = Chemical of potential concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
J = Estimated value
C = Carcinogenic
N = Non Carcinogenic
FED MCL = Federal Maximum Contaminant Level (U S EPA Summer 2000)
SMCL = Federal Secondary Maximum Contaminant Level based on aesthetic FED water quality (U S EPA Summer 2000)
IDEM = Indiana Department of Environmental Management Risk Integrated System of Closure (RISC) residential closure levels for groundwater (IDEM July 2001)

TABLE 4-19

CHEMICALS RETAINED AS CHEMICALS OF POTENTIAL CONCERN FOR HUMAH HEALTH RISK ASSESSMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical | Surface Soil | | | Subsurface Soil | | | Ground Water | Sediment | | Surface Water | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Direct Contact | Soil to Air | Soil to Ground water | Direct Contact | Soil to Air | Soil to Ground water | | Shallow | Deep | Low Flow | High Flow |
| **Dioxin/Furans (ng/kg)** | | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | | | X | | | X | | | | | |
| 1,2,3,4,6,7,8-HPCDD | | | X | | | X | | | | | |
| 1,2,3,4,6,7,8-HPCDF | | | X | | | | | | | | |
| 1,2,3,4,7,8-HXCDF | | | X | | | | | | | | |
| 1,2,3,6,7,8-HXCDD | | | X | | | | | | | | |
| 1,2,3,7,8,9-HXCDD | | | X | | | | | | | | |
| 1,2,3,7,8-PECDD | | | X | | | | | | | | |
| 2,3,4,7,8-PECDF | | | X | | | | | | | | |
| 2,3,7,8-TCDD | | | X | | | | | | | | |
| TOTAL HPCDD | X | | X | | | | | | | | |
| TOTAL HXCDD | | | X | | | | | | | | |
| TOTAL HXCDF | | | X | | | | | | | | |
| TOTAL PECDD | | | X | | | | | | | | |
| TOTAL TCDD | | | X | | | | | | | | |
| 2,3,7,8-TCDD Equivalents | X | | X | | | X | | | | | |
| **Volatile Organic Compounds (µg/kg)** | | | | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | | | | | | X | X | | | | |
| 1,1,2-Trichloroethane | | | | | | | X | | | | |
| 1,1-Dichloroethene | | | | | | | X | | | | |
| Acetone | | | | | | | | | | | X |
| Bromomethane | | | | | | | | | | X | |
| cis-1,2-Dichloroethene | | | | | | | X | | | | |
| Methylene Chloride | | | | | | | | | | | X |
| Tetrachloroethene | | | | | | | X | | | | |
| Trans-1,2-Dichloroethene | | | | | | | X | | | | |
| Trichloroethene | | | X | | | X | X | | | | |
| Vinyl Chloride | | | | | | | X | | | | |
| **Semivolatile Organic Compounds (µg/kg)** | | | | | | | | | | | |
| Acetophenone | | | | X | | | | | | | |
| Benzo(a)pyrene | | | | X | | | | | | | |
| Benzo(b)fluoranthene | | | | | | X | | | | | |
| bis(2-ethylhexyl)phthalate | | | | | | | | | | | X |
| **Herbicides (µg/kg)** | | | | | | | | | | | |
| Pentachlorophenol | | | | | | | | | | | X |
| **Energetics** | | | | | | | | | | | |
| 2,4-Dinitrotoluene | | | X | | | X | | | | | |
| 2,4,6-Trinitrotoluene | X | | | | | | X | | | | |
| 2-Amino-4,6-Dinitrotoluene | X | | | X | | | X | | X | X | X |
| 4-Amino-2,6-Dinitrotoluene | X | | | X | | | X | | | X | X |

TABLE 4-19

CHEMICALS RETAINED AS CHEMICALS OF POTENTIAL CONCERN FOR HUMAH HEALTH RISK ASSESSMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical | Surface Soil | | | Subsurface Soil | | | Ground Water | Sediment | | Surface Water | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Direct Contact | Soil to Air | Soil to Ground water | Direct Contact | Soil to Air | Soil to Ground water | | Shallow | Deep | Low Flow | High Flow |
| HMX | X | | | | | | | | | | |
| RDX | X | | | X | | | X | | | X | X |
| **Inorganics (mg/kg)** | | | | | | | | | | | |
| Aluminum | | | | | | | X | X | X | | |
| Antimony | | | | | | | | X | X | | X |
| Barium | X | | X | X | | X | X | X | X | | |
| Cadmium | X | | X | X | | X | X | | X | | |
| Chromium | X | | X | | | | X | | | | |
| Cobalt | | | | X | | | | | | | |
| Copper | | | | X | | X | | | | | |
| Iron | X | | | X | | | X | | | | |
| Lead | X | | X | X | | X | | X | X | X | X |
| Manganese | | | | X | | | X | | | | |
| Mercury | | | X | | | | | | | | |
| Nickel | | | X | X | | X | X | | | | |
| Silver | | | | | | X | | | | | |
| Thallium | | | | | | | X | | | | |
| Zinc | | | X | | | X | | | | | |
| Nitrate | | | | | | | X | | | | |

Notes
X - Indicates chemical was retained as a COPC
COPC - Chemicals of potential concern

TABLE 4-20

ECOLOGICAL RISK SCREENING - SURFACE SOIL
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Surface Soil COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dioxins (ng/kg)** | | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | 11/11 | 176 J | 3440 J | 03SS470002 | 1364 | 1364 | NA | 0 2 | 17286 | YES | ASL |
| 1,2,3,4,6,7,8,9-OCDF | 3/11 | 7 6 J | 62 2 J | 03SS170002 | 27 | 8 | NA | 39 | 1.6 | YES | ASL |
| 1,2,3,4,6,7,8-HPCDD | 11/11 | 3 2 | 233 | 03SS170002 | 36 | 36 | NA | 0 2 | 1171 | YES | ASL |
| 1,2,3,4,6,7,8-HPCDF | 5/11 | 0 19 J | 32 1 | 03SS170002 | 11 | 5 | NA | 39 | 0 8 | NO | BSL |
| 1,2,3,4,7,8,9-HPCDF | 4/11 | 0 7 J | 2 1 J | 03SS170002 | 1 2 | 0 5 | NA | 39 | 0 05 | NO | BSL |
| 1,2,3,4,7,8-HXCDD | 4/11 | 0 58 J | 2 1 J | 03SS170002 | 1 1 | 0 5 | NA | 0 2 | 11 | YES | ASL |
| 1,2,3,4,7,8-HXCDF | 2/11 | 3 1 | 3 9 | | 3 5 | 0 8 | NA | 39 | 0 1 | NO | BSL |
| 1,2,3,6,7,8-HXCDD | 5/11 | 0 33 J | 10 1 | 03SS170002 | 2 7 | 1 3 | NA | 0 2 | 51 | YES | ASL |
| 1,2,3,6,7,8-HXCDF | 6/11 | 0 19 J | 2 4 J | 03SS170002 | 1 1 | 0 6 | NA | 39 | 0 1 | NO | BSL |
| 1,2,3,7,8,9-HXCDD | 5/11 | 0 35 J | 6 5 | 03SS170002 | 2 8 | 1 4 | NA | 0 2 | 33 | YES | ASL |
| 1,2,3,7,8,9-HXCDF | 1/11 | 0 22 J | 0 22 J | 03SS230002 | 0 2 | 0 1 | NA | 39 | 0 01 | NO | BSL |
| 1,2,3,7,8-PECDD | 5/11 | 0 4 J | 1 3 J | 03SS170002 | 0 7 | 0 4 | NA | 0 2 | 6.5 | YES | ASL |
| 1,2,3,7,8-PECDF | 3/11 | 0 37 J | 1 1 J | 03SS260002 | 0 8 | 0 3 | NA | 39 | 0 03 | NO | BSL |
| 2,3,4,6,7,8-HXCDF | 5/11 | 0 43 J | 2 7 J | 03SS170002 | 1 4 | 0 7 | NA | 39 | 0 1 | NO | BSL |
| 2,3,4,7,8-PECDF | 4/11 | 0 39 J | 1 4 J | 03SS230002 | 0 9 | 0 4 | NA | 39 | 0 04 | NO | BSL |
| 2,3,7,8-TCDD | 5/11 | 0 19 J | 3 9 | 03SS260002 | 1 0 | 0 5 | NA | 0 2 | 20 | YES | ASL |
| 2,3,7,8-TCDF | 4/11 | 0 5 J | 0 78 J | 03SS470002 | 0 6 | 0 3 | NA | 39 | 0 02 | NO | BSL |
| TEQ BIRD | 11/11 | 0 07 | 7 5 | 03SS260002 | 1 9 | 1 9 | NA | NA | NA | YES | NTX |
| TEQ HUMAN | 11/11 | 0 12 | 7 4 | 03SS170002 | 2 0 | 2 0 | NA | NA | NA | YES | NTX |
| TOTAL HPCDD | 10/11 | 6 7 J | 419 | 03SS170002 | 77 | 70 | NA | NA | NA | YES | NTX |
| TOTAL HPCDF | 5/11 | 0 19 | 19 | 03SS230002 | 7 | 7 7 | NA | NA | NA | YES | NTX |
| TOTAL HXCDD | 2/11 | 2 | 4 | 03SS290002 | 3 | 5 8 | NA | NA | NA | YES | NTX |
| TOTAL HXCDF | 2/11 | 3 2 | 17 8 | 03SS230002 | 11 | 5 6 | NA | NA | NA | YES | NTX |
| TOTAL PECDD | 1/11 | 0 45 J | 0 45 J | 03SS320002 | 0 5 | 1 4 | NA | NA | NA | YES | NTX |
| TOTAL TCDD | 1/11 | 1 | 1 | 03SS170002 | 1 | 0 7 | NA | NA | NA | YES | NTX |
| **Volatile Organics (µg/kg)** | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 4/15 | 2 J | 19 J | 03SS280002 | 9 | 3 9 | NA | 29800 | 0 0006 | NO | BSL |
| 2-HEXANONE | 1/15 | 5 J | 5 J | 03SS460002 | 5 | 2 6 | NA | 12600 | 0 0004 | NO | BSL |
| 4-METHYL-2-PENTANONE | 1/15 | 4 J | 4 J | 03SS460002 | 4 | 2 5 | NA | 443000 | 0 00001 | NO | BSL |
| TETRACHLOROETHENE | 2/15 | 1 J | 3 J | 03SS230002 | 2 | 2 5 | NA | 9920 | 0 0003 | NO | BSL |
| TOTAL XYLENES | 1/15 | 82 | 82 | 03SS470002 | 82 | 7 4 | NA | 10000 | 0 01 | NO | BSL |
| TRICHLOROETHENE | 3/15 | 3 J | 14 J | 03SS230002 | 7 | 3 6 | NA | 12400 | 0 001 | NO | BSL |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | |
| 1,4-PHENYLENEDIAMINE | 1/29 | 210 J | 210 J | 03SS340002 | 210 | 45 | NA | 6160 | 0 03 | NO | BSL |
| 2-METHYLNAPHTHALENE | 2/45 | 24 | 290 | 03SS240002 | 157 | 8 4 | NA | 3240 | 0 1 | NO | BSL |
| ACENAPHTHENE | 1/45 | 18 | 18 | 03SS240002 | 18 | 1 8 | NA | 682000 | 0 00003 | NO | BSL |
| ACENAPHTHYLENE | 2/45 | 11 | 14 | 03SS110002 | 13 | 1 9 | NA | 682000 | 0 00002 | NO | BSL |
| ANTHRACENE | 1/45 | 12 | 12 | 03SS110002 | 12 | 5 9 | NA | 1480000 | 0 00001 | NO | BSL |
| BENZO(A)ANTHRACENE | 3/45 | 8 | 37 | 03SS180002 | 21 | 7 | NA | 5210 | 0 01 | NO | BSL |
| BENZO(A)PYRENE | 5/45 | 1 5 | 54 | 03SS240002 | 29 | 4 5 | NA | 1520 | 0 04 | NO | BSL |
| BENZO(B)FLUORANTHENE | 13/45 | 9 | 160 | 03SS180002, 03SS240002 | 40 | 13 | NA | 59800 | 0 003 | NO | BSL |

TABLE 4-20

ECOLOGICAL RISK SCREENING - SURFACE SOIL
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Surface Soil COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BENZO(G,H,I)PERYLENE | 7/45 | 8 | 67 | 03SS180002 | 24 | 4 9 | NA | 119000 | 0 001 | NO | BSL |
| BIS(2-ETHYLHEXYL)PHTHALATE | 7/45 | 84 J | 870 | 03SS180002 | 282 | 78 | NA | 926 | 0 9 | NO | BSL |
| CHRYSENE | 7/45 | 8 | 68 | 03SS180002 | 20 | 8 6 | NA | 4730 | 0 01 | NO | BSL |
| DI-N-BUTYL PHTHALATE | 9/45 | 110 J | 4500 | 03SS180002 | 941 | 220 | NA | 150 | 30 | YES | ASL |
| DI-N-OCTYL PHTHALATE | 1/39 | 270 J | 270 J | 03SS250002 | 270 | 46 | NA | 709000 | 0 0004 | NO | BSL |
| DIBENZO(A,H)ANTHRACENE | 1/45 | 8 | 8 | 03SS240002 | 8 | 1 6 | NA | 18400 | 0 0004 | NO | BSL |
| FLUORANTHENE | 8/45 | 8 | 250 | 03SS240002 | 48 | 9 7 | NA | 122000 | 0 002 | NO | BSL |
| FLUORENE | 1/45 | 15 | 15 | 03SS240002 | 15 | 1 7 | NA | 122000 | 0 0001 | NO | BSL |
| INDENO(1,2,3-CD)PYRENE | 5/45 | 8 | 49 J | 03SS180002 | 23 | 3 8 | NA | 109000 | 0 0004 | NO | BSL |
| NAPHTHALENE | 4/45 | 11 | 130 | 03SS240002 | 48 | 5 6 | NA | 99 | 1.3 | YES | ASL |
| PHENANTHRENE | 5/45 | 8 | 320 | 03SS240002 | 80 | 10 | NA | 45700 | 0 01 | NO | BSL |
| PYRENE | 9/45 | 8 | 250 | 03SS240002 | 44 | 10 | NA | 78500 | 0 003 | NO | BSL |
| **Energetics (mg/kg)** | | | | | | | | | | | |
| 1,3,5-TRINITROBENZENE | 3/48 | 0 72 | 11 J | 03SS240002 | 4 3 | 0 4 | NA | 0 4 | 29 | YES | ASL |
| 2,4,6-TRINITROTOLUENE | 4/48 | 0 39 J | 1700 J | 03SS240002 | 553 | 46 | NA | NA | NA | YES | NTX |
| 2,4-DINITROTOLUENE | 1/48 | 1 J | 1 J | 03SS240002 | 1 | 0 1 | NA | 1 3 | 0 8 | NO | BSL |
| 2-AMINO-4,6-DINITROTOLUENE | 7/48 | 0 56 | 30 J | 03SS240002 | 5 2 | 0 9 | NA | NA | NA | YES | NTX |
| 2-NITROTOLUENE | 1/48 | 0 28 J | 0 28 J | 03SS330002 | 0 3 | 0 1 | NA | NA | NA | YES | NTX |
| 4-AMINO-2,6-DINITROTOLUENE | 7/48 | 0 35 J | 15 J | 03SS240002 | 3 | 0 5 | NA | NA | NA | YES | NTX |
| HMX | 9/47 | 0 34 | 1600 J | 03SS240002 | 195 | 37 | NA | NA | NA | YES | NTX |
| RDX | 6/48 | 0 93 | 2400 J | 03SS240002 | 425 | 53 | NA | NA | NA | YES | NTX |
| **Herbicides (µg/kg)** | | | | | | | | | | | |
| 2,4,5-T | 1/5 | 6 4 | 6 4 | 03SS320002 | 6 4 | 1 9 | NA | 596 | 0 01 | NO | BSL |
| 2,4-D | 3/5 | 6 7 | 8 3 J | 03SS320002 | 7 5 | 4 8 | NA | 27 | 0 3 | NO | BSL |
| DINOSEB | 1/3 | 11 | 11 | 03SS290002 | 11 | 4 2 | NA | 22 | 0 5 | NO | BSL |
| **Inorganics (mg/kg)** | | | | | | | | | | | |
| ALUMINUM | 32/32 | 2350 J | 14900 J | 03SS270002 | 7819 | 7819 | NO | NA | NA | NO | BKG |
| ANTIMONY | 8/32 | 0 49 J | 4 4 J | 03SS240002 | 1 7 | 0 7 | NO | 0 1 | 31 | NO | BKG |
| ARSENIC | 30/32 | 3 J | 28 4 J | 03SS330002 | 6 8 | 6 5 | NO | 5 7 | 5 | NO | BKG |
| BARIUM | 32/32 | 66 2 J | 2040 J | 03SS480002 | 220 | 220 | YES | 1 04 | 1962 | YES | ASL |
| BERYLLIUM | 31/32 | 0 33 J | 1 4 | 03SS180002 | 0 8 | 0 7 | YES | 1 06 | 1.3 | YES | ASL |
| CADMIUM | 29/32 | 0 35 | 4 4 | 03SS240002 | 1 0 | 0 9 | YES | 0 002 | 1982 | YES | ASL |
| CALCIUM | 32/32 | 1180 J | 244000 J | 03SS330002 | 24251 | 24251 | YES | NA | NA | NO | NT |
| CHROMIUM | 32/32 | 7 7 J | 288 J | 03SS270002 | 25 | 25 | YES | 0 4 | 720 | YES | ASL |
| COBALT | 32/32 | 3 J | 19 9 J | 03SS340002 | 13 | 13 | NO | 0 14 | 142 | NO | BKG |
| COPPER | 32/32 | 5 4 J | 63 9 J | 03SS270002 | 22 | 22 | YES | 3 | 22 | YES | ASL |
| IRON | 32/32 | 8280 J | 51600 J | 03SS340002 | 23437 | 23437 | YES | NA | NA | YES | NTX |
| LEAD | 32/32 | 9 2 J | 10200 J | 03SS240002 | 358 | 358 | YES | 0 1 | 189838 | YES | ASL |
| MAGNESIUM | 32/32 | 556 J | 15000 J | 03SS330002 | 2183 | 2183 | NO | NA | NA | NO | NT |
| MANGANESE | 32/32 | 260 J | 1760 J | 03SS390002 | 998 | 998 | NO | NA | NA | NO | BKG |
| MERCURY | 31/32 | 0 017 J | 0 26 J | 03SS280002 | 0 1 | 0 1 | YES | 0 07 | 3.6 | YES | ASL |
| NICKEL | 32/32 | 8 9 J | 32 6 J | 03SS180002 | 17 | 17 | YES | 14 | 2.4 | YES | ASL |

TABLE 4-20

ECOLOGICAL RISK SCREENING - SURFACE SOIL
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Surface Soil COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| POTASSIUM | 32/32 | 330 J | 2180 J | 03SS180002 | 647 | 647 | NO | NA | NA | NO | NT |
| SELENIUM | 29/32 | 0 17 J | 0 42 | 03SS270002, 03SS290002 | 0 3 | 0 3 | NO | 0 03 | 15 | NO | BKG |
| SILVER | 5/32 | 0 32 J | 0 72 | 03SS380002 | 0 5 | 0 1 | YES | 4 | 0 2 | NO | BSL |
| SODIUM | 9/32 | 87 1 J | 598 J | 03SS170002 | 243 | 100 | YES | NA | NA | NO | NT |
| THALLIUM | 32/32 | 0 05 | 0 21 | 03SS270002 | 0 1 | 0 1 | NO | 0 06 | 3 7 | NO | BKG |
| VANADIUM | 32/32 | 10 8 | 29 1 | 03SS270002 | 19 | 19 | NO | 1 6 | 18 | NO | BKG |
| ZINC | 32/32 | 19 5 J | 739 J | 03SS280002 | 101 | 101 | YES | 6 6 | 112 | YES | ASL |
| **Miscellaneous Parameters** | | | | | | | | | | | |
| NITRATE (mg/kg) | 46/48 | 0 8 | 49 | 03SS240002 | 4 4 | 4 2 | NA | NA | NA | NO | NZ |
| NITRITE (mg/kg) | 2/39 | 2 4 J | 5 6 J | 03SS010002 | 4 0 | 5 8 | NA | NA | NA | NO | NZ |
| NITRITE/NITRATE (mg\kg) | 46/48 | 0 8 | 49 J | 03SS240002 | 4 4 | 4 2 | NA | NA | NA | NO | NZ |
| PERCENT MOISTURE (%) | 48/48 | 6 4 | 25 6 | 03SS270002 | 15 | 15 | NA | NA | NA | NO | NZ |
| PERCHLORATE (mg/kg) | 3/48 | 24 J | 470 J | 03SS220002 | 235 | 25 | NA | NA | NA | NO | NZ |

Shaded name indicates that the constituent was selected as a COPC Shaded values indicate that the site concentration(s) exceeds this particular criterion

Footnotes.

1 The sample and duplicate were counted as two samples when determinnig the minimum and maximum detected concentrations and location of maximum concentrations, but were only counted as one sample when determining the frequency of detection One-half of the detection limit was used when averaging non-detected data

2 The maximum detected concentration was used for screening purposes

3 Refer to Section 3 4 for discussion of the method used to calculate background exceedences

4 Region 5 EDQLs (U S EPA, 1999)

5 Refer to Section 8 3 2 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
NZ = Not applicable because these parameters are used to characterize the soil and/or cannot be used to evaluate ecological risks
NA = Not applicable due to no current available screening levels

TABLE 4-21

ECOLOGICAL RISK SCREENING - SHALLOW SEDIMENT
SWMU 3 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA
PAGE 1 OF 2

| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Sediment COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (µg/kg)** | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 1/15 | 2 J | 2 J | 03SD180006 | 2 | 2 | NA | 247 | 0 01 | NO | BSL |
| 2-BUTANONE | 1/15 | 18 J | 18 J | 03SD170006 | 18 | 3 | NA | 137 | 0 1 | NO | BSL |
| 4-METHYL-2-PENTANONE | 1/15 | 2 J | 2 J | 03SD190006 | 2 | 2 | NA | 544 | 0 004 | NO | BSL |
| ACETONE | 2/15 | 36 J | 160 J | 03SD050006 | 98 | 34 | NA | 453 | 0 4 | NO | BSL |
| CARBON DISULFIDE | 2/15 | 1 4 J | 2 J | 03SD180006 | 1 7 | 2 1 | NA | 134 | 0 01 | NO | BSL |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | |
| ACENAPHTHENE | 1/15 | 25 | 25 | 03SD180006 | 25 | 2 4 | NA | 6 7 | 3.7 | YES | ASL |
| DI-N-BUTYL PHTHALATE | 2/15 | 77 J | 590 | 03SD110006 | 334 | 104 | NA | 111 | 5.3 | YES | ASL |
| DIPHENYLAMINE | 3/15 | 96 J | 420 J | 03SD150006 | 205 | 75 | NA | 35 | 12 | YES | ASL |
| FLUORANTHENE | 2/15 | 11 | 12 J | 03SD140006 | 12 | 2 3 | NA | 111 | 0 1 | NO | BSL |
| PHENANTHRENE | 1/15 | 14 J | 14 J | 03SD140006 | 14 | 1 7 | NA | 42 | 0 3 | NO | BSL |
| PYRENE | 1/15 | 11 | 11 | 03SD110006 | 11 | 2 3 | NA | 53 | 0 2 | NO | BSL |
| **Energetics (mg/kg)** | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 4/15 | 0 29 J | 0 69 | 03SD110006 | 0 5 | 0 2 | NA | NA | NA | YES | NTX |
| 2,4-DINITROTOLUENE | 1/15 | 1 1 | 1 1 | 03SD060006 | 1 1 | 0 2 | NA | 0 08 | 15 | YES | ASL |
| 2-AMINO-4,6-DINITROTOLUENE | 1/15 | 0 37 J | 0 37 J | 03SD110006 | 0 4 | 0 1 | NA | NA | NA | YES | NTX |
| HMX | 3/15 | 1 1 | 130 | 03SD110006 | 46 | 9 2 | NA | NA | NA | YES | NTX |
| **Pesticides/PCB's (µg/kg)** | | | | | | | | | | | |
| METHOXYCHLOR | 1/15 | 17 J | 17 J | 03SD180006 | 17 | 6 5 | NA | 3 6 | 4.7 | YES | ASL |
| **Herbicides (µg/kg)** | | | | | | | | | | | |
| 2,4,5-T | 4/15 | 2 7 J | 4 8 J | 03SD190006 | 3 5 | 1 6 | NA | 58700 | 0 0001 | NO | BSL |
| 2,4,5-TP (SILVEX) | 5/14 | 2 4 J | 4 5 J | 03SD180006 | 3 3 | 1 7 | NA | 7350 | 0 001 | NO | BSL |
| 2,4-D | 7/10 | 4 9 J | 20 J | 03SD080006 | 10 | 7 6 | NA | 5 8 | 3.5 | YES | ASL |
| DINOSEB | 3/14 | 3 1 J | 8 2 J | 03SD080006 | 5 2 | 1 8 | NA | 11 8 | 0 7 | NO | BSL |
| HEXACHLOROPHENE | 1/15 | 3 5 J | 3 5 J | 03SD080006 | 3 5 | 4 2 | NA | 231000 | 0 00002 | NO | BSL |
| **Inorganics (mg/kg)** | | | | | | | | | | | |
| ALUMINUM | 15/15 | 4590 | 23200 J | 03SD150006 | 11195 | 11195 | YES | NA | NA | YES | NTX |
| ANTIMONY | 8/15 | 1 1 J | 7 6 J | 03SD150006 | 2 9 | 1 8 | YES | NA | NA | YES | NTX |
| ARSENIC | 15/15 | 4 3 | 22 | 03SD150006 | 9 5 | 9 5 | NO | 5 9 | 3 7 | NO | BKG |
| BARIUM | 15/15 | 91 6 J | 853 J | 03SD050006 | 266 | 266 | YES | NA | NA | YES | NTX |
| BERYLLIUM | 15/15 | 0 09 | 1 7 | 03SD150006 | 0 9 | 0 9 | NO | NA | NA | NO | BKG |
| CADMIUM | 15/15 | 0 37 | 3 5 J | 03SD110006 | 1 2 | 1 2 | YES | 0 6 | 5.9 | YES | ASL |
| CALCIUM | 15/15 | 833 J | 37500 J | 03SD090006 | 7705 | 7705 | YES | NA | NA | NO | NT |
| CHROMIUM | 15/15 | 8 4 J | 40 8 J | 03SD150006 | 24 | 24 | NO | 26 | 1 6 | NO | BKG |
| COBALT | 15/15 | 7 9 J | 31 2 J | 03SD150006 | 17 | 17 | NO | 50 | 0 6 | NO | BSL |
| COPPER | 15/15 | 8 1 | 198 | 03SD150006 | 56 | 56 | YES | 16 | 12 | YES | ASL |
| IRON | 15/15 | 12900 J | 68600 J | 03SD150006 | 34833 | 34833 | NO | NA | NA | NO | BKG |
| LEAD | 15/15 | 13 3 | 653 J | 03SD060006 | 142 | 142 | YES | 31 | 21 | YES | ASL |
| MAGNESIUM | 15/15 | 489 J | 14700 J | 03SD090006 | 2480 | 2480 | NO | NA | NA | NO | NT |
| MANGANESE | 15/15 | 444 J | 2780 J | 03SD150006 | 1281 | 1281 | NO | NA | NA | NO | BKG |
| MERCURY | 15/15 | 0 02 | 0 31 | 03SD150006 | 0 1 | 0 1 | NO | 0 2 | 1 8 | NO | BKG |
| NICKEL | 15/15 | 10 3 J | 36 3 J | 03SD100006 | 22 3 | 22 3 | NO | 16 | 2 3 | NO | BKG |
| POTASSIUM | 15/15 | 294 J | 1260 J | 03SD060006 | 508 | 508 | NO | NA | NA | NO | NT |

TABLE 4-21

ECOLOGICAL RISK SCREENING - SHALLOW SEDIMENT
SWMU 3 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Sediment COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SELENIUM | 3/15 | 0 2 | 0 26 | 03SD150006 | 0 2 | 0 2 | NO | NA | NA | NO | BKG |
| SILVER | 3/15 | 0 46 J | 0 71 J | 03SD110006 | 0 6 | 0 1 | NO | 0 5 | 1 4 | NO | BKG |
| SODIUM | 2/15 | 94 7 J | 138 J | 03SD060006 | 116 | 22 41 | NO | NA | NA | NO | NT |
| THALLIUM | 15/15 | 0 06 | 0 12 | 03SD150006 | 0 1 | 0 1 | NO | NA | NA | NO | BKG |
| TIN | 2/15 | 4 4 J | 13 8 J | 03SD120006 | 9 1 | 2 1 | YES | NA | NA | YES | NTX |
| VANADIUM | 15/15 | 12 2 J | 44 1 J | 03SD150006 | 24 | 24 | NO | NA | NA | NO | BKG |
| ZINC | 15/15 | 27 5 J | 385 J | 03SD160006 | 173 | 173 | YES | 120 | 3.2 | YES | ASL |
| **Miscellaneous Parameters** | | | | | | | | | | | |
| NITRATE (mg/kg) | 13/15 | 2 2 | 8 4 | 03SD080006 | 4 | 3 6 | NA | NA | NA | NO | NZ |
| NITRITE (mg/kg) | 2/11 | 3 4 J | 3 5 J | 03SD170006 | 3 5 | 2 8 | NA | NA | NA | NO | NZ |
| NITRITE/NITRATE (mg/kg) | 15/15 | 2 2 J | 8 4 | 03SD080006 | 4 | 4 | NA | NA | NA | NO | NZ |
| TOTAL ORGANIC CARBON (mg/kg) | 14/15 | 4600 | 28000 | 03SD080006 | 10214 | 9567 | NA | NA | NA | NO | NZ |
| PERCENT MOISTURE (%) | 15/15 | 7 4 | 34 9 | 03SD080006 | 20 | 20 | NA | NA | NA | NO | NZ |
| PH (S U ) | 15/15 | 7 J | 8 1 J | 03SD070006 | 7 7 | 7 7 | NA | NA | NA | NO | NZ |

Shaded name indicates that the constituent was selected as a COPC Shaded values indicate that the site concentration(s) exceeds this particular criterion

Footnotes

1 The sample and duplicate were counted as two samples when determinnig the minimum and maximum detected concentrations and location of maximum concentrations, but were only counted as one sample when determining the frequency of detection One-half of the detection limit was used when averaging non-detected data.
2 The maximum detected concentration was used for screening purposes
3 Refer to Section 3 4 for discussion of the method used to calculate background exceedences
4 Region 5 EDQLs (U S EPA, 1999)
5 Refer to Section 8 3 2 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
NZ = Not applicable because these parameters are used to characterize the sediments and/or cannot be used to evaluate ecological risks
NA = Not applicable due to no current available screening levels

TABLE 4-22

ECOLOGICAL RISK SCREENING - DEEP SEDIMENT
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Sediment COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (µg/kg)** | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 5/15 | 1 J | 4 | 03SD190612 | 2 2 | 1 5 | NA | 247 | 0 02 | NO | BSL |
| 2-BUTANONE | 3/15 | 10 | 60 | 03SD180612 | 28 | 6 5 | NA | 137 | 0 4 | NO | BSL |
| ACETONE | 4/15 | 29 J | 220 J | 03SD180612 | 95 | 32 | NA | 453 | 0 5 | NO | BSL |
| CARBON DISULFIDE | 3/15 | 1 J | 1 1 J | 03SD060612 | 1 | 1 2 | NA | 134 | 0 01 | NO | BSL |
| TOLUENE | 1/15 | 54 | 54 | 03SD180612 | 54 | 4 5 | NA | 52500 | 0 001 | NO | BSL |
| TRICHLOROFLUOROMETHANE | 1/15 | 2 J | 2 J | 03SD090612 | 2 | 1 1 | NA | 3 | 0 7 | NO | BSL |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | |
| BENZO(A)ANTHRACENE | 1/15 | 11 | 11 | 03SD160612 | 11 | 1 5 | NA | 32 | 0 3 | NO | BSL |
| BENZO(B)FLUORANTHENE | 2/15 | 11 | 15 | 03SD160612 | 13 | 2 4 | NA | 10400 | 0 001 | NO | BSL |
| CHRYSENE | 1/15 | 10 | 10 | 03SD160612 | 10 | 1 4 | NA | 57 | 0 2 | NO | BSL |
| DI-N-BUTYL PHTHALATE | 2/15 | 110 J | 880 | 03SD110612 | 495 | 115 | NA | 110 5 | 8 | YES | ASL |
| FLUORANTHENE | 1/15 | 27 | 27 | 03SD160612 | 27 | 2 6 | NA | 111 | 0 2 | NO | BSL |
| PHENANTHRENE | 1/15 | 23 | 23 | 03SD160612 | 23 | 2 3 | NA | 42 | 0 5 | NO | BSL |
| PYRENE | 1/15 | 19 | 19 | 03SD160612 | 19 | 2 | NA | 53 | 0 4 | NO | BSL |
| **Energetics (mg/kg)** | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 5/15 | 0 35 J | 2 2 | 03SD120612 | 0 9 | 0 4 | NA | NA | NA | YES | NTX |
| 2-AMINO-4,6-DINITROTOLUENE | 2/15 | 0 35 J | 0 73 | 03SD110612 | 0 5 | 0 2 | NA | NA | NA | YES | NTX |
| 4-AMINO-2,6-DINITROTOLUENE | 1/15 | 0 4 J | 0 4 J | 03SD120612 | 0 4 | 0 2 | NA | NA | NA | YES | NTX |
| HMX | 4/15 | 0 37 J | 19 | 03SD110612 | 5 1 | 1 5 | NA | NA | NA | YES | NTX |
| RDX | 2/15 | 0 45 J | 0 45 J | 03SD110612 | 0 4 | 0 2 | NA | NA | NA | YES | NTX |
| **Herbicides (µg/kg)** | | | | | | | | | | | |
| 2,4,5-T | 5/15 | 2 5 J | 4 5 | 03SD110612 | 3 5 | 1 8 | NA | 58700 | 0 0001 | NO | BSL |
| 2,4,5-TP (SILVEX) | 2/15 | 2 3 J | 2 9 J | 03SD060612 | 2 6 | 1 1 | NA | 7350 | 0 0004 | NO | BSL |
| 2,4-D | 5/12 | 6 9 J | 28 J | 03SD050612 | 13 | 5 9 | NA | 5 8 | 4.8 | YES | ASL |
| DINOSEB | 2/15 | 3 5 J | 3 5 J | 03SD170612, 03SD140612 | 3 5 | 1 2 | NA | 11 8 | 0 3 | NO | BSL |
| HEXACHLOROPHENE | 2/15 | 2 8 J | 7 6 J | 03SD080612 | 5 2 | 4 3 | NA | 231000 | 0 00003 | NO | BSL |
| PENTACHLOROPHENOL | 2/11 | 2 1 J | 3 7 J | 03SD050612 | 2 9 | 0 7 | NA | 30100 | 0 0001 | NO | BSL |
| **Inorganics (mg/kg)** | | | | | | | | | | | |
| ALUMINUM | 15/15 | 3150 | 56900 | 03SD110612 | 13120 | 13120 | YES | NA | NA | YES | NTX |
| ANTIMONY | 8/15 | 0 85 J | 6 7 J | 03SD110612 | 2 7 | 1 6 | YES | NA | NA | YES | NTX |
| ARSENIC | 15/15 | 3 5 | 17 5 | 03SD150612 | 9 4 | 9 4 | NO | 5 9 | 3 | NO | BKG |
| BARIUM | 15/15 | 47 5 J | 981 J | 03SD110612 | 260 | 260 | YES | NA | NA | YES | NTX |
| BERYLLIUM | 15/15 | 0 43 | 1 5 | 03SD150612, 03SD110612 | 0 97 | 0 97 | NO | NA | NA | NO | BKG |
| CADMIUM | 14/15 | 0 39 J | 4 | 03SD120612 | 1 5 | 1 4 | YES | 0 6 | 6.7 | YES | ASL |
| CALCIUM | 15/15 | 676 J | 32300 | 03SD060612 | 4547 | 4547 | YES | NA | NA | NO | NT |
| CHROMIUM | 15/15 | 8 J | 48 9 J | 03SD110612 | 28 | 28 | NO | 26 | 1 9 | NO | BKG |
| COBALT | 15/15 | 7 9 J | 29 1 J | 03SD150612 | 16 | 16 | NO | 50 | 0 6 | NO | BSL |
| COPPER | 15/15 | 7 9 | 273 | 03SD110612 | 59 | 59 | YES | 16 | 17 | YES | ASL |
| IRON | 15/15 | 12500 J | 87700 J | 03SD060612 | 44767 | 44767 | NO | NA | NA | NO | BKG |
| LEAD | 15/15 | 11 8 | 445 | 03SD110612 | 98 | 98 | YES | 31 | 14 | YES | ASL |
| MAGNESIUM | 15/15 | 368 J | 4980 J | 03SD060612 | 1255 | 1255 | NO | NA | NA | NO | NT |
| MANGANESE | 15/15 | 316 J | 2320 J | 03SD150612 | 1109 | 1109 | NO | NA | NA | NO | BKG |
| MERCURY | 13/15 | 0 02 | 0 13 | 03SD120612, 03SD140612 | 0 06 | 0 06 | YES | 0 2 | 0 7 | NO | BSL |

TABLE 4-22

ECOLOGICAL RISK SCREENING - DEEP SEDIMENT
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Sediment COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NICKEL | 15/15 | 10 1 J | 36 1 J | 03SD110612 | 22 | 22 | NO | 16 | 2 3 | NO | BKG |
| POTASSIUM | 15/15 - | 236 J | 802 J | 03SD050612 | 446 | 446 | NO | NA | NA | NO | NT |
| SELENIUM | 1/15 | 0 36 | 0 36 | 03SD130612 | 0 4 | 0 1 | NO | NA | NA | NO | BKG |
| SILVER | 4/15 | 0 23 J | 0 43 J | 03SD110612 | 0 3 | 0 1 | YES | 0 5 | 0 9 | NO | BSL |
| SODIUM | 1/15 | 88 5 J | 88 5 J | 03SD060612 | 89 | 12 | NO | NA | NA | NO | NT |
| THALLIUM | 15/15 | 0 05 | 0 12 | 03SD090612, 03SD150612 | 0 1 | 0 1 | NO | NA | NA | NO | BKG |
| TIN | 3/15 | 1 5 J | 4 1 J | 03SD100612 | 2 4 | 1 1 | YES | NA | NA | YES | NTX |
| VANADIUM | 15/15 | 10 2 | 47 1 | 03SD110612 | 27 | 27 | NO | NA | NA | NO | BKG |
| ZINC | 15/15 | 21 4 J | 1120 J | 03SD110612 | 223 | 223 | YES | 120 | 9.3 | YES | ASL |
| **Miscellaneous Parameters** | | | | | | | | | | | |
| NITRATE (mg/kg) | 14/15 | 1 6 | 6 5 | 03SD120612 | 3 6 | 3 4 | NA | NA | NA | NO | NZ |
| NITRITE (mg/kg) | 2/10 | 2 6 J | 2 7 J | 03SD130612 | 2 7 | 5 2 | NA | NA | NA | NO | NZ |
| NITRITE/NITRATE (mg/kg) | 15/15 | 2 6 | 6 5 | 03SD120612 | 3 8 | 3 8 | NA | NA | NA | NO | NZ |
| TOTAL ORGANIC CARBON (mg/kg) | 15/15 | 2300 J | 34000 | 03SD080612 | 9400 | 9400 | NA | NA | NA | NO | NZ |
| PERCENT MOISTURE (%) | 15/15 | 8 2 | 38 8 | 03SD180612 | 22 | 22 | NA | NA | NA | NO | NZ |
| PH (S U ) | 15/15 | 6 8 J | 8 J | 03SD110612 | 7 5 | 7 5 | NA | NA | NA | NO | NZ |

Shaded name indicates that the constituent was selected as a COPC Shaded values indicate that the site concentration(s) exceeds this particular criterion

Footnotes:

1 The sample and duplicate were counted as two samples when determinnig the minimum and maximum detected concentrations and location of maximum concentrations, but were only counted as one sample when determining the frequency of detection One-half of the detection limit was used when averaging non-detected data
2 The maximum detected concentration was used for screening purposes
3 Refer to Section 3 4 for discussion of the method used to calculate background exceedences
4 Region 5 EDQLs (U S EPA, 1999)
5 Refer to Section 8 3 2 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
NZ = Not applicable because these parameters are used to characterize the sediments and/or cannot be used to evaluate ecological risks
NA = Not applicable due to no current available screening levels

TABLE 4-23

ECOLOGICAL RISK SCREENING - SURFACE WATER AT LOW-FLOW
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Surface Water COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (µg/L)** | | | | | | | | | | | |
| 2-BUTANONE | 1/5 | 0 6 J | 0 6 J | 03SW1701 | 0 6 | 0 3 | NA | 7100 | 0 0001 | NO | BSL |
| BROMOMETHANE | 3/6 | 0 8 | 1 6 | 03SW1701 | 1 1 | 0 7 | NA | NA | NA | YES | NTX |
| TRICHLOROETHENE | 1/6 | 0 4 J | 0 4 J | 03SW1701 | 0 4 | 0 3 | NA | 75 | 0 01 | NO | BSL |
| **Energetics (µg/L)** | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | 1/6 | 0 56 | 0 56 | 03SW1701 | 0 6 | 0 2 | NA | NA | NA | YES | NTX |
| 2-AMINO-4,6-DINITROTOLUENE | 2/6 | 0 37 J | 0 75 J | 03SW0601 | 0 6 | 0 3 | NA | NA | NA | YES | NTX |
| 4-AMINO-2,6-DINITROTOLUENE | 4/6 | 0 54 J | 1 7 | 03SW0601 | 0 9 | 0 7 | NA | NA | NA | YES | NTX |
| HMX | 6/6 | 3 1 J | 12 | 03SW0601 | 6 5 | 6 5 | NA | NA | NA | YES | NTX |
| RDX | 6/6 | 2 3 | 11 | 03SW1701 | 6 2 | 6 2 | NA | NA | NA | YES | NTX |
| **Herbicides (µg/L)** | | | | | | | | | | | |
| 2,4,5-T | 1/5 | 0 064 J | 0 064 J | 03SW0601 | 0 06 | 0 03 | NA | 686 | 0 0001 | NO | BSL |
| **Total Metals (µg/L)** | | | | | | | | | | | |
| ALUMINUM | 6/6 | 24 | 213 J | 03SW0601 | 79 | 79 | NO | NA | NA | NO | BKG |
| ARSENIC | 6/6 | 0 23 | 0 56 | 03SW0601 | 0 3 | 0 3 | NO | 53 | 0 01 | NO | BSL |
| BARIUM | 6/6 | 61 6 | 120 J | 03SW0601 | 93 | 93 | NO | 5000 | 0 02 | NO | BSL |
| CALCIUM | 6/6 | 26400 J | 31600 | 03SW0601 | 28583 | 28583 | YES | NA | NA | NO | NT |
| CHROMIUM | 1/6 | 0 6 J | 0 6 J | 03SW0601 | 0 6 | 0 3 | YES | 42 | 0 01 | NO | BSL |
| COBALT | 5/6 | 0 12 | 0 31 | 03SW0601 | 0 2 | 0 2 | NO | 5 | 0 1 | NO | BSL |
| COPPER | 6/6 | 0 75 | 2 5 | 03SW0601 | 1 6 | 1 6 | NO | 5 | 0 5 | NO | BSL |
| IRON | 6/6 | 114 J | 373 | 03SW0601 | 207 | 207 | NO | NA | NA | NO | BKG |
| LEAD | 6/6 | 0 2 | 20 | 03SW0601 | 4 | 4 | YES | 1 3 | 15 | YES | ASL |
| MAGNESIUM | 6/6 | 6290 J | 10300 J | 03SW0601 | 7837 | 7837 | YES | NA | NA | NO | NT |
| MANGANESE | 6/6 | 7 4 J | 34 8 J | 03SW1901 | 20 | 20 | NO | NA | NA | NO | BKG |
| NICKEL | 6/6 | 1 | 1 9 J | 03SW0601 | 1 3 | 1 3 | NO | 29 | 0 1 | NO | BSL |
| POTASSIUM | 6/6 | 1170 J | 5100 | 03SW0601 | 2312 | 2312 | NO | NA | NA | NO | NT |
| SODIUM | 6/6 | 3730 | 5850 | 03SW0601 | 4588 | 4588 | NO | NA | NA | NO | NT |
| TIN | 5/6 | 2 8 J | 4 9 J | 03SW1901, 03SW1601 | 4 1 | 3 7 | YES | 73 | 0 1 | NO | BSL |
| VANADIUM | 4/6 | 0 12 | 0 54 | 03SW0601 | 0 2 | 0 2 | NO | 19 | 0 03 | NO | BSL |
| ZINC | 5/6 | 1 8 | 3 4 | 03SW1701 | 2 6 | 2 7 | NO | 59 | 0 1 | NO | BSL |
| **Dissolved Metals (µg/L)** | | | | | | | | | | | |
| ALUMINUM | 2/6 | 5 6 | 10 6 | 03SW1501-F | 8 1 | 5 0 | NO | NA | NA | NO | BKG |
| ANTIMONY | 1/6 | 1 2 J | 1 2 J | 03SW0601-F | 1 2 | 0 3 | NO | 31 | 0 04 | NO | BSL |
| ARSENIC | 5/6 | 0 21 | 0 42 | 03SW0601-F | 0 3 | 0 2 | YES | 53 | 0 01 | NO | BSL |
| BARIUM | 6/6 | 63 1 | 114 J | 03SW0601-F | 93 | 93 | YES | 5000 | 0 02 | NO | BSL |
| CALCIUM | 6/6 | 26900 J | 31200 | 03SW0601-F | 28067 | 28067 | YES | NA | NA | NO | NT |
| CHROMIUM | 1/6 | 0 53 J | 0 53 J | 03SW1701-F | 0 5 | 0 2 | YES | 42 | 0 01 | NO | BSL |
| COBALT | 6/6 | 0 11 | 0 73 | 03SW1601-F | 0 2 | 0 2 | NO | 5 | 0 1 | NO | BSL |
| COPPER | 6/6 | 0 54 | 1 5 | 03SW0601-F | 1 1 | 1 1 | YES | 5 | 0 3 | NO | BSL |
| IRON | 6/6 | 97 6 | 154 J | 03SW0601-F | 112 | 112 | YES | NA | NA | YES | NTX |
| LEAD | 1/6 | 1 1 | 1 1 | 03SW0601-F | 1 1 | 0 2 | NO | 1 3 | 0 8 | NO | BSL |
| MAGNESIUM | 6/6 | 6000 J | 10400 J | 03SW0601-F | 7698 | 7698 | YES | NA | NA | NO | NT |
| MANGANESE | 6/6 | 3 4 J | 35 6 J | 03SW1901-F | 13 | 13 | NO | NA | NA | NO | BKG |
| NICKEL | 6/6 | 1 1 | 1 4 | 03SW1701-F | 1 2 | 1 2 | NO | 29 | 0 05 | NO | BSL |

TABLE 4-23

ECOLOGICAL RISK SCREENING - SURFACE WATER AT LOW-FLOW
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Surface Water COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dissolved Metals (µg/L) (Continued)** | | | | | | | | | | | |
| POTASSIUM | 6/6 | 1150 J | 5010 | 03SW0601-F | 2252 | 2252 | NO | NA | NA | NO | NT |
| SELENIUM | 1/6 | 0 52 J | 0 52 J | 03SW0601-F | 0 5 | 0 3 | YES | 5 | 0 1 | NO | BSL |
| SODIUM | 6/6 | 3540 | 6020 | 03SW0601-F | 4477 | 4477 | NO | NA | NA | NO | NT |
| TIN | 5/6 | 4 6 J | 5 6 J | 03SW1701-F | 5 1 | 4 6 | YES | 73 | 0 1 | NO | BSL |
| VANADIUM | 1/6 | 0 18 | 0 18 | 03SW0601-F | 0 2 | 0 1 | NO | 19 | 0 01 | NO | BSL |
| ZINC | 5/6 | 1 5 | 2 8 | 03SW1701-F | 2 2 | 1 8 | YES | 59 | 0 05 | NO | BSL |
| **Miscellaneous Parameters (mg/L)** | | | | | | | | | | | |
| TOTAL SUSPENDED SOLIDS | 2/6 | 9 | 20 J | 03SW0601 | 15 | 6 | NA | NA | NA | NO | NZ |
| DISSOLVED OXYGEN (mg/L) | 6/6 | 7 9 | 10 92 | 03SW1501 | 10 | 10 | NA | NA | NA | NO | NZ |
| NITRATE (mg/L) | 6/6 | 0 1 | 0 2 | 03SW1701 | 0 2 | 0 2 | NA | NA | NA | NO | NZ |
| NITRITE (mg/L) | 6/6 | 0 | 0 004 | 03SW1701 | 0 002 | 0 002 | NA | NA | NA | NO | NZ |
| OXIDATION REDUCTION POTENTIAL (mv) | 6/6 | 316 4 | 396 | 03SW1801 | 359 | 359 | NA | NA | NA | NO | NZ |
| pH (S U ) | 6/6 | 6 62 | 8 25 | 03SW0601 | 7 5 | 7 5 | NA | NA | NA | NO | NZ |
| SPECIFIC CONDUCTANCE (ms/cm) | 6/6 | 0 261 | 0 312 | 03SW0601 | 0 3 | 0 3 | NA | NA | NA | NO | NZ |
| TEMPERATURE (°C) | 6/6 | 14 5 | 25 45 | 03SW0601 | 16 7 | 16 7 | NA | NA | NA | NO | NZ |
| TURBIDITY (NTU) | 6/6 | 0 | 8 4 | 03SW0601 | 2 | 2 | NA | NA | NA | NO | NZ |

Shaded name indicates that the constituent was selected as a COPC Shaded values indicate that the site concentration(s) exceeds this particular criterion

Footnotes

1 The sample and duplicate were counted as two samples when determinnig the minimum and maximum detected concentrations and location of maximum concentrations, but were only counted as one sample when determining the frequency of detection One-half of the detection limit was used when averaging non-detected data
2 The maximum detected concentration was used for screening purposes
3 Refer to Section 3 4 for discussion of the method used to calculate background exceedences
4 Region 5 EDQLs (U S EPA, 1999)
5 Refer to Section 8 3 2 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
NZ = Not applicable because these parameters are used to characterize the surface water and/or cannot be used to evaluate ecological risks
NA = Not applicable due to no current available screening levels

TABLE 4-24

ECOLOGICAL RISK SCREENING - SURFACE WATER AT HIGH-FLOW
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Surface Water COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (µg/L)** | | | | | | | | | | | |
| METHYLENE CHLORIDE | 2/11 | 9 5 J | 13 | 03SW0802 | 11 | 2 5 | NA | 430 | 0 03 | NO | BSL |
| ACETONE | 1/3 | 64 | 64 | | 64 | 30 | NA | 78000 | 0 001 | NO | BSL |
| **Semivolatile Organics (µg/L)** | | | | | | | | | | | |
| ACENAPHTHYLENE | 1/11 | 0 22 | 0 22 | 03SW0902 | 0 2 | 0 03 | NA | 4840 | 0 00005 | NO | BSL |
| BIS(2-ETHYLHEXYL)PHTHALATE | 2/11 | 4 | 6 | 03SW1402 | 5 | 1 3 | NA | 2 1 | 2.9 | YES | ASL |
| **Energetics (µg/L)** | | | | | | | | | | | |
| 2-AMINO-4,6-DINITROTOLUENE | 1/11 | 1 5 J | 1 5 J | 03SW1702 | 1 5 | 0 3 | NA | NA | NA | YES | NTX |
| 4-AMINO-2,6-DINITROTOLUENE | 2/11 | 1 4 J | 2 9 | 03SW1702 | 2 2 | 0 5 | NA | NA | NA | YES | NTX |
| HMX | 10/11 | 1 1 J | 90 | 03SW0902 | 19 | 17 | NA | NA | NA | YES | NTX |
| NITROCELLULOSE | 1/11 | 3200 | 3200 | 03SW1502 | 3200 | 745 | NA | NA | NA | YES | NTX |
| RDX | 9/11 | 0 62 | 63 | 03SW1702 | 14 | 12 | NA | NA | NA | YES | NTX |
| **Herbicides (µg/L)** | | | | | | | | | | | |
| 2,4,5-T | 3/10 | 0 23 J | 0 63 J | 03SW0902 | 0 4 | 0 1 | NA | 686 | 0 001 | NO | BSL |
| 2,4-D | 2/11 | 0 28 J | 0 36 J | 03SW0902 | 0 3 | 0 1 | NA | NA | NA | YES | NTX |
| PENTACHLOROPHENOL | 1/8 | 0 71 J | 0 71 J | 03SW1102 | 0 7 | 0 1 | NA | 5 23 | 0 1 | NO | BSL |
| **Total Metals (µg/L)** | | | | | | | | | | | |
| ALUMINUM | 7/11 | 211 | 2010 | 03SW1102 | 1242 | 826 | NO | NA | NA | NO | BKG |
| ANTIMONY | 2/11 | 2 J | 3 J | 03SW0602 | 2 5 | 0 6 | YES | 31 | 0 1 | NO | BSL |
| ARSENIC | 11/11 | 0 29 | 2 5 | 03SW1102 | 1 1 | 1 1 | NO | 53 | 0 05 | NO | BSL |
| BARIUM | 11/11 | 45 6 J | 156 J | 03SW1802 | 107 | 107 | NO | 5000 | 0 03 | NO | BSL |
| BERYLLIUM | 4/11 | 0 12 | 0 13 | 03SW0902, 03SW1302 | 0 1 | 0 1 | NO | 7 6 | 0 02 | NO | BSL |
| CADMIUM | 3/11 | 0 83 | 1 4 | 03SW1402 | 1 1 | 0 5 | YES | 0 7 | 2 | YES | ASL |
| CALCIUM | 11/11 | 6890 | 58900 | 03SW1702 | 36561 | 36561 | YES | NA | NA | NO | NT |
| CHROMIUM | 9/11 | 0 67 J | 4 5 J | 03SW1102 | 2 1 | 1 7 | NO | 42 | 0 1 | NO | BSL |
| COBALT | 11/11 | 0 12 | 1 9 | 03SW0902 | 0 8 | 0 8 | NO | 5 | 0 4 | NO | BSL |
| COPPER | 11/11 | 0 94 | 18 4 | 03SW1102 | 7 2 | 7 2 | YES | 5 | 3.7 | YES | ASL |
| IRON | 10/11 | 115 J | 2550 J | 03SW1102 | 1328 | 1212 | NO | NA | NA | NO | BKG |
| LEAD | 11/11 | 0 25 | 285 | 03SW1102 | 43 | 43 | YES | 1 3 | 219 | YES | ASL |
| MAGNESIUM | 8/11 | 6460 | 14300 | 03SW0602 | 10400 | 8245 | NO | NA | NA | NO | NT |
| MANGANESE | 10/11 | 33 1 | 201 | 03SW1902 | 96 | 88 | NO | NA | NA | NO | BKG |
| NICKEL | 11/11 | 1 5 | 5 3 | 03SW0902 | 2 8 | 2 8 | NO | 29 | 0 2 | NO | BSL |
| POTASSIUM | 4/11 | 5300 J | 21600 J | 03SW0602 | 12240 | 6042 | NO | NA | NA | NO | NT |
| SELENIUM | 3/11 | 0 43 | 0 62 | 03SW0602 | 0 5 | 0 3 | YES | 5 | 0 1 | NO | BSL |
| SODIUM | 6/11 | 5090 | 8070 | 03SW1102 | 6567 | 4718 | NO | NA | NA | NO | NT |
| TIN | 6/11 | 3 J | 4 7 J | 03SW1602, 03SW1702 | 4 2 | 2 4 | NO | 73 | 0 1 | NO | BSL |
| VANADIUM | 11/11 | 0 22 | 3 9 | 03SW1102 | 1 8 | 1 8 | NO | 19 | 0 2 | NO | BSL |
| ZINC | 11/11 | 2 5 | 111 | 03SW1102 | 32 | 32 | YES | 59 | 2 | YES | ASL |
| **Dissolved Metals (µg/L)** | | | | | | | | | | | |
| ALUMINUM | 5/11 | 260 | 332 | 03SW1302-F | 282 | 183 | NO | NA | NA | NO | BKG |
| ANTIMONY | 3/11 | 1 J | 2 4 J | 03SW0602-F | 1 8 | 0 6 | YES | 31 | 0 1 | NO | BSL |
| ARSENIC | 11/11 | 0 25 | 1 | 03SW1102-F | 0 5 | 0 5 | YES | 53 | 0 02 | NO | BSL |
| BARIUM | 11/11 | 37 7 J | 147 J | 03SW1802-F | 94 | 94 | NO | 5000 | 0 03 | NO | BSL |
| CADMIUM | 1/11 | 1 2 | 1 2 | 03SW1602-F | 1 2 | 0 4 | NO | 0 7 | 1 8 | NO | BKG |
| CALCIUM | 11/11 | 7550 | 61200 | 03SW1702-F | 33888 | 33888 | YES | NA | NA | NO | NT |
| CHROMIUM | 9/11 | 0 51 J | 1 4 J | 03SW0902-F | 0 9 | 0 7 | NO | 42 | 0 03 | NO | BSL |

TABLE 4-24

ECOLOGICAL RISK SCREENING - SURFACE WATER AT HIGH-FLOW
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical | Frequency of Detection[1] | Minimun Concentration[1] | Maximum Concentration[1][2] | Location of Maximum Concentration | Average of Positive Detections[1] | Average of All Results[1] | Above Background?[3] | Surface Water COPC Screening Level[4] | Ecological Effects Quotient[5] | Retain as a COPC ? | Rationale for Contaminant Deletion or Selection[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dissolved Metals (µg/L) (Continued)** | | | | | | | | | | | |
| COBALT | 11/11 | 0 11 | 0 72 | 03SW1902-F | 0 3 | 0 3 | NO | 5 | 0 1 | NO | BSL |
| COPPER | 11/11 | 0 84 | 7 6 | 03SW0902-F | 3 3 | 3 3 | NO | 5 | 1 5 | NO | BKG |
| IRON | 2/11 | 109 | 171 | 03SW1302-F | 140 | 66 | NO | NA | NA | NO | BKG |
| LEAD | 9/11 | 0 12 J | 22 6 J | 03SW1102-F | 4 3 | 3 5 | NO | 1 3 | 17 | NO | BKG |
| MAGNESIUM | 8/11 | 6000 | 14000 | 03SW0602-F | 10338 | 8200 | NO | NA | NA | NO | NT |
| MANGANESE | 6/11 | 17 4 | 100 | 03SW1902-F | 39 | 25 | NO | NA | NA | NO | BKG |
| NICKEL | 11/11 | 0 88 | 2 4 | 03SW0902-F | 1 6 | 1 6 | NO | 29 | 0 1 | NO | BSL |
| POTASSIUM | 4/11 | 5220 | 22900 | 03SW0602-F | 12773 | 6235 | NO | NA | NA | NO | NT |
| SELENIUM | 2/11 | 0 43 | 0 51 | 03SW0602-F | 0 5 | 0 2 | NO | 5 | 0 1 | NO | BSL |
| SODIUM | 7/11 | 5000 | 9830 | 03SW1702-F | 8150 | 6095 | NO | NA | NA | NO | NT |
| TIN | 11/11 | 3 5 J | 7 3 J | 03SW0602-F | 5 | 5 | NO | 73 | 0 1 | NO | BSL |
| VANADIUM | 11/11 | 0 18 | 0 61 | 03SW1102-F | 0 4 | 0 4 | NO | 19 | 0 03 | NO | BSL |
| ZINC | 11/11 | 2 2 | 21 7 | 03SW1902-F | 8 | 8 | NO | 58 9 | 0 4 | NO | BSL |
| **Miscellaneous Parameters (mg/L)** | | | | | | | | | | | |
| TOTAL SUSPENDED SOLIDS | 8/11 | 2 | 100 | 03SW1102 | 50 | 37 | NA | NA | NA | NO | NZ |
| DISSOLVED OXYGEN (mg/L) | 11/11 | 2 39 | 13 94 | 03SW1102 | 9 1 | 9 1 | NA | NA | NA | NO | NZ |
| NITRATE (mg/L) | 10/10 | 0 02 | 1 44 | 03SW0602 | 0 4 | 0 4 | NA | NA | NA | NO | NZ |
| NITRITE (mg/L) | 10/10 | 0 | 0 023 | 03SW0602 | 0 004 | 0 004 | NA | NA | NA | NO | NZ |
| OXIDATION REDUCTION POTENTIAL (mv) | 11/11 | 150 | 320 7 | 03SW1902 | 256 | 256 | NA | NA | NA | NO | NZ |
| PH (S U ) | 11/11 | 7 2 | 8 73 | 03SW0902 | 7 8 | 7 8 | NA | NA | NA | NO | NZ |
| SPECIFIC CONDUCTANCE (ms/cm) | 11/11 | 0 058 | 0 427 | 03SW1702 | 0 3 | 0 3 | NA | NA | NA | NO | NZ |
| TEMPERATURE (°C) | 11/11 | 16 73 | 23 5 | 03SW1102 | 21 | 21 | NA | NA | NA | NO | NZ |
| TURBIDITY (NTU) | 11/11 | 0 75 | 190 | 03SW1102 | 60 | 60 | NA | NA | NA | NO | NZ |

Shaded name indicates that the constituent was selected as a COPC Shaded values indicate that the site concentration(s) exceeds this particular criterion

Footnotes:

1 The sample and duplicate were counted as two samples when determinnig the minimum and maximum detected concentrations and location of maximum concentrations, but were only counted as one sample when determining the frequency of detection One-half of the detection limit was used when averaging non-detected data
2 The maximum detected concentration was used for screening purposes
3 Refer to Section 3 4 for discussion of the method used to calculate background exceedences
4 Region 5 EDQLs (U S EPA, 1999)
5 Refer to Section 8 3 2 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
NZ = Not applicable because these parameters are used to characterize the surface water and/or cannot be used to evaluate ecological risks
NA = Not applicable due to no current available screening levels.

TABLE 4-25

SUMMARY OF MEDIUM SPECIFIC CHEMICALS RETAINED AS CHEMICALS OF POTENTIAL CONCERN FOR ECOLGOICAL RISK ASSESSMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| CHEMICAL | SURFACE SOIL | SEDIMENT | | SURFACE WATER | |
|---|---|---|---|---|---|
| | | SHALLOW (0-6") | DEEP (6-12") | LOW-FLOW | HIGH-FLOW |
| **Dioxin/Furans (ng/kg)** | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | X | | | | |
| 1,2,3,4,6,7,8,9-OCDF | X | | | | |
| 1,2,3,4,6,7,8-HPCDD | X | | | | |
| 1,2,3,4,7,8-HXCDD | X | | | | |
| 1,2,3,6,7,8-HXCDD | X | | | | |
| 1,2,3,7,8,9-HXCDD | X | | | | |
| 1,2,3,7,8-PECDD | X | | | | |
| 2,3,7,8-TCDD | X | | | | |
| TEQ BIRD | X | | | | |
| TEQ HUMAN | X | | | | |
| TOTAL HPCDD | X | | | | |
| TOTAL HPCDF | X | | | | |
| TOTAL HXCDD | X | | | | |
| TOTAL HXCDF | X | | | | |
| TOTAL PECDD | X | | | | |
| TOTAL TCDD | X | | | | |
| **Volatile Organic Compounds (µg/kg)/(µg/L)** | | | | | |
| Bromomethane | | | | X | |
| **Semivolatile Organic Compounds (µg/kg)/(µg/L)** | | | | | |
| Acenapthene | | X | | | |
| Benzo(b)fluoranthene | | | | | X |
| Bis(2-ethylhexyl)phthalate | | | | | |
| Di-n-butyl phthalate | X | X | X | | |
| Diphenylamine | | X | | | |
| **Herbicides (µg/kg)/(µg/L)** | | | | | |
| 2,4-D | | X | X | | X |
| **Pesticides (µg/kg)** | | | | | |
| Methoxychlor | | X | | | |
| **Energetics (µg/kg)/(µg/L)** | | | | | |
| 1,3,5-Trinitrobenzene | X | | | | |
| 2,4-Dinitrotoluene | | X | | | |
| 2,4,6-Trinitrotoluene | X | X | X | X | |
| 2-Amino-4,6-Dinitrotoluene | X | X | X | X | X |
| 2-Nitrotoluene | X | | | | |
| 4-Amino-2,6-Dinitrotoluene | X | | X | X | X |
| HMX | X | X | X | X | X |
| Nitrocellulose | | | | | X |
| RDX | X | | X | X | X |

TABLE 4-25

SUMMARY OF MEDIUM SPECIFIC CHEMICALS RETAINED AS CHEMICALS OF POTENTIAL CONCERN FOR ECOLGOICAL RISK ASSESSMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| CHEMICAL | SURFACE SOIL | SEDIMENT | | SURFACE WATER | |
|---|---|---|---|---|---|
| | | SHALLOW (0-6") | DEEP (6-12") | LOW-FLOW | HIGH-FLOW |
| **Inorganics (mg/kg)/(mg/L)** | | | | | |
| Aluminum | | X | X | | |
| Antimony | | X | X | | |
| Barium | X | X | X | | |
| Beryllium | X | | | | |
| Cadmium | X | X | X | | X |
| Chromium | X | | | | |
| Copper | X | X | X | | X |
| Iron | X | | | X | |
| Lead | X | X | X | X | X |
| Mercury | X | | | | |
| Nickel | X | | | | |
| Tin | | X | X | | |
| Zinc | X | X | X | | X |

Notes
All of the above chemicals were selected as a COPC for the medium indicated by the X.

COPCs - Chemicals of potential concern.

TABLE 4-26

SUMMARY OF MEDIUM-SPECIFIC CHEMICALS OF POTENTIAL CONCERN
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| CHEMICAL | SURFACE SOIL | SUB-SURFACE SOIL | GROUND WATER | SEDIMENT | | SURFACE WATER | |
|---|---|---|---|---|---|---|---|
| | | | | SHALLOW (0-6") | DEEP (6-12") | LOW-FLOW | HIGH-FLOW |
| **Dioxin/Furans (ng/kg)** | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | E, H | H | | | | | |
| 1,2,3,4,6,7,8,9-OCDF | E | | | | | | |
| 1,2,3,4,6,7,8-HPCDD | E, H | H | | | | | |
| 1,2,3,4,6,7,8-HPCDF | H | | | | | | |
| 1,2,3,4,7,8-HXCDD | E | | | | | | |
| 1,2,3,4,7,8-HXCDF | H | | | | | | |
| 1,2,3,6,7,8-HXCDD | E, H | | | | | | |
| 1,2,3,7,8,9-HXCDD | E, H | | | | | | |
| 1,2,3,7,8-PECDD | E, H | | | | | | |
| 2,3,4,7,8-PECDF | H | | | | | | |
| 2,3,7,8-TCDD | E, H | | | | | | |
| TEQ BIRD | E | | | | | | |
| TOTAL HPCDD | E, H | | | | | | |
| TOTAL HPCDF | E | | | | | | |
| TOTAL HXCDD | E, H | | | | | | |
| TOTAL HXCDF | E, H | | | | | | |
| TOTAL PECDD | E, H | | | | | | |
| TOTAL TCDD | E, H | | | | | | |
| 2,3,7,8-TCDD Equivalents* | E, H | H | | | | | |
| **Volatile Organic Compounds (µg/kg)/(µg/L)** | | | | | | | |
| 1,1,2,2-Tetrachloroethane | | H | H | | | | |
| 1,1,2-Trichloroethane | | | H | | | | |
| 1,1-Dichloroethene | | | H | | | | |
| Acetone | | | | | | | H |
| Bromomethane | | | | | | E, H | |
| cis-1,2-Dichloroethene | | | H | | | | |
| Methylene Chloride | | | | | | | H |
| Tetrachloroethene | | | H | | | | |
| Trans-1,2-Dichloroethene | | | H | | | | |
| Trichloroethene | H | H | H | | | | |
| Vinyl Chloride | | | H | | | | |
| **Semivolatile Organic Compounds (µg/kg)/(µg/L)** | | | | | | | |
| Acetophenone | | H | | | | | |
| Acenaphthene | | | | E | | | |
| Benzo(a)pyrene | | H | | | | | |
| Benzo(b)fluoranthene | | H | | | | | |
| bis(2-ethylhexyl) phthalate | | | | | | | E, H |
| Di-n-butyl phthalate | E | | | E | E | | |
| Diphenylamine | | | | E | | | |
| Naphthalene | E | | | | | | |

TABLE 4-26

SUMMARY OF MEDIUM-SPECIFIC CHEMICALS OF POTENTIAL CONCERN
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| CHEMICAL | SURFACE SOIL | SUB-SURFACE SOIL | GROUND WATER | SEDIMENT | | SURFACE WATER | |
|---|---|---|---|---|---|---|---|
| | | | | SHALLOW (0-6") | DEEP (6-12") | LOW-FLOW | HIGH-FLOW |
| **Herbicides (µg/kg)/(µg/L)** | | | | | | | |
| 2,4-D | | | | E | E | | E |
| Pentachlorophenol | | | | | | | H |
| **Pesticides (µg/kg)** | | | | | | | |
| Methoxychlor | | | | E | | | |
| **Energetics (µg/kg)/(µg/L)** | | | | | | | |
| 1,3,5-Trinitrobenzene | E | | | | | | |
| 2,4-Dinitrotoluene | H | H | | E | | | |
| 2,4,6-Trinitrotoluene | E, H | | H | E | E | E | |
| 2-Amino-4,6-Dinitrotoluene | E, H | H | H | E | E, H | E, H | E, H |
| 2-Nitrotoluene | E | | | | | | |
| 4-Amino-2,6-Dinitrotoluene | E, H | H | H | E | E | E, H | E, H |
| HMX | E, H | | | E | E | E | E |
| Nitrocellulose | | | | | | | E |
| RDX | E, H | H | H | | E | E, H | E, H |
| **Inorganics (mg/kg)/(mg/L)** | | | | | | | |
| Aluminum | | | H | E, H | E, H | | |
| Antimony | | | | E, H | H | | H |
| Barium | E, H | H | H | E, H | E, H | | |
| Beryllium | E | | | | | | |
| Cadmium | E, H | H | H | E | E, H | | E |
| Chromium | E, H | | H | | | | |
| Cobalt | | H | | | | | |
| Copper | E | H | | E | E | | E |
| Iron | E, H | H | H | | | E | |
| Lead | E, H | H | | E, H | E, H | E, H | E, H |
| Manganese | | H | H | | | | |
| Mercury | E, H | | | | | | |
| Nickel | E, H | H | H | | | | |
| Silver | | H | | | | | |
| Thallium | | | H | | | | |
| Tin | | | | E | E | | |
| Zinc | E, H | H | | E | E | | E |

Notes
E Indicates that the chemical was retained as a COPC for the ecological risk assessent
H Indicates that the chemical was retained as a COPC for the human health risk assessment
* 2,3,7,8-TCDD Equivalents includes TEQ Mammal

COPCs - Chemicals of potential concern

# 5.0 NATURE AND EXTENT OF CONTAMINATION

Soil (surface and subsurface), ground water, surface water, and sediment samples were collected from OJT/LSC and analyzed for the presence of site-related contamination during this investigation. The chemical analyses performed on individual samples were selected based on the history of site operations and the need to conduct a technically defensible RFI. Areas that were known as potentially contaminated with particular chemicals were analyzed for those and related chemicals as presented in Table 2-2 of Section 2. Based on analytical data obtained during this investigation, the nature and extent of COPCs and related chemicals, such as chemical degradation products, are discussed on a matrix-specific basis in the following subsections.

The QAPP for OJT/LSC (TtNUS, 2001b) states that the extent of contamination will be delineated by the perimeter encompassing both a Hazard Index (HI) of 1.0 and an incremental lifetime cancer risk (ILCR) of 10E-4 for a future potential resident. This was not necessary because an identification of sample concentrations at various sampling areas was sufficient to establish the extent of contamination. Contaminants are discussed relative to COPC screening levels that were used to select them as COPCs. All references to bounding of contamination refer to spatial contaminant patterns that exhibit concentrations in excess of COPC screening levels toward the center, and concentrations less than COPC screening levels in a direction away from the center of the contaminated area.

Figures 5-1 through 5-7 are environmental media-specific presentations of chemical concentrations. Chemicals shown are the COPCs and related chemicals such as degradation products. In this project, all detected degradation products were, themselves, COPCs. All COPCs for the medium of interest are plotted at each sampling location where they were analyzed and detected. If a chemical was not detected or its concentration at a particular location was not measured, then the chemical was not shown on the figure. Flags such as "ECO" and "R9RES" are incorporated into the tags to show where an analyte concentration exceeds one or more risk-based criteria that were used as the bases for COPC selection criteria.

If a COPC was selected for one medium, it was also plotted as if it was detected in an associated medium. For example, COPCs in surface soil were also plotted for subsurface soil whether or not they were selected as COPCs in subsurface soil. This was done to show relationships for the affected analytes, if any, in the associated media. The associated media were: Surface soil/subsurface soil; high-flow surface water/low-flow surface water; shallow sediment/deep sediment; total/dissolved metals in ground water or surface water.

A flag such as "ECO" or "R9TAP" appearing in a tag next to a chemical name indicates that the chemical concentration at the location of interest exceeded the screening criterion presented in Section 4.0. For the selection of human health COPCs, the U.S. EPA Region 9 PRGs for direct contact with soil (R9RES) and ingestion of tap water (R9TAP) were divided by 10 for noncarcinogenic compounds. For the figures, a R9RES or R9TAP flag appears next to a noncarcinogenic chemical when the concentration exceeds the unadjusted U.S. EPA Region 9 PRG. Consequently, it is possible for a noncarcinogenic COPC to appear on a figure with no flag next to it. The U.S. EPA Region 9 PRGs for carcinogens were not divided by 10 so this discrepancy does not arise for carcinogens. The U.S. EPA Region 9 PRGs for soil and ground water are presented in Tables 4-8 and 4-9, respectively.

Some chemicals plotted on the tag maps have no ecological screening criteria (and hence no COPC screening levels). Those chemicals were selected as COPCs and do not show exceedance flags because there are no screening criteria

## 5.1 SURFACE SOIL

Forty-eight surface soil samples were collected across the approximately 6-acre OJT. Figure 1-7 displays the locations where these samples were collected and Table 2-2 identifies the analyte fractions for which each sample was analyzed. Figures 5-1 and 5-2 present a geographical depiction of organic and inorganic COPC concentrations in surface soil, respectively. The same organic and inorganic constituents are plotted for both surface and subsurface soil samples although a particular analyte might be a COPC in only one of those media. This was done so the change in concentrations with soil depth could be seen. Table 4-1 presents a summary of the results reported for the surface soil samples collected from OJT/LSC. Tables 4-10 and 4-11 present a summary of descriptive statistics for surface soil detections, including ranges of detections, frequencies of detection, locations of maximum concentrations, comparisons to background concentrations, and human health risk assessment screening criteria. Appendix E contains a copy of the entire analytical database for OJT/LSC surface soil.

### Volatile Organic Compounds

Fifteen surface soil samples were analyzed for VOCs near the Burn Pit, the Burn Area, and the fill dump areas. Figure 5-1 shows that COPC, trichloroethene, was detected in just three of those samples at concentrations ranging from 3 µg/kg to 14 µg/kg, which are generally greater than the 3 µg/kg human health COPC screening level (See Table 4-11, DAF1). The greatest concentration was detected in sample 03SS230002 at 14 µg/kg. Five other non-COPC VOCs were also detected in up to four samples

as shown in Table 4-10, but not at concentrations great enough to classify those chemicals as COPCs. In general, the VOC concentrations are low and sparsely distributed even when rejected data are considered. The locations where VOCs were detected are localized to three small areas near soil borings 03SB23, 03SB48, and 03SB26. These areas are not completely bounded in all directions relative to the trichloroethene screening level, but the observed concentrations do not appear to reflect a significant VOC contaminant source.

**Semivolatile Organic Compounds**

Forty-five surface soil samples were analyzed for SVOCs across the OJT/LSC. Only borings located on the hillside east of the Burn Area and Burn Pit were not analyzed for SVOCs. Figure 5-1 shows that COPCs, naphthalene and di-n-butyl phthalate, were detected in four and nine samples at concentrations ranging from 11 µg/kg to 130 µg/kg and 110 µg/kg to 4,500 µg/kg, respectively. Naphthalene exceeded the risk based concentrations or (ARARs) that were used as the basis for COPC screening levels, herefore referred to as Risk-based Criteria (RBCs). The exceedances, which are identified on the tags of Figure 5-1, with codes such as "ECO" and "R9RES" occurred in sample 03SB240002 only. Di-n-butyl phthalate exceeded the ECO RBC in samples 03SB130002, 03SB170002, 03SB180002, 03SB260002, and 03SB450002 (See Table 4-20). Fifteen Polycyclic Aromatic Hydrocarbons (PAHs), two phthalates, and 1,4-phenylenediamine were also detected in up to nine samples as shown in Table 4-10, but not at concentrations great enough to classify those chemicals as COPCs even when possible negative concentration biases are considered. The bulk of the PAH and phthalate detections occur in or near the Burn Area and Burn Pit, as might be expected (PAHs are combustion products). PAHs could also have come from sources such as discarded oil, combustion products and the creosote-coated utility poles to which bomb casings were lashed. Phthalates may be attributed to the disposal and burning of plastics. The samples that contain PAHs and phthalates that are located outside the burn area are sparsely distributed but suggest that burning or disposal could have occurred in other areas along the OJT/LSC, or the contaminants were spread by air transport/deposition.

**Energetics**

Forty-eight surface soil samples were analyzed for energetics across the OJT/LSC Figure 5-1 shows that COPCs, (1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 2-nitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX) were detected in up to nine samples at concentrations ranging from 0.28 mg/kg to 2,400 mg/kg. All but samples 03SB330002, 03SB380002, and 03SB450002 are located within or just outside the Burn Area and Burn Pit, indicating that residual energetics from site operations remain in the surface soils of this area. The sample concentrations at

borings 03SB22 and 03SB24 of the locations near the Burn Pit and Burn Area exceed their COPC screening levels by at least one order of magnitude. Energetic compounds, as a group, represent the most prevalent surface soil contaminants at the OJT/LSC. Energetics are well bounded along the eastern edge of the Jeep Trail, with the exception of a couple of detections of HMX at borings 03SB01 and 03SB03, neither of which exceeds the COPC screening level. Energetics are not bounded west of the Jeep Trail near the Burn Area, including the area southwest of the Burn Pit where the only surface soil sample collected in that area (03SB260002) had an HMX concentration of 58 mg/kg and an RDX concentration of 4.3 mg/kg. The concentrations of Energetics greater than COPC screening levels are well bounded north and south of the Burn Area. All energetic concentrations that exceed R9RES screening levels were found within 100 feet of soil boring 03SB24, which had the greatest energetic concentrations of all soil borings, by at least a factor of five. This boring is located at the southeast end of the Burn Pit. The area covered by the locations exceeding R9RES criteria constitute approximately one tenth of an acre.

**Dioxins and Furans**

Eleven surface soil samples along the OJT were analyzed for PCDDs and PCDFs, especially at areas suspected of past burn activities. All 17 individual isomers for PCDDs and PCDFs and six total PCDDs and PCDFs (total HPCDD, total HPCDF, total HXCDD, total HXCDF, total PECDD, and total TCDD) were detected in surface samples at concentrations ranging from 0.12 ng/kg to 3,440 ng/kg. The TEQs rather than the individual PCDD or PCDF concentrations are plotted on Figure 5-1 because only the 2,3,7,8-TCDD TEQs are evaluated for human health and ecological risks. TEQs ranged from 0.12 ng/kg to 7.4 ng/kg. 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 represent burning processes carried out along the OJT. The 2,3,7,8-TCDD TEQs (bird and mammal) reported from locations 03SB17, 03SB23, and 03SB26 (See Figure 5-1) are similar to background soil concentrations reported in the literature; concentrations in the remaining samples are less than background 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 eight ng/kg [Agency for Toxic Substances and Disease Registry (ATSDR), 1997]. Sample 03SS170002, located at the southeastern end of the Burn Area, contained the greatest concentrations of PCDDs and PCDFs. Based on contaminant patterns, most PCDDs and PCDFs are contained around the perimeter of the Burn Pit and could be attributed to the combustion of chlorinated-solvent-soaked rags or other chlorinated fuels. It

is logical to expect that the PCDDs and PCDFs generated through combustion were dispersed by wind because individual PCDD and PCDF concentrations and the TEQs generally decrease with distance from the Burn Area and Burn Pit.

**Pesticide and PCBs**

Five surface soil samples were analyzed for pesticides and PCBs along the old jeep trail extending from the north to south site boundaries. No pesticides or PCBs were detected at OJT/LSC in surface soils. This is an indication that these chemicals are not significant site contaminants.

**Herbicides**

Five surface soil samples were analyzed for herbicides along the old jeep trail. Dinoseb, 2,4-D and 2,4,5-T were detected infrequently in OJT surface soils at concentrations ranging from 6.4 µg/kg to 11 µg/kg. As shown in Figure 1-7, the locations of these samples and the concentrations are along the OJT and are consistent with topical spot applications at OJT/LSC. No herbicides were retained as COPCs for surface soil samples because their concentrations were less than the COPC screening levels. The existence of a negative concentration bias for herbicides does not reverse this conclusion.

**Metals**

Thirty-two surface soil samples were analyzed for metals across the OJT/LSC except for the area between the northern end of the Burn Pit to soil boring 03SB39 located to the north. Due to the operational history of the Burn Area, only explosives and semivolatiles were analyzed in samples collected from this area. Figure 5-2 shows that COPCs, barium, cadmium, chromium, iron, lead, mercury, nickel, and zinc exceeded human health and ecological COPC screening levels and that beryllium and copper exceeded ecological screening levels only. Four of the detected metals (calcium, magnesium, potassium, and sodium) are considered to be essential nutrients and are not discussed any further. Nine non-COPC metals were also detected in surface soils but at concentrations that are statistically indistinguishable from background concentrations or less than COPC screening levels.

- Barium, chromium, iron, lead, nickel, copper, and zinc were detected in 32 of 32 samples. Concentrations ranged from 66.2 mg/kg to 2,040 mg/kg (barium), 7.7 mg/kg to 288 mg/kg (chromium), 8,280 mg/kg to 51,600 mg/kg (iron), 9.2 mg/kg to 10,200 mg/kg (lead), 8.9 mg/kg to 32.6 mg/kg (nickel), 5.4 mg/kg to 63.9 mg/kg (copper), and 19.5 mg/kg to 739 mg/kg (zinc).

- Beryllium and Mercury were detected in 31 of 32 samples at concentrations ranging from 0.33 mg/kg to 1.4 mg/kg, and 0.017 mg/kg to 0.26 mg/kg, respectively.

- Cadmium was detected in 29 of 32 samples at concentrations ranging from 0.35 mg/kg to 4.4 mg/kg.

These metals could have been associated with waste incinerated at the Burn Area and Burn Pit. The majority of metal concentrations that exceed typical background concentrations are at sampling locations in or near the Burn Area and Burn Pit. The spatial distributions of these metals suggest a limited exposure potential of receptors to the metals outside the Burn Area and Burn Pit exposure unit because the greatest concentrations of metals are associated with a few borings spread across the site. Further evaluation of this is presented in Section 7.1. Iron was detected in all samples at concentrations greater than screening levels. The iron concentration in surface soil is rather evenly distributed across the sampled locations of the OJT/LSC, with no hot spots, suggesting that the iron is not an operationally related contaminant. Locations of elevated chromium concentrations are physically bounded by the depression surrounding borings 03SB27 and 03SB28. Iron is poorly bounded but poses limited human health risk as explained in Section 7.1.

**Miscellaneous Parameters**

Nitrate concentrations ranged from 0.8 mg/kg to 49 mg/kg. Nitrite concentrations ranged from 2.4 mg/kg to 5.6 mg/kg. Perchlorate concentrations ranged from 24 µg/kg to 470 µg/kg. All nitrate and nitrite detections were less than COPC screening levels and no toxicity information is available for the perchlorate results. The maximum detection for nitrate was in sample 03SS240002, which also had the maximum detections for the energetics COPCs. The presence of nitrate in high concentrations is interpreted to be an indication of the degradation of the energetics.

## 5.2 SUBSURFACE SOIL

Sixty-two surface soil samples were collected across the approximately 6-acre OJT/LSC site. Figure 1-7 displays the locations where these samples were collected and Table 2-2 identifies the analyte fractions for which each sample was analyzed. Figures 5-3 and 5-4 present a geographical depiction of organic and inorganic COPC concentrations in subsurface soil, respectively. The same organic and inorganic constituents are plotted for both surface and subsurface soil samples although a particular analyte might be a COPC in only one of these media. This was done so the change in concentrations with soil depth could be seen. Table 4-2 presents a summary of the results reported for the surface soil samples collected from OJT/LSC. Tables 4-13 presents a summary of descriptive statistics for subsurface soil

detections, including ranges of detections, frequencies of detection, locations of maximum concentrations, comparisons to background concentrations, and human health risk assessment screening criteria. Appendix E contains a copy of the entire analytical database for OJT/LSC subsurface soil.

**Volatile Organic Compounds**

Twenty-five subsurface soil samples were analyzed for VOCs near the Burn Pit, the Burn Area, and the fill dump areas. Figure 5-3 shows that COPCs, trichloroethene and 1,1,2,2-tetrachloroethene, were detected in six and two of those samples at concentrations ranging from 6 µg/kg to 33 µg/kg and 1 µg/kg to 2 µg/kg, respectively. These concentrations were generally greater than the 0.2 µg/kg and 3 µg/kg human health COPC screening levels (See Table 4-13, DAF1), respectively. Five other non-COPC VOCs were also detected in up to five samples as shown in Table 4-13, but not at concentrations great enough to classify those chemicals as COPCs in subsurface soil. Chlorinated solvent detections are concentrated in locations 03SB46, 03SB47, and 03SB48. All of these soil borings are located in or near the topographical depression toward the southeastern end of the sampled area. While the exact location of the source is not known it is likely to be located within 100 feet of well 03-07 based on the observed VOC ground water concentrations described in Section 5.3. The source location is estimated to be northwest of well 03-07.

**Semivolatile Organic Compounds**

Sixty-two subsurface soil samples along the OJT/LSC were analyzed for SVOCs. Figure 5-3 shows that COPCs, benzo(a)pyrene, benzo(b)fluoranthene, and acetophenone were detected in two samples each, at concentrations ranging from 11 µg/kg to 110 µg/kg, 14 µg/kg to 290 µg/kg, and 81 µg/kg to 120 µg/kg, respectively. Benzo(a)pyrene and benzo(b)fluoranthene exceeded RBCs (See Table 4-12, R9RES and Table 4-13, DAF1, respectively) in sample 03SB180204 only. This is evident by the presence of R9RES and DAF1 flags in the tags of Figure 5-3 at soil boring 03SB18. Acetophenone exceeded the one tenth RBC for non-carcinogenic compounds (See Table 4-12, R9RES) in samples 03SB220204 and 03SB240406. Fourteen PAHs, three phthalates, and three phenolic compounds were also detected in up to seven samples as shown in Tables 4-12 and 4-13, but not at concentrations great enough to classify those chemicals as COPCs, even when possible negative concentration biases are considered. The bulk of the PAH and phthalate detections occur in or near the Burn Area and Burn Pit, as might be expected (PAHs are combustion products). PAHs could also have come from sources such as discarded oil, combustion products and the creosote-coated utility poles to which bomb casings were lashed. Phthalates may be attributed to the disposal and burning of plastics. The samples that contain PAHs and phthalates that are located outside the Burn Area are sparsely distributed but suggest that burning or

disposal could have occurred in other areas along the OJT/LSC. Acetophenone was not detected in borings 03SB19, 03SB21, or 03SB23 which bound borings 03SB22 and 03SB24 on three sides. This chemical was not detected in any surface soils, including the surface soil sample immediately above these subsurface samples. Soil boring 03SB18, located on the northwestern edge of the Burn Pit, was the only location that had a PAH concentration greater than COPC screening levels.

**Energetics**

Sixty-two subsurface soil samples along the OJT/LSC were analyzed for energetics. Figure 5-1 shows that COPCs, 2,4-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and RDX, were detected in up to five subsurface soil samples at concentrations ranging from 0.42 mg/kg to 4.4 mg/kg. 2,4-dinitrotoluene was detected in sample 03SB180204 only, and its concentration in that sample (0.63 mg/kg) exceeded the human health COPC screening level (See Table 4-13, DAF1). RDX had the greatest concentration at sample 03SB241215 (4.4 mg/kg). In general, the energetics concentrations are less and the frequencies of detection are less in subsurface samples than in surface samples. The majority of locations where detections occur are within the same footprint as the surface samples. This is consistent with the long term burning of explosives in the Burn Area and Burn Pit The vertical extent of contamination is well bounded at all locations except 03SB24, as evident by no detectable energetic compounds in the deepest soil interval or by a decreasing concentration trend with increasing depth. With the exception of location 03SB24, none of the detected energetics in the deepest sol interval exceed COPC screening levels.

Of all the soil borings, soil boring 03SB24 had the greatest RDX concentration in surface soil (2.4 mg/kg). The subsurface soil energetics concentrations are 1.4 mg/kg in the 4 to 6-foot interval and 4.4 mg/kg RDX in the 12 to 15-foot interval. None of the energetic concentrations in subsurface soils exceed risk-based concentrations at soil boring 03SB24. As shown in Figure 5-3 where none of the energetic compound concentrations have a flag next to them in subsurface soil at boring 03SB24. Only 2,4-dinitrotoluene exhibits an exceedance of the DAF1 at soil boring 03SB18 (Figure 5-3) and the 2,4-dinitrotoluene concentration (0.63 mg/kg) is very near to the nominal detection limit of 0.3 mg/kg. Thus, the concentrations of energetic compounds are sufficiently well bounded to support the evaluation of risk at this site.

**Dioxins and Furans**

Two subsurface soil samples were analyzed for PCDDs and PCDFs at the lowest sample depth bgs in the north and south ends of the Burn Pit. Three individual isomers (1,2,3,4,6,7,8,9-OCDD,

1,2,3,4,6,7,8-HPCDD, and 1,2,3,6,7,8-HXCDD) for PCDDs and PCDFs and two total PCDDs and PCDFs (total HPCDD and total PECDD) were detected in subsurface samples at concentrations ranging from 0.029 ng/kg to 970 ng/kg. The TEQs rather than the individual PCDD or PCDF concentrations are plotted on Figure 5-3 because only the 2,3,7,8-TCDD (TEQs) are evaluated for human health and ecological risks. The dioxin results in subsurface samples are less in concentration and number of compounds detected as compared to the surface sample results. Dioxins were only analyzed in subsurface soils at borings 03SB19 and 03SB24 so the full extent of contamination cannot be determined. However, the observed concentrations may be attributable to the combustion of chlorinated-solvent-soaked rags or other chlorinated fuels. The 2,3,7,8-TCDD TEQs (bird and mammal) reported from locations 03SB19 (bird 0.019 ng/kg, mammal 0.029 ng/kg) and 03SB24 (bird 0.11 ng/kg, mammal 0.21 ng/kg) (See Figure 5-3) are less than 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 (ATSDR, 1997)].

Although the full extent of dioxin and furan contamination greater than COPC screening levels cannot be defined from just two samples, the two samples analyzed for these chemicals were located where dioxin/furan contamination, if present, would be detected. The relatively low concentrations of the detected dioxins and furans indicate that these chemicals are not significant site contaminants. They may even represent local anthropogenic background concentrations based on comparisons of site TEQs to literature values; however, there are no available background data for dioxins and furans at NSWC Crane as noted above (U.S. EPA, 2000d). The insignificance of dioxin and furans at the OJT/LSC is also evident from a review of Figure 5-3 that shows no risk-based criteria exceedance flags next to the plotted TEQs. This is the case even at soil boring 03SB24 where several chemicals exhibited the greatest degree of contamination. Therefore, while dioxins and furans were detected at concentrations greater than COPC screening levels, the concentrations are low, and additional investigation of dioxins or furans is not warranted.

**Pesticide and PCBs**

Subsurface samples were not analyzed for pesticides and PCBs. Given that surface soils showed no detectable concentrations of these chemicals, there is a high level of confidence that these chemicals would play a minor role or no role at all as site related contaminants in subsurface soils.

**Herbicides**

Subsurface samples were not analyzed for herbicides. Given that surface soils showed sparsely distributed and low concentrations of these chemicals, there is a high level of confidence that these chemicals are not significant site-related contaminants in subsurface soils despite the observed negative concentration biases.

**Metals**

Thirty-seven subsurface soil samples were analyzed for metals across the OJT/LSC for the area between the northern end of the Burn Area to soil boring 03SB39 located to the north. Twenty-four of the metals were detected in at least one subsurface soil sample. Four of the detected metals (calcium, magnesium, potassium, and sodium) are considered to be essential nutrients and are not discussed any further. Figure 5-4 shows that COPCs, barium, cadmium, cobalt, copper, iron, lead, manganese, nickel, silver, and zinc exceeded human health COPC screening levels. Ten additional non-COPC metals were also detected in subsurface soils but at concentrations that are statistically indistinguishable from background concentrations or less than COPC screening levels. The samples exhibiting metal concentrations that exceed COPC screening levels are scattered throughout the OJT/LSC at various depths and generally extend as far as the lateral OJT/LSC boundaries. The maximum concentrations of seven out of the ten occurred in borings 03SB24 and 03SB48. This, coupled with maximum concentrations (See Tables 4-12 and 4-13), of non-COPC metals at the same locations, reinforces the understanding that most of the site-related contaminants are found primarily in or near the Burn Area, Burn Pit, and the topographical depression near the southeastern end of the sampled area.

**Miscellaneous Parameters**

Nitrate concentrations ranged from 1.1 mg/kg to 38 mg/kg. Nitrite concentrations ranged from 2.3 mg/kg to 15 mg/kg. Perchlorate concentrations ranged from 32 µg/kg to 43 µg/kg. All nitrate and nitrite detections were less than COPC screening levels and no toxicity information is available for the perchlorate results. Maximum detections for nitrate and perchlorate occurred in sample 03SB390206. Sample 03SB390206 did not contain any detections for energetics so the presence of nitrate in this sample could indicate migration from the breakdown of energetic compounds from surface contamination upgradient of boring 03SB39.

## 5.3 GROUND WATER

Fifteen ground water samples were collected across the approximately 6-acre OJT plus additional area outside of the OJT. Figure 1-7 displays the locations where these samples were collected and Table 2-2 identifies the analyte fractions for which each sample was analyzed. Figures 5-5 and 5-6 present a geographical depiction of organic and inorganic COPC concentrations in ground water, respectively. Table 4-3 presents a summary of the results reported for the surface soil samples collected from OJT/LSC. Table 4-14 presents a summary of descriptive statistics for ground water detections, including ranges of detections, frequencies of detection, locations of maximum concentrations, comparisons to background concentrations, and human health risk assessment screening criteria. Appendix E contains a copy of the entire analytical database for OJT/LSC ground water samples. Sample 03GW2501 was analyzed for dissolved TAL metals because the turbidity of the ground water after stabilization (25 NTUs) was greater than 10 NTUs. Sample 03GW1601 was designated to be the OJT/LSC upgradient ground water sample.

### Volatile Organic Compounds

Figure 5-5 shows that 8 VOCs (1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride) were detected in ground water samples. Chlorinated solvents were detected in ground water samples 03GW0701, 03GW1201, 03GW1501, 03GW2001, 03GW2201, and 03GW2401 at concentrations exceeding COPC screening levels. The chlorinated solvent detections that exceed COPC screening levels are from wells located in the south central portion of the OJT/LSC. The maximum detected concentrations of the chlorinated solvents were observed in sample 03GW0701. This indicates that the chlorinated VOC source is located near well 03-07. Furthermore, the ground water flows northeast and southwest from that point for a short distance until the Karst conduits for Spring A and C are reached and then the direction of flow is almost directly south (Section 1.3.4). The VOC concentrations decrease in the northeasterly and southwesterly directions from well 03-07 to the Karst conduits for Spring A and C. When these data are viewed with the potentiometric surface map (Figure 1-18) it is apparent that the flow direction is primarily northeasterly. The samples collected at the farthest points downgradient of well 03-07 had detections for chlorinated solvents (03-20: trichloroethene at 0.3 µg/L and 03-24: trichloroethene at 23 µg/L, 1,1,2,2-tetrachloroethane at 3.9 µg/L, 1,1,2-trichloroethane at 0.5 µg/L, cis-1,2-dichloroethene at 7.7 µg/L, and trans-1,2-dichloroethene at 1.2 µg/L). Based on VOC concentration data alone, the extent of ground water VOC contamination does not appear to be bounded. However, Section 6.3.2 explains how the ground water flow characteristics are preventing northeasterly migration of VOCs beyond the vicinity of well 03-07.

**Semivolatile Organic Compounds**

Bis(2-ethylhexyl) phthalate was detected in sample 03GW2301 at a concentration of 2 µg/L. This compound is considered to be a common laboratory contaminant, and the low concentration found only in well 03-23 at the OJT/LSC is similar to those concentrations commonly found in laboratory method blanks. Bis (2-ethylhexyl) phthalate was also detected infrequently in surface and subsurface soil samples from the OJT/LSC. This compound is not considered to be a significant site contaminant. The observed ground water concentration is not great enough to cause it to be selected as a COPC in ground water.

**Energetics**

Six energetics (1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX) were detected in the ground water samples. Maximum detected concentrations of energetics occurred in sample 03GW2101, located south of, and downgradient to, the Burn Area. RDX, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene were retained as COPCs. Ground water concentrations of RDX exceeding the COPC screening levels generally extend to the OJT/LSC site boundary, thus it is unbounded. However, the RDX concentrations decrease from the north to south, which is the general direction of regional ground water flow. Given that RDX was also detected in the surface and subsurface soils at the OJT/LSC, the soils could be a source of energetics contamination in ground water. The energetics, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene are not detected in the most southerly, easterly, or westerly wells at OJT/LSC indicating that these energetics are bounded in three directions.

**Metals**

Twenty metals were detected in the ground water samples. Four of the detected metals (calcium, magnesium, potassium, and sodium) are considered to be essential nutrients and are not discussed any further. Cobalt, copper, lead, vanadium, selenium, and zinc were statistically determined to exceed background concentrations but were not retained as COPCs because their maximum concentrations are less than their respective COPC screening levels.

Aluminum, barium, cadmium, chromium, iron, manganese, nickel, and thallium were retained as COPCs.

- Barium, iron, and nickel were detected in all 15 ground water samples at concentrations ranging from 19.4 µg/L to 275 µg/L, 103 µg/L to 1,650 µg/L, and 1.3 µg/L to 91.2 µg/L, respectively.

- Aluminum, chromium, and manganese were detected in 10, 12, and 13 of 15 samples at concentrations ranging from 7.5 µg/L to 372 µg/L, 0.24 µg/L to 90.8 µg/L, and 2.1 µg/L to 445 µg/L, respectively.

- Cadmium and thallium were detected in one sample at a concentration of 12 µg/L and 0.5 µg/L, respectively.

Sample 03GW2501 was analyzed for total metals (unfiltered sample) and dissolved metals (filtered sample) because the turbidity exceeded 10 NTUs. Un-filtered and filtered samples yielded similar concentrations for barium, chromium, and nickel. This indicates that any particulate matter in the sample contributed little to the total metal concentration for these metals. Aluminum (total = 372 µg/L, dissolved = 23.7 µg/L), iron (total = 768 µg/L, dissolved = 98.8 µg/L) and manganese (total = 27.0 µg/L, dissolved = 1.0 µg/L) were detected at greater concentrations in the un-filtered sample. This indicates that the preponderance of these metals is associated with particulate matter. Lead, thallium, vanadium, and zinc were detected in the unfiltered sample at concentrations near the detection limit, but were not detected in the filtered sample.

The maximum detected metal concentrations were divided among 11 of 15 sampling locations. As shown in Figure 5-6, there does not appear to be a pattern of contamination in the ground water for barium, aluminum, chromium, manganese, and iron. Well 03-12 had the greatest nickel concentration by a factor of ten over the next highest well and nickel is well bounded. Well 03-18, the furthest downgradient well at the OJT/LSC, had the only detection in ground water for cadmium. Cadmium and thallium were not detected in any wells in the Burn Area or Burn Pit, which are considered to be the most likely source areas of ground water contamination and further investigation of these metals is not recommended. Metals detected in ground water were also detected in surface and subsurface soil samples at SWMU 03 as would be expected for naturally occurring metals and for ground water contaminants.

**Miscellaneous Parameters**

Nitrate concentrations ranged from 0.01 mg/L to 1.65 mg/L, with the maximum occurring in sample 03GW1001. Nitrite concentrations ranged from 0.001 mg/L to 0.03 mg/L, with the maximum occurring in sample 03GW2201. Nitrate and nitrite extend to the OJT/LSC boundaries and may be breakdown products or residual components of explosives. Nitrate exceeded the human health COPC screening level and has been retained as a COPC.

## 5.4 SHALLOW SEDIMENT

As detailed in Table 2-2, 15 shallow sediment samples were collected and analyzed for the analyte fractions marked in the table. Figure 1-7 displays the locations where shallow sediment samples were collected. Figures 5-7 and 5-8 present a geographical depiction of organic and inorganic COPC concentrations in shallow and deep sediments. The same organic and inorganic constituents are plotted for both shallow and deep sediment samples although a particular analyte might be a COPC in only one of those media. This was done so the change in concentrations with sediment depth could be seen. Table 4-15 presents a summary of descriptive statistics for shallow sediment detections, including ranges of detections, frequencies of detection, locations of maximum concentrations, comparisons to background concentrations, and human health risk assessment screening criteria. Appendix E contains a copy of the entire analytical database for OJT/LSC sediment samples. Shallow sediment samples 03SD010006, 03SD020006, 03SD030006, and 03SD040006, which were collected in Little Sulphur Creek upgradient of the main treatment area in SWMU 03, were used as the upgradient shallow sediment samples for the OJT/LSC evaluation

### Volatile Organic Compounds

Five VOCs (1,1,1-trichloroethene, 2-butanone, 4-methyl-2-pentanone, acetone, and carbon disulfide) were detected in the shallow sediment samples. Carbon disulfide was detected in samples 03SD060006 and 03SD180006 at concentrations of 1.4 µg/kg and 2 µg/kg respectively. Acetone was detected in samples 03SD050006 and 03SD060006 at concentrations of 160 µg/kg and 36 µg/kg respectively. 1,1,1-Trichloroethene was detected in sample 03SD180006 at a concentration of 2 µg/kg. 3-Butanone was detected in sample 03SD170006 at a concentration of 18 µg/kg. 4-Methyl-2-pentanone was detected in sample 03SD190006 at a concentration of 2 µg/kg.

No VOCs were retained as COPCs for shallow sediment samples because none of the measured VOC concentrations exceeds its COPC screening level. There is no apparent pattern of VOC contamination. Although VOCs were detected in some soil and ground water samples, the VOCs do not appear to have had a significant adverse impact on shallow sediments.

### Semivolatile Organic Compounds

Four PAHs (acenaphthene, fluoranthene, phenanthrene, and pyrene), di-n-butyl phthalate, and diphenylamine were detected in shallow sediment samples. Acenapthene, di-n-butyl phthalate, and diphenylamine exceeded the ecological COPC screening levels and were retained as COPCs. No SVOCs exceeded human health COPC screening levels even after consideration of possible negative

concentration biases. Diphenylamine was detected in samples 03SD070006, 03SD120006, and 03SD150006 at concentrations ranging from 96-µg/kg to 420 µg/kg. Di-n-butyl phthalate was detected in samples 03SD100006 and 03SD110006 at concentrations of 77 µg/kg and 590 µg/kg respectively. Acenaphthene was detected in sample 03SD180006 at a concentration of 25 µg/kg. The detections for these COPCs were highly localized and there is no pattern of spatial distribution. The SVOCs in shallow sediments were likely to have been deposited over time from past activities at OJT/LSC. Nevertheless, these chemicals represent minor OJT/LSC contaminants.

**Energetics**

Four energetics (2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2-amino-4,6-dinitrotoluene, and HMX) were detected in a select number of the 15 shallow sediment samples that were collected along the LSC. Figure 5-7 shows that 2,4-dinitrotoluene exceeds the ecological COPC screening level, while the other detected energetics were retained as COPCs because they have no ecological toxicity screening level. No energetics exceeded the human health COPC screening levels. The energetics are detected infrequently, 2,4,6-trinitrotoluene was detected in four samples (03SD070006, 03SD100006, 03SD110006, and 03SD130006) at concentrations ranging from 0.29 mg/kg to 0.69 mg/kg, HMX was detected in three samples (03SD070006, 03SD110006, and 03SD130006) at concentrations ranging from 1.1 mg/kg to 130 mg/kg, and 2,4-dinitrotoluene and 2-amino-4,6-dinitrotoluene were detected in one samples 03SD060006 and 03SD110006, respectively, at concentrations of 1.1 mg/kg and 0.37 mg/kg, respectively. The energetics in shallow sediments were most likely deposited from past activities from the ammunition burial ground and OJT. The maximum concentration of HMX occurs in sample 03SD110006 which is located approximately eighty feet down stream of the maximum surface soil HMX concentration located at boring 03SB24. This infers that explosives located in the surface soil are still being washed into Little Sulphur Creek.

**Pesticide and PCBs**

Figure 5-7 show that methoxychlor exceeded the ecological COPC screening level and was retained as a COPC. Methoxychlor was detected only in sample 03SD180006 at a concentration of 17 µg/kg. Methoxychlor was most likely deposited from topical spot applications associated with past activities at OJT.

**Herbicides**

Five herbicides (2,4,5-T, 2,4,5-TP, 2,4-D, dinoseb, and hexachlorophene) were detected in several of the shallow sediment samples (Figure 5-7). 2,4,5-T was detected in 4 samples at concentrations ranging

from 2.7 µg/kg to 4.8 µg/kg. 2,4,5-TP was detected in five samples at concentrations ranging from 2.4 µg/kg to 4.5 µg/kg. 2,4-D was detected in seven samples at concentrations ranging from 4.9 µg/kg to 20 µg/kg. Dinoseb was detected in three samples at concentrations ranging from 3.1 µg/kg to 8.2 µg/kg. Hexachlorophene was detected in one sample at a concentration of 3.5 µg/kg. In addition, pentachlorophenol results were rejected in three samples, 2,4-D results were rejected in six samples, and 2,4,5-TP and Dinoseb results were each rejected in one sample. Figure 5-7 shows that 2,4-D exceeds the ecological COPC screening level and was retained as a COPC. The 2,4-D concentrations from samples collected at the OJT/LSC are similar in concentration to the up-gradient samples collected at the ABG and were most likely deposited from topical spot applications associated with past activities at OJT. The presence of rejected data does not change this impression. Furthermore, the consistency of herbicide detections in various media suggests that the major herbicides contaminants have been detected.

**Metals**

Twenty-four metals were detected in the shallow sediment samples. Four of the detected metals (calcium, magnesium, potassium, and sodium) are considered to be essential nutrients and are not discussed any further. Figure 5-8 shows that concentrations of COPCs, aluminum, antimony, barium, and lead exceed human health and ecological COPC screening levels and that cadmium, copper, tin and zinc concentrations exceed ecological screening levels only. Twelve non-COPC metals were also detected in sediment samples at concentrations statistically determined to be similar to background concentrations.

- Aluminum, barium, cadmium, copper, lead, and zinc were detected in 15 of 15 samples at concentrations ranging from 4,590 mg/kg to 23,200 mg/kg, 91.6 mg/kg to 853 mg/kg, 0.37 mg/kg to 3.5 mg/kg, 8.1 mg/kg to 198 mg/kg, 13.3 mg/kg to 653 mg/kg, and 27.5 mg/kg to 385 mg/kg respectively.
- Antimony was detected in eight samples at concentrations ranging from 1.1 mg/kg to 7.6 mg/kg.
- Tin was detected in two samples at 4.4 mg/kg and 13.8 mg/kg, respectively.

The samples exhibiting metal concentrations that exceed COPC screening levels are scattered throughout the ABG and OJT/LSC and generally extend to the LSC downgradient sampling boundary near the NSWC Crane boundary. The maximum concentrations of three (aluminum, antimony, and copper) out of the eight metals occurred in sample 03SD150006. Tin was retained as an ecological COPC because its concentration exceeded the background concentration and an ecological COPC-screening level does not exist for it. They are detected infrequently at concentrations greater than background but only because they were not detected in the background samples. Antimony

concentrations exceeding COPC screening levels are bounded by sample 03SD160006 to the south, although the concept of bounding should not be taken too literally because localized areas of contamination appear to be the rule rather than the exception. Aluminum was detected in all samples except 03SD080006, 03SD090006, 03SD170006, 03SD190006, and 03SD140006 at concentrations greater than human health COPC screening levels. Barium and lead maximum concentrations were in samples 03SD050006 and 03SD060006, respectively, which are both located in the ABG. This suggests that the ABG is a source of barium and lead in the OJT sediments.

**Miscellaneous Parameters**

Nitrate was detected in 13 of 15 samples at concentrations ranging from 2.2 mg/kg to 8.4 mg/kg, with the maximum occurring in sample 03SD080006. Nitrite was detected in samples 03SD100006 and 03SD170006 at concentrations of 3.4 mg/kg and 3.5 mg/kg. Total organic carbon was detected in 14 of 15 samples at concentrations ranging from 4,600 mg/kg to 28,000 mg/kg. Perchlorate was not detected in any shallow sediment samples.

## 5.5 DEEP SEDIMENT

As shown in Table 2-2, 15 deep sediment samples were collected and analyzed for the analyte fractions marked in the table. Figure 1-7 displays the locations where deep sediment samples were collected. Figures 5-7 and 5-8 present a geographical depiction of organic and inorganic COPC concentrations in shallow and deep sediments. The same organic and inorganic constituents are plotted for both shallow and deep sediment samples although a particular analyte might be a COPC in only one of those media. This was done so the change in concentrations with sediment depth could be seen. Table 4-16 presents a summary of descriptive statistics for deep sediment detections, including ranges of detections, frequencies of detection, locations of maximum concentrations, comparisons to background concentrations, and human health risk assessment screening criteria. Appendix E contains a copy of the entire analytical database for OJT/LSC sediment samples. Deep sediment samples 03SD010612, 03SD020612, 03SD030612, and 03SD040612, which were collected in Little Sulphur Creek upgradient of the main treatment area in SWMU 03, were used as the upgradient shallow sediment samples for the OJT/LSC evaluation.

**Volatile Organic Compounds**

Six VOCs (1,1,1-trichloroethene, 2-butanone, acetone, carbon disulfide, toluene, and trichlorofluoromethane) were detected in the deep sediment samples. The first four chemicals in this list were also detected in shallow sediment. 1,1,1-Trichloroethene was detected in five deep sediment

samples at concentrations ranging from 1 µg/kg to 4 µg/kg. Acetone was detected in four samples at concentrations ranging from 29 µg/kg to 220 µg/kg. Carbon disulfide and 2-butanone were detected in three samples at concentrations ranging from 1 µg/kg to 1.1 µg/kg and 10 µg/kg to 60 µg/kg, respectively. Toluene and trichlorofluoromethane were detected in one sample at a concentration of 54 µg/kg and 2 µg/kg, respectively.

Similar to shallow sediment, no VOCs were retained as COPCs for deep sediment samples because none of the measured VOC concentrations exceeds its COPC screening level. Although VOCs were detected in some soil and ground water samples, the VOCs do not appear to have had a significant adverse impact on deep sediments.

**Semivolatile Organic Compounds**

Six PAHs (benzo(a)anthracene, benzo(b)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene) and di-n-butyl phthalate were detected in deep sediment samples, although only di-n-butylphthalate has been retained as a COPC. Figure 5-7 shows that the COPC, di-n-butyl phthalate, was detected in samples 03SD100612 and 03SD110612 at concentrations of 110 µg/kg and 880 µg/kg, respectively. All six PAHs were detected in sample 03SD160612 and benzo(b)fluoranthene was detected in sample 03SD180612, at concentrations ranging from 10 µg/kg to 27 µg/kg. The di-n-butyl phthalate in deep sediment samples mimics the shallow sediment samples in both location and concentration. The deep sediment PAH detections do not generally mimic the shallow sediment detections with regard to sampling location The PAHs and di-n-butyl phthalate are detected infrequently. At location 03SD16 the PAH concentrations were undetected in shallow sediment and the PAHs are unbounded in the vertical direction at that location only. Di-n-butyl phthalate is bounded by downgradient sample 03SD120612. Possible negative concentration biases for these compounds have little to no impact on this conclusion.

**Energetics**

Five energetics (2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX) were detected in the 15 deep sediment samples. Figure 5-7 shows that 2-amino-4,6-dinitrotoluene exceeds the ecological and human health COPC screening levels, while the other detected energetics were retained as COPCs because they have no ecological toxicity screening level. The energetics were detected infrequently, 2,4,6-Trinitrotoluene was detected in five samples at concentrations ranging from 0.35 µg/kg to 2.2 µg/kg. HMX was detected in four samples at concentrations ranging from 0.37 µg/kg to 19 µg/kg. RDX and 2-amino-4,6-dinitrotoluene were detected in two samples at concentrations of

0.73 µg/kg and 0.35 µg/kg, and 0.45 µg/kg and 0.45 µg/kg, respectively. 4-Amino-2,6-dinitrotoluene was detected in one sample (03SD120612) at a concentration of 0.4 µg/kg. Maximum detected concentrations occurred in samples 03SD110612 and 03SD120612. The maximum HMX value in shallow and deep sediment occurred at location 03SD11, indicating possible vertical migration through the sediment. The energetics in deep sediments were most likely deposited from past activities at the ammunition burial ground and OJT. RDX is the most widely distributed energetic contaminant with detectable concentrations as far south as Spring B.

**Pesticide and PCBs**

No pesticides or PCBs were detected in deep sediment samples at the OJT/LSC.

**Herbicides**

Six herbicides (2,4,5-T, 2,4,5-TP, 2,4-D, dinoseb, hexachlorophene, and pentachlorophenol) were detected in the deep sediment samples. All but pentachlorophenol were also detected in selected in shallow sediment samples. 2,4,5-T and 2,4-D were detected in five samples at concentrations ranging from 2.5 µg/kg to 4.5 µg/kg and 6.9 µg/kg to 28 µg/kg, respectively. The remaining detected herbicides were detected in two samples at concentrations ranging from 2.1 µg/kg to 7.6 µg/kg. Figure 5-7 shows that 2,4-D exceeds the ecological COPC screening level and was retained as a COPC. Herbicides in deep sediment samples were most likely deposited from surface water runoff washing soils into LSC. No herbicides were detected in deep sediments south of sampling location 03SWSD17. Thus the herbicides are bounded in the downgradient direction. Despite a negative concentration bias for herbicides, the consistency of herbicide detections in various media suggests that all major herbicide contaminants have been identified.

**Metals**

Twenty-four metals were detected in the deep sediment samples. Four of the detected metals (calcium, magnesium, potassium, and sodium) are considered to be essential nutrients and are not discussed any further. Figure 5-8 shows that concentrations of COPCs, aluminum, barium, cadmium, antimony, and lead exceeded human health and ecological COPC screening levels and that COPCs, copper, tin, and zinc concentrations exceed ecological screening levels only. Twelve non-COPC metals were also detected in sediment samples at concentrations statistically determined to be similar to background concentrations. Only the COPCs are discussed here.

- Aluminum, barium, copper, lead, and zinc were detected in 15 of 15 samples at concentrations ranging from 3,150 mg/kg to 56,900, 47.5 mg/kg to 981 mg/kg, 7.9 mg/kg to 273 mg/kg, 11.8 mg/kg to 445 mg/kg, 0.05 mg/kg to 0.12 mg/kg, and 21.4 mg/kg to 1,120 mg/kg respectively.
- Cadmium was detected in 14 of 15 samples at concentrations ranging from 0.39 mg/kg to 4 mg/kg.
- Antimony was detected in 8 of 15 samples at concentrations ranging from 0.85 mg/kg to 6.7 mg/kg.
- Tin was detected in 3 of 15 samples at concentrations ranging from 1.5 mg/kg to 4.1 mg/kg.

Tin was detected infrequently but was retained as an ecological COPC because the concentration exceeded background concentration and a COPC screening level does not exist for tin. The samples exhibiting metal concentrations that exceed COPC screening levels are scattered throughout the ABG and OJT/LSC and generally extend to the sampling boundaries. The maximum concentrations of six (aluminum, antimony, barium, copper, lead, and zinc) out of the eight COPC metals occurred in sample 03SD110612. This sample is located downstream of the OJT Burn Area and Burn Pit where most site activities are known or suspected to have taken place. Lead was detected in sample 03SD110612 at a concentration greater than U.S. EPA Region 9 PRG. Barium in samples O3SD110612 and 03SD120612 and cadmium in sample 03SD120612 were detected at concentrations greater than human health COPC screening levels, but they do not exceed the human health screening levels in other samples. It is possible that these metals could have been associated with incineration activities at either the ABG or OJT. The distribution of these metals in deep sediments is spotty. However, in the shallow sediments these metals are detected to the sampling boundaries. Lead was not detected at concentrations greater than U.S. EPA PRG downgradient of sample 03SD110612. Barium and cadmium are not detected at concentrations greater than human health screening levels downgradient of samples 03SD110612 and 03SD120612, respectively. The OJT supports vehicular traffic and several of the metals detected at the jeep trail (e.g., copper, iron, aluminum, lead, nickel, zinc) could be associated with traffic, disposal or burning of waste and other potential sources. These metals would then wash into the LSC in overland runoff, be deposited in combustion plumes, be blown by wind, etc.. Thus, with the observed spatial patterns of contamination, it is difficult to determine the origin of the detected metals, even those metals whose concentrations exceed COPC screening levels. The metals are generally scattered throughout the LSC sediments, and copper and lead concentrations exceed ecological COPC screening levels in the most down gradient shallow and deep sampling location (03SD19). Cadmium, copper, lead and zinc concentrations exceed ecological screening levels as far downgradient as sampling location 03SD18.

**Miscellaneous Parameters**

Nitrate was detected in 14 of 15 samples at concentrations ranging from 1.6 mg/kg to 6.5 mg/kg. Nitrite was detected in samples 03SD060612 and 03SD130612 at concentrations of 2.6 mg/kg and 2.7 mg/kg,

respectively. Total organic carbon was detected in 15 of 15 samples at concentrations ranging from 2,300 mg/kg to 34,000 mg/kg. No miscellaneous parameters were retained as COPCs.

## 5.6 LOW-FLOW SURFACE WATER

As shown in Table 2-2, six low-flow surface water samples were collected and analyzed for the analyte fractions marked in the table. Figure 1-7 displays the locations where low-flow surface water samples were collected. Figures 5-9 and 5-10 present a geographical depiction of organic and inorganic COPC concentrations in low-flow and high-flow surface water samples. The same organic and inorganic constituents are plotted for both low-flow and high-flow surface water samples although a particular analyte might be a COPC in only one of those media. This was done so changes in concentrations with flow rate could be seen. Table 4-17 presents a summary of descriptive statistics for low-flow surface water detections, including ranges of detections, frequencies of detection, locations of maximum concentrations, comparisons to background concentrations, and human health risk assessment screening criteria. Appendix E contains a copy of the entire analytical database for OJT/LSC surface water samples. The QAPP, Ammunition Burning Grounds, Little Sulphur Creek, and Jeep Trail, Phase III RCRA Facility Investigation (TtNUS, 2001b) indicated that 12 low-flow surface water samples would be collected at 12 locations; however, at the time of the field investigation all but six of these locations were dry. Therefore only six low-flow surface water samples were collected. Surface water samples 03SW0101, 03SW0201, and 03SW0301, which were collected in Little Sulphur Creek upgradient of the main treatment area in SWMU 03, were used as the upgradient surface water samples for the OJT/LSC evaluation.

### Volatile Organic Compounds

Figure 5-9 shows that three VOCs (bromomethane, 2-butanone, and trichloroethene) were detected in low-flow surface waters. The COPC, bromomethane, was detected in samples 03SW1501, 03SW1601, and 03SW1701 at concentrations ranging from 0.8 µg/L to 1.6 µg/L, which exceed the COPC screening level. The maximum concentration was observed in sample 03SW1701. Bromomethane is not detected downgradient of sample 03SW1701 and is therefore bounded. Trichloroethene, while not a COPC for low-flow surface water, was detected in sample 03SW1701 at 0.6 µg/L This chemical was selected as a COPC in ground water. Based on these data, it does not appear that ground water VOCs were contaminating surface water to any significant degree at the time of sampling

### Semivolatile Organic Compounds

No SVOCs were detected in OJT/LSC low-flow surface waters.

**Energetics**

Five energetics (2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX) were retained as COPCs in low-flow surface water samples. Figure 5-9 shows that RDX exceeds the R9TAP screening level, while the other detected energetics were retained as COPCs because they have no ecological toxicity screening level. These same chemicals were detected consistently in most of the other media investigated. HMX and RDX were detected in all six low-flow surface samples at concentrations ranging from 3.1 µg/L to 12 µg/L, and from 2.3 µg/L to 11 µg/L, respectively. 4-Amino-2,6-dinitrotoluene was detected in four samples at concentrations ranging from 0.54 µg/L to 1.7 µg/L. 2-Amino-4,6-dinitrotoluene was detected in two samples at concentrations of 0.75 µg/L and 0.37 µg/L, respectively. RDX, HMX, and 4-amino-4,6-dinitrotoluene were detected in sample 03SW1901, which is the most downgradient sample collected, and are therefore unbounded. 2,4,6-Trinitrotoluene and 2-amino-4,6-dinitrotoluene are not detected downgradient of sample 03SW1701 and are therefore bounded.

**Pesticide and PCBs**

No pesticides or PCBs were detected in low-flow surface water samples at the OJT/LSC.

**Herbicides**

2,4,5-T was detected in sample 03SW0601 at a concentration of 0.064 µg/L. Sample 03SW0601 is located at the ABG and the low concentration is consistent with topical applications of herbicides at the ABG. No herbicides were retained as COPCs in low-flow surface water samples. The existence of a negative concentration bias is believed to be inconsequential, especially considering the site history.

**Metals**

Seventeen metals were detected in the low-flow surface water samples. Four of the detected metals (calcium, magnesium, potassium, and sodium) are considered to be essential nutrients and are not discussed any further. Figure 5-10 shows that lead (total) exceeds the ecological and human health COPC screening level in sample 03SW0601, and iron (total) exceeds background and has no current screening level available.

The total metals maximum concentrations for aluminum, arsenic, barium, chromium, cobalt, copper, iron, lead, magnesium, vanadium, and nickel occurred in sample 03SW0601. Sample 03SW0601, located in

the ABG, also had the highest turbidity value (8.4 NTU) indicating that the high metals concentrations are associated with the high particulate matter concentrations. Lead (total) is bounded downgradient by sample 03SW0801, with respect to ecological and human health screening levels. Iron extends to the sampling boundaries and is therefore not bounded.

**Miscellaneous Parameters**

Total suspended solids were detected in samples 03SW0601 and 03SW1701 at concentrations of 20 mg/L and 9 mg/L, respectively. Sample 03SW0601 also had the maximum concentrations in 16 of the 17 metals detected for low-flow surface waters. This implies that suspended solids are a major contribution to the metals concentrations.

## 5.7 HIGH-FLOW SURFACE WATER

As shown in Table 2-2, eleven high-flow surface water samples were collected and analyzed for the analyte fractions marked in the table. Figure 1-7 displays the locations where high-flow surface water samples were collected. Figures 5-9 and 5-10 present a geographical depiction of organic and inorganic COPC concentrations in low-flow and high-flow surface water samples. The same organic and inorganic constituents are plotted for both low-flow and high-flow surface water samples although a particular analyte might be a COPC in only one of those media. This was done so changes in concentrations with flow rate could be seen. Table 4-17 presents a summary of descriptive statistics for high-flow surface water detections, including ranges of detections, frequencies of detection, locations of maximum concentrations, comparisons to background concentrations, and human health risk assessment screening criteria. Appendix E contains a copy of the entire analytical database for OJT/LSC surface water samples. The QAPP, Ammunition Burning Grounds, Little Sulphur Creek, and Jeep Trail, Phase III RCRA Facility Investigation (TtNUS, 2001b) indicated that 12 high-flow surface water samples would be collected at 12 locations; however, at the time of the field investigation one of these locations was dry. Therefore only eleven high-flow surface water samples were collected. Surface water samples 03SW0102, 03SW0202, and 03SW0302, which were collected in Little Sulphur Creek upgradient of the main treatment area in SWMU 03 were used as the upgradient surface water samples for the OJT/LSC evaluation of inorganic chemical concentrations.

**Volatile Organic Compounds**

Methylene chloride was detected in samples 03SW0802 and 03SW0902 at concentrations ranging from 9.5 µg/L to 13 µg/L, with the maximum occurring in sample 03SW0902. Acetone was detected in sample 03SW0902 at a concentration 64 µg/L. The methylene chloride and acetone detections were at

concentrations greater than human health COPC screening levels. Acetone and methylene chloride were not detected in any other downgradient samples and are therefore bounded. Because these two analytes are very volatile and are also common laboratory contaminants, it is questionable whether the observed concentrations reflect actual surface water contamination. It is suspected that the observed concentrations are laboratory artifacts. Although the available data are insufficient to demonstrate this.

**Semivolatile Organic Compounds**

Bis(2-ethylhexyl) phthalate was detected in samples 03SW0902 and 03SW1402 at concentrations of 4 µg/L and 6 µg/L, respectively. Acenaphthylene was detected in sample 03SW0902 at a concentration of 0.22 µg/L. The bis(2-ethylhexyl) phthalate concentration for sample 03SW1402 exceeds human health and ecological COPC screening levels. The acenaphthylene concentrations did not exceed screening levels. Bis(2-ethylhexyl) phthalate is not detected downgradient of sample 03SW1402 and is therefore bounded. Phthalates are considered to be a common environmental laboratory contaminant. The concentrations of bis(2-ethylhexyl) phthalate found in samples 03SW0902 and 03SW1402 are similar to those typically detected in laboratory method blanks. Thus the observed concentrations are suspected of being laboratory artifacts although the available data are insufficient to demonstrate this.

**Energetics**

Five energetics (2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, nitrocellulose, and RDX) were detected in the in the high-flow surface water samples. Figure 5-9 shows that RDX, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene exceed ecological and human health COPC screening levels, while the other detected energetics were retained as COPCs because they have no ecological toxicity screening level. HMX was detected in 10 of 11 high-flow surface samples at concentrations ranging from 1.1 µg/L to 90 µg/L. RDX was detected in 9 of 11 samples at concentrations ranging from 0.62 µg/L to 63 µg/L. 4-Amino-2,6-dinitrotoluene was detected in samples 03SW0602 and 03SW1702 at concentrations of 1.4 µg/L and 2.9 µg/L, respectively. 2-Amino-4,6-dinitrotoluene was detected in sample 03SW1702 at a concentration of 1.5 µg/L. Nitrocellulose was detected in sample 03SW1502 at a concentration of 3,200 µg/L. RDX and HMX were detected in sample 03SW1902, which is the most downgradient sample collected, and are therefore not bounded. 2-Amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene are bounded downgradient by sample 03SW1802. Nitrocellulose was detected only in sample 03SW1502 and is bounded in the downgradient direction.

**Pesticide and PCBs**

No pesticides or PCBs were detected in high-flow surface water samples at the OJT/LSC.

**Herbicides**

2,4,5-T was detected in three samples at concentrations ranging from 0.23 µg/L and 0.63 µg/L. 2,4-D was detected in samples 03SW0902 and 03SW1302 at concentrations of 0.36 µg/L and 0.28 µg/L, respectively. Pentachlorophenol was detected in sample 03SW1102 at a concentration of 0.71 µg/L. Pentachlorophenol exceeds the human health COPC screening level and 2,4-D was retained as a COPC because it has no ecological toxicity screening level. Pentachlorophenol and 2,4-D are bounded relative to COPC screening levels in the downgradient direction by samples 03SW1102 and 03SW1302, respectively. The observed concentrations are likely to be biased low for all herbicides but the consistency of herbicide detections in the various media suggests that the primary herbicide contaminants have been identified.

**Metals**

Twenty-one metals were detected in the high-flow 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. Figure 5-10 shows that antimony (total and dissolved) exceed human health COPC screening levels, lead exceeds the ecological and human health COPC screening level, and cadmium, copper, and zinc exceed the ecological COPC screening levels.

Antimony (total and dissolved) is not detected downgradient of 03SW1102 and is therefore bounded. Lead and zinc were not detected at concentrations greater than COPC toxicity screening levels downgradient of sample 03SW1102. Copper was not detected at concentrations greater than COPC toxicity screening levels downgradient of sample 03SW1402. The maximum total lead, copper, and zinc concentrations occurred in sample 03SW1102, collected upstream of the OJT Burn Area and Burn Pit. The maximum suspended solid concentrations also occurred in sample 03SW1102. There is an approximate five times difference in the filtered result compared to the total result for sample 03SW1102 indicting that suspended solids is contributing to the total lead result. The maximum suspended solids concentration is five times higher in the high-flow samples as compared to the low-flow samples indicating that the suspended solids is contributing to the total metals concentrations as shown by the higher number of COPCs in the high-flow samples. The location of the most highly concentration metals suggests that the ABG is a contributor of contamination to the LSC near the OJT Burn Area and Burn Pit.

**Miscellaneous Parameters**

Total suspended solids were measured in sample 03SW1102 at a concentration of 100 mg/L. Sample 03SW1102 also had the maximum concentrations in 9 of the 21 metals detected for high-flow surface waters. These data suggest that suspended solids are a major contribution to the metals concentrations.

## 5.8 SUMMARY

Chlorinated solvents (1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethene, tetrachloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride) were detected most frequently of the VOCs analyzed, and were detected in all media except high flow surface water samples. Trichloroethene was retained as a COPC in surface soils and 1,1,2,2-tetrachloroethane was retained as a COPC in subsurface soils. The chlorinated solvents as a group were most prevalent in ground water and the maximum concentrations occurred in well 03-07, which is located in the south central portion of the OJT/LSC. Chlorinated solvent concentrations decrease with distance from well 03-07 in the direction of ground water flow, which is northeasterly and southwesterly. Bromomethane was retained as a COPC for low-flow surface water samples. Bromomethane was not detected downgradient of sample 03SW1701, which is located within 1,000 feet of the southern boundary of NSWC Crane. Acetone and methylene chloride were retained as COPCs for high flow surface water samples. Acetone and methylene chloride were not detected down gradient of sample 03SW0902, which is located upstream of the OJT.

PAHs and phthalates were the non-energetic organic chemicals to be detected with the greatest frequency in the OJT/LSC media. Benzo(a)pyrene, benzo(b)fluoranthene, and acetophenone were retained as COPCs in subsurface soil. None of these three compounds were retained as a COPC in surface soil samples. Boring location 03SB18, located on the northwestern edge of the Burn Pit was the only location that had a PAH concentration greater than COPC screening levels. The PAHs were generally found at the greatest concentrations near the Burn Area and Burn Pit, suggesting that they are operationally related contaminants. Acetophenone was detected in borings 03SB22 and 03SB24 but not detected in borings 03SB19, 03SB21, or 03SB23, which bound acetophenone on three sides. Bis(2-ethylhexyl) phthalate was detected in sample 03SW1402 at a concentration greater than the MCL. However, the bis(2-ethylhexyl) phthalate concentration of 6 µg/L is similar to concentrations typically found in laboratory method blanks and is therefore suspected not to be an operational contaminant. Various sources could have contributed to the observed PAH and other SVOC concentrations, including site operations (burning of explosives and other materials), vehicular traffic, aerial deposition, local fires,

etc.. Nevertheless, these chemical are considered to be operationally related site contamination in the absence of data showing otherwise.

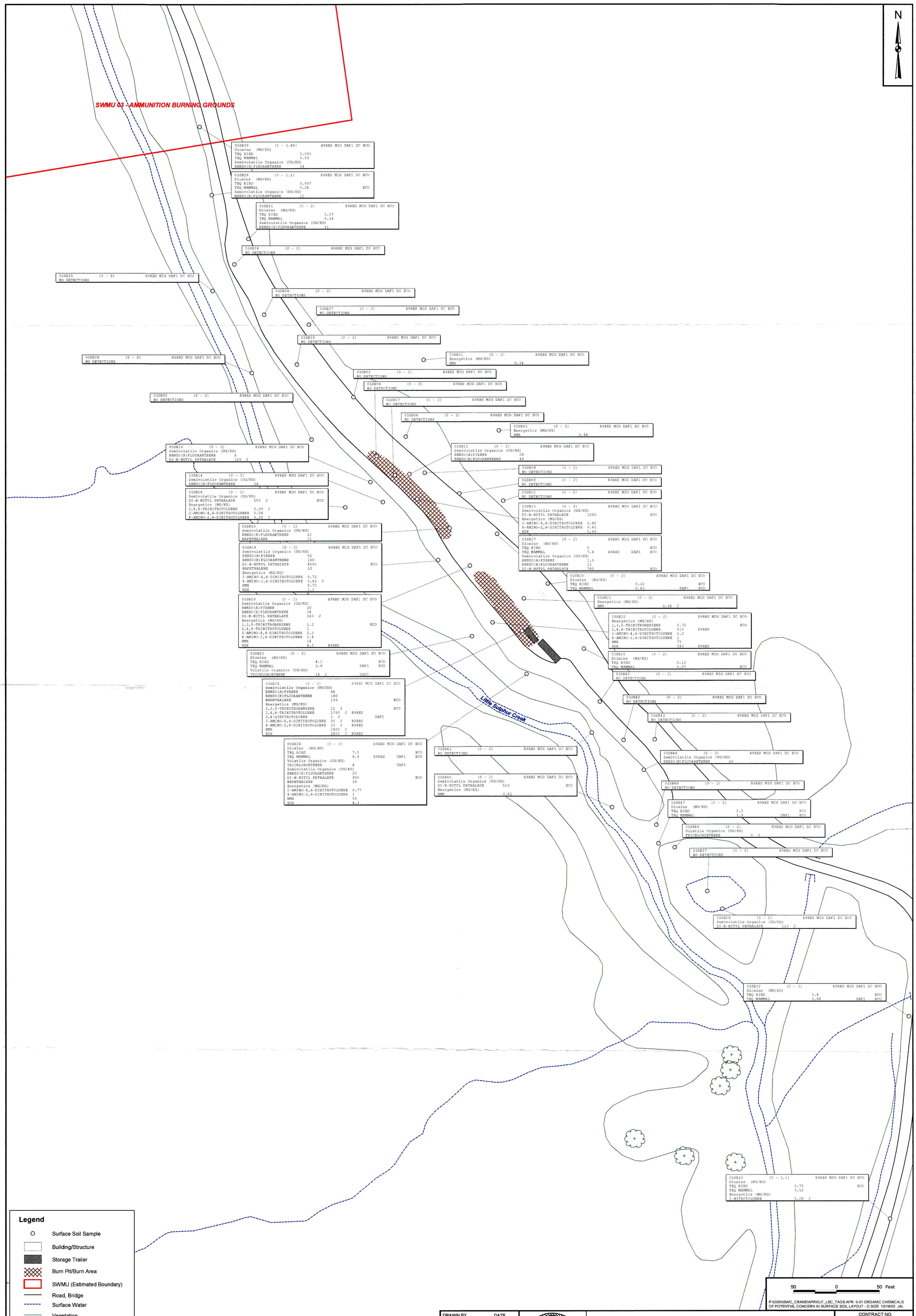
The energetics (1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 2-nitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX) were widely detected in the OJT / LSC media, primarily near the Burn Pit and Burn Area. As a group, these chemicals are the most prevalent operationally related contaminants at the OJT, although there are indications that some of the ground water, sediment, and surface water energetics contamination is originating at the ABG. RDX, HMX, 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, 2-nitrotoluene, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene were retained as COPCs in surface soil samples. All energetic concentrations that exceed COPC screening levels were found within 30 feet of soil boring 03SB24, located at the southeastern end of the Burn Pit. Of all soil sampling locations, soil boring 03SB24 had the greatest concentrations of energetics. The energetics are bounded on the north, east, and south of this boring by non-detects or concentrations less than COPC screening levels. RDX, 2,4-dinitrotoluene, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene were retained as COPCs in the subsurface soil samples. The energetics concentrations and frequencies of detection in subsurface samples are less than in surface samples. The majority of locations where detections occur in subsurface samples are within the same footprint as the surface samples. Furthermore, the concentrations tend to decrease in a vertical direction with soil depth. RDX, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene were retained as COPCs in ground water. Ground water concentrations of RDX exceeding the COPC screening level generally extend to the OJT/LSC site boundary, thus this chemical is unbounded. However, the RDX concentrations decrease from the north to the south, which is the general direction of ground water flow, indicating that the main source of contamination is upgradient of the OJT. Well 03-16, upgradient of the OJT and located between the ABG and OJT, had 24 µg/L RDX and 1.3 µg/L HMX, indicating that the ABG is a likely contributor to the ground water contamination at OJT. The energetics, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene are not detected in the most southerly, easterly, or westerly wells at OJT/LSC indicating that these energetics are bounded in three directions. 2-Amino-4,6-dinitrophenol was retained as a COPC in the deep sediment samples and was not detected south of location 03SWSD12. RDX, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene were retained as COPCs in low-flow surface water samples. RDX and 4-amino-2,6-dinitrotoluene were detected in sample 03SW1901, which is the most downgradient sample collected, and therefore are not bounded. 2-Amino-4,6-dinitrotoluene is not detected downgradient of sample 03SW1701. RDX, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene were retained as COPCs in high-flow surface water samples. RDX was detected in sample 03SW1902, which is the most downgradient sample collected, and therefore is not bounded. 2-Amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene are not detected downgradient of sample 03SW1701.

All seventeen individual isomers for polychlorinated PCDDs and PCDFs and six total PCDDs and PCDFs (total HPCDD, total HPCDF, total HXCDD, total HXCDF, total PECDD, and total TCDD) were detected in the OJT / LSC surface and subsurface soils. 1,2,3,4,6,7,8,9-OCDD, 1,2,3,4,6,7,8,9-OCDF, 1,2,3,4,6,7,8-HPCDD, 1,2,3,4,7,8-HXCDD, 1,2,3,6,7,8,-HXCDD, 1,2,3,7,8,9-HXCDD, 1,2,3,7,8,-PECDD, 2,3,7,8-TCDD, total-HPCDD, total-HPCDF, total-HXCDD, total-HXCDF, total-PECDD, total-TCDD, 2,3,7,8-TCDD TEQ (bird and mammal) were retained as COPCs in surface soil samples. Sample 03SS170002 contained the greatest concentrations of PCDDs and PCDFs. Based on contaminant patterns, most PCDDs and PCDFs are contained around the perimeter of the Burn Pit, and could be attributable to the combustion of chlorinated-solvent-soaked rags or other chlorinated fuels. It is logical to expect that the PCDDs and PCDFs were dispersed by wind because concentrations and TEQs generally decrease with distance from the Burn Area. Three individual isomers (1,2,3,4,6,7,8,9-OCDD, 1,2,3,4,6,7,8-HPCDD, and 2,3,7,8-TCDD TEQ (mammal) were retained as COPCs in subsurface soils. The dioxin results in subsurface samples are lower in concentration and number of compounds detected as compared to the surface sample results. This indicates that dioxins are bounded in the vertical direction, although it is acknowledged only two subsurface soil samples were analyzed for dioxins and furans. These compounds were only analyzed in soil borings 03SB19 and 03SB24 so the extent of contamination cannot be determined. It is not expected that these contaminants represent a significant contamination source at the OJT/LSC.

Pesticide/PCBs were not analyzed in subsurface soils or ground water. No pesticide/PCBs were detected in surface soil or deep sediment samples, indicating that these chemicals are not site-related contaminants. Methoxychlor was detected in shallow sediment sample 03SD18006 and this pesticide may have been deposited from topical spot applications associated with past activities at OJT. Methoxychlor was the only pesticide retained as a COPC in any media at OJT/LSC. The vertical and horizontal extent of methoxychlor contamination is localized to the shallow sediment at sampling location 03SD18 and does represent a significant contamination source.

Six herbicides (2,4,5-T, dinoseb, 2,4-D, 2,4,5-TP, hexachlorophene, pentachlorophenol) were detected in OJT/LSC media. 2,4-D was retained as a COPC in shallow and deep sediment samples. The 2,4-D concentrations in sediments are similar to upgradient sediment concentrations and may have been deposited from surface soil washing into LSC. Pentachlorophenol and 2,4-D were retained as COPCs in high-flow surface water samples. Pentachlorophenol and 2,4-D were not detected downgradient of samples 03SW1102 and 03SW1302, respectively and are therefore bounded.

Twenty-four out of a list of 27 metals were detected in OJT/LSC media. Barium, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, and zinc were retained as COPCs in surface soil samples. Barium, cadmium, cobalt, copper, iron, lead, manganese, nickel, silver, and zinc were retained as COPCs in subsurface soil samples. Aluminum, barium, cadmium, chromium, iron, manganese, nickel, and thallium were retained as COPCs in ground water samples. Aluminum, antimony, barium, cadmium, copper, lead, tin, and zinc were retained as COPCs in shallow sediment samples. Aluminum, antimony, barium, cadmium, copper, lead, tin, and zinc were retained as COPCs in deep sediment samples. Lead and iron were retained as COPCs in low-flow surface water samples. Antimony (total and dissolved), lead, cadmium, copper, and zinc were retained as COPCs in high-flow surface water samples. Metals were retained as COPCs in all media at OJT/LSC and were detected in greatest frequency in surface and subsurface soils in the area of the Burn Area and Burn Pit. Soil borings 03SB24 and 03SB48, in particular, showed the greatest metal concentrations. These locations of relatively high metal concentrations appear to represent small, contaminated areas that should have little effect on receptor exposures.


N
SWMU 03 - AMMUNITION BURNING GROUNDS
03SB30 (0 - 1.65) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 0.091
TEQ MAMMAL 0.18
Semivolatile Organics (UG/KG)
BENZO(B)FLUORANTHENE 14
03SB29 (0 - 1.1) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 0.087
TEQ MAMMAL 0.24 ECO
Semivolatile Organics (UG/KG)
BENZO(B)FLUORANTHENE 12
03SB31 (0 - 2) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 0.07
TEQ MAMMAL 0.14
Semivolatile Organics (UG/KG)
BENZO(B)FLUORANTHENE 11
03SB34 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB35 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB36 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB37 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB39 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB38 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB01 (0 - 2) R9RES MIG DAF1 DC ECO
Energetics (MG/KG)
HMX 0.34
03SB02 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB06 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB05 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB07 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB04 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB03 (0 - 2) R9RES MIG DAF1 DC ECO
Energetics (MG/KG)
HMX 0.44
03SB10 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
BENZO(B)FLUORANTHENE 9
DI-N-BUTYL PHTHALATE 120 J
03SB11 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
BENZO(A)PYRENE 28
BENZO(B)FLUORANTHENE 49
03SB08 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB14 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
BENZO(B)FLUORANTHENE 14
03SB09 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB12 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB16 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
DI-N-BUTYL PHTHALATE 150 J ECO
Energetics (MG/KG)
2,4,6-TRINITROTOLUENE 0.39 J
2-AMINO-4,6-DINITROTOLUENE 0.56
4-AMINO-2,6-DINITROTOLUENE 0.35 J
03SB13 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
DI-N-BUTYL PHTHALATE 1200 ECO
Energetics (MG/KG)
2-AMINO-4,6-DINITROTOLUENE 0.82
4-AMINO-2,6-DINITROTOLUENE 0.63
RDX 0.93
03SB15 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
BENZO(B)FLUORANTHENE 12
NAPHTHALENE 11
03SB17 (0 - 2) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 5 ECO
TEQ MAMMAL 7.4 R9RES DAF1 ECO
Semivolatile Organics (UG/KG)
BENZO(A)PYRENE 1.5
BENZO(B)FLUORANTHENE 11
DI-N-BUTYL PHTHALATE 760 ECO
03SB18 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
BENZO(A)PYRENE 52
BENZO(B)FLUORANTHENE 160
DI-N-BUTYL PHTHALATE 4500 ECO
NAPHTHALENE 33
Energetics (MG/KG)
2-AMINO-4,6-DINITROTOLUENE 0.72
4-AMINO-2,6-DINITROTOLUENE 0.43 J
HMX 0.72
RDX 1.2
03SB20 (0 - 2) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 0.32 ECO
TEQ MAMMAL 0.43 DAF1 ECO
03SB21 (0 - 2) R9RES MIG DAF1 DC ECO
Energetics (MG/KG)
HMX 0.36 J
03SB19 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
BENZO(A)PYRENE 10
BENZO(B)FLUORANTHENE 24
DI-N-BUTYL PHTHALATE 140 J
Energetics (MG/KG)
1,3,5-TRINITROBENZENE 1.2 ECO
2,4,6-TRINITROTOLUENE 2
2-AMINO-4,6-DINITROTOLUENE 2.3
4-AMINO-2,6-DINITROTOLUENE 1.4
HMX 14
RDX 6.2 R9RES
03SB22 (0 - 2) R9RES MIG DAF1 DC ECO
Energetics (MG/KG)
1,3,5-TRINITROBENZENE 0.72 ECO
2,4,6-TRINITROTOLUENE 510 R9RES
2-AMINO-4,6-DINITROTOLUENE 1.2
4-AMINO-2,6-DINITROTOLUENE 2
HMX 77
RDX 140 R9RES
03SB23 (0 - 2) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 4.1 ECO
TEQ MAMMAL 3.8 DAF1 ECO
Volatile Organics (UG/KG)
TRICHLOROETHENE 14 J DAF1
03SB25 (0 - 2) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 0.13
TEQ MAMMAL 0.27 ECO
03SB40 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB24 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
BENZO(A)PYRENE 54
BENZO(B)FLUORANTHENE 160
NAPHTHALENE 130 ECO
Energetics (MG/KG)
1,3,5-TRINITROBENZENE 11 J ECO
2,4,6-TRINITROTOLUENE 1700 J R9RES
2,4-DINITROTOLUENE 1 J DAF1
2-AMINO-4,6-DINITROTOLUENE 30 J R9RES
4-AMINO-2,6-DINITROTOLUENE 15 J R9RES
HMX 1600 J
RDX 2400 J R9RES
03SB42 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB43 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
Little Sulphur Creek
03SB26 (0 - 2) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 7.5 ECO
TEQ MAMMAL 6.9 R9RES DAF1 ECO
Volatile Organics (UG/KG)
TRICHLOROETHENE 4 DAF1
Semivolatile Organics (UG/KG)
BENZO(B)FLUORANTHENE 20
DI-N-BUTYL PHTHALATE 980 ECO
NAPHTHALENE 19
Energetics (MG/KG)
2-AMINO-4,6-DINITROTOLUENE 0.77
4-AMINO-2,6-DINITROTOLUENE 1
HMX 58
RDX 4.3
03SB41 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB44 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
BENZO(B)FLUORANTHENE 30
03SB45 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
DI-N-BUTYL PHTHALATE 510 ECO
Energetics (MG/KG)
HMX 0.51
03SB46 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB47 (0 - 2) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 2.5 ECO
TEQ MAMMAL 1.9 DAF1 ECO
03SB48 (0 - 2) R9RES MIG DAF1 DC ECO
Volatile Organics (UG/KG)
TRICHLOROETHENE 3 J
03SB27 (0 - 2) R9RES MIG DAF1 DC ECO
NO DETECTIONS
03SB28 (0 - 2) R9RES MIG DAF1 DC ECO
Semivolatile Organics (UG/KG)
DI-N-BUTYL PHTHALATE 110 J
03SB32 (0 - 2) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 0.6 ECO
TEQ MAMMAL 0.68 DAF1 ECO
03SB33 (0 - 1.1) R9RES MIG DAF1 DC ECO
Dioxins (NG/KG)
TEQ BIRD 0.75 ECO
TEQ MAMMAL 0.12
Energetics (MG/KG)
2-NITROTOLUENE 0.28 J
Legend
Surface Soil Sample
Building/Structure
Storage Trailer
Burn Pit/Burn Area
SWMU (Estimated Boundary)
Road, Bridge
Surface Water
Vegetation
Miscellaneous
R9RES = EPA Region 9 Residential Preliminary Remediation Goal.
DC = IDEM Tier 1 Direct Contact Values.
MIG = IDEM Tier 1 Migration to Ground Water Values.
DAF1 = U.S. EPA SSL Migration to Ground Water DAF of 1.
ECO = EPA Region 5 Ecological Data Quality Level.
50 0 50 Feet
P:\GIS\NSWC_CRANE\APR\OJT_LSC_TAGS.APR 5-01 ORGANIC CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL LAYOUT - D SIZE 10/16/03 JAL
DRAWN BY A. JANOCHA DATE 6/13/02
CHECKED BY J. GOERDT DATE 11/11/02
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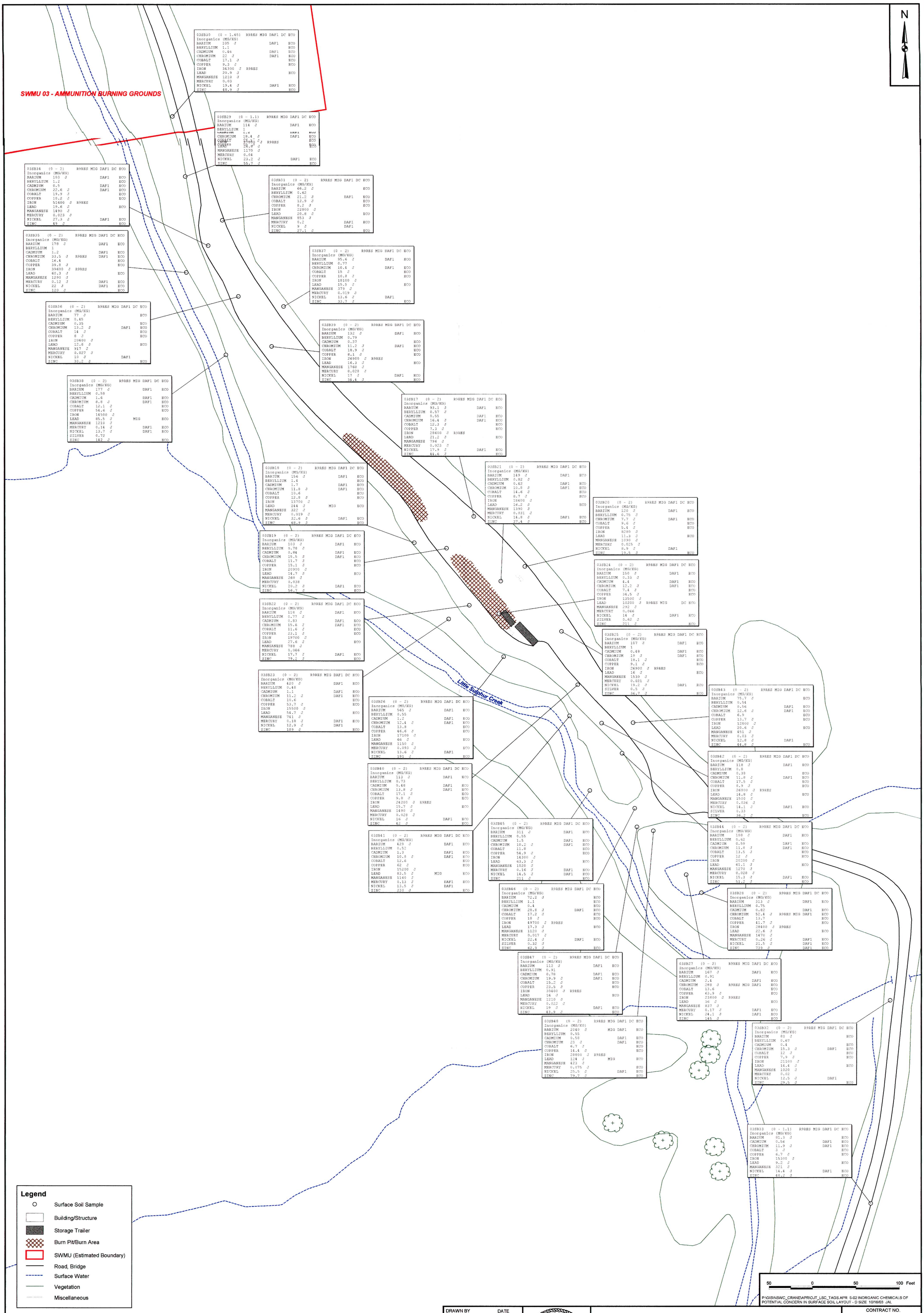
SCALE AS NOTED
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
ORGANIC CHEMICALS OF POTENTIAL CONCERN
IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHURS CREEK
NSWC CRANE
CRANE, INDIANA
CONTRACT NO. 3960
OWNER NO. CTO 159
APPROVED BY T. JOHNSTON DATE 11/12/02
DRAWING NO. FIGURE 5-1
REV. 0




03SB30 (0 - 1.65) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 105 J | | DAF1 | ECO |
| BERYLLIUM | 1.1 | | | ECO |
| CADMIUM | 0.46 | | DAF1 | ECO |
| CHROMIUM | 22 J | | DAF1 | ECO |
| COBALT | 17.1 J | | | ECO |
| COPPER | 9.3 J | | | ECO |
| IRON | 34300 J | R9RES | | |
| LEAD | 20.9 J | | | ECO |
| MANGANESE | 1210 J | | | |
| MERCURY | 0.03 | | | |
| NICKEL | 19.4 J | | DAF1 | ECO |
| ZINC | 48.9 J | | | ECO |

03SB29 (0 - 1.1) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 114 J | | DAF1 | ECO |
| BERYLLIUM | 1 | | | |
| CADMIUM | 1.6 | | DAF1 | ECO |
| CHROMIUM | 18.4 J | | DAF1 | ECO |
| COBALT | 14.3 J | | | ECO |
| COPPER | 17600 J | R9RES | | ECO |
| LEAD | 26.8 J | | | ECO |
| MANGANESE | 1170 J | | | |
| MERCURY | 0.04 | | | |
| NICKEL | 23.2 J | | DAF1 | ECO |
| ZINC | 55.7 J | | | ECO |

03SB34 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 103 J | | DAF1 | ECO |
| BERYLLIUM | 1.2 | | | ECO |
| CADMIUM | 0.5 | | DAF1 | ECO |
| CHROMIUM | 22.6 J | | DAF1 | ECO |
| COBALT | 19.9 J | | | ECO |
| COPPER | 10.2 J | | | ECO |
| IRON | 51600 J | R9RES | | |
| LEAD | 19.6 J | | | ECO |
| MANGANESE | 1490 J | | | |
| MERCURY | 0.023 J | | | |
| NICKEL | 27.3 J | | DAF1 | ECO |
| ZINC | 49 J | | | ECO |

03SB31 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 66.2 J | | | ECO |
| BERYLLIUM | 0.62 | | | |
| CHROMIUM | 21.2 J | | DAF1 | ECO |
| COBALT | 12.9 J | | | ECO |
| COPPER | 8.2 J | | | ECO |
| IRON | 22800 J | | | |
| LEAD | 20.8 J | | | ECO |
| MANGANESE | 853 J | | | |
| MERCURY | 0.2 | | DAF1 | ECO |
| NICKEL | 9 J | | DAF1 | |
| ZINC | 27.1 J | | | ECO |

03SB35 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 178 J | | DAF1 | ECO |
| BERYLLIUM | 1 | | | |
| CADMIUM | 1.2 | | DAF1 | ECO |
| CHROMIUM | 33.5 J | R9RES | DAF1 | ECO |
| COBALT | 16.4 | | | ECO |
| COPPER | 39.8 J | | | ECO |
| IRON | 39600 J | R9RES | | |
| LEAD | 60.3 J | | | ECO |
| MANGANESE | 1290 J | | | |
| MERCURY | 0.12 J | | DAF1 | ECO |
| NICKEL | 22 J | | DAF1 | ECO |
| ZINC | 120 J | | | ECO |

03SB37 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 95.6 J | | DAF1 | ECO |
| BERYLLIUM | 0.77 | | | |
| CHROMIUM | 10.4 J | | DAF1 | ECO |
| COBALT | 15 J | | | ECO |
| COPPER | 10.8 J | | | ECO |
| IRON | 18100 J | | | |
| LEAD | 15.5 J | | | ECO |
| MANGANESE | 379 J | | | |
| MERCURY | 0.019 J | | | |
| NICKEL | 13.6 J | | DAF1 | |
| ZINC | 33.7 J | | | ECO |

03SB36 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 77 J | | | ECO |
| BERYLLIUM | 0.45 | | | |
| CADMIUM | 0.35 | | | ECO |
| CHROMIUM | 13.2 J | | DAF1 | ECO |
| COBALT | 14 J | | | ECO |
| COPPER | 8 J | | | ECO |
| IRON | 20600 J | | | |
| LEAD | 12.8 J | | | ECO |
| MANGANESE | 917 J | | | |
| MERCURY | 0.027 J | | | |
| NICKEL | 10 J | | DAF1 | |
| ZINC | 30.2 J | | | ECO |

03SB39 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 132 J | | DAF1 | ECO |
| BERYLLIUM | 0.79 | | | |
| CADMIUM | 0.37 | | | ECO |
| CHROMIUM | 11.2 J | | DAF1 | ECO |
| COBALT | 18.9 J | | | ECO |
| COPPER | 8.1 J | | | ECO |
| IRON | 26900 J | R9RES | | |
| LEAD | 16.3 J | | | ECO |
| MANGANESE | 1760 J | | | |
| MERCURY | 0.028 J | | | |
| NICKEL | 17 J | | DAF1 | ECO |
| ZINC | 34.4 J | | | ECO |

03SB38 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 177 J | | DAF1 | ECO |
| BERYLLIUM | 0.58 | | | |
| CADMIUM | 1.6 | | DAF1 | ECO |
| CHROMIUM | 8.8 J | | DAF1 | ECO |
| COBALT | 12.1 J | | | ECO |
| COPPER | 54.6 J | | | ECO |
| IRON | 14500 J | | | |
| LEAD | 85.5 J | MIG | | ECO |
| MANGANESE | 1210 J | | | |
| MERCURY | 0.14 J | | DAF1 | ECO |
| NICKEL | 13.7 J | | DAF1 | ECO |
| SILVER | 0.72 | | | |
| ZINC | 142 J | | | ECO |

03SB17 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 93.1 J | | DAF1 | ECO |
| BERYLLIUM | 0.57 J | | | |
| CADMIUM | 0.55 | | DAF1 | ECO |
| CHROMIUM | 16.4 J | | DAF1 | ECO |
| COBALT | 12.3 J | | | ECO |
| COPPER | 7.3 J | | | ECO |
| IRON | 28600 J | R9RES | | |
| LEAD | 21.2 J | | | ECO |
| MANGANESE | 796 J | | | |
| MERCURY | 0.023 J | | | |
| NICKEL | 17.9 J | | DAF1 | ECO |
| ZINC | 44.6 J | | | ECO |

03SB18 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 156 J | | DAF1 | ECO |
| BERYLLIUM | 1.4 | | | ECO |
| CADMIUM | 1.7 | | DAF1 | ECO |
| CHROMIUM | 11.8 J | | DAF1 | ECO |
| COBALT | 10.6 | | | ECO |
| COPPER | 12.8 J | | | ECO |
| IRON | 13700 J | | | |
| LEAD | 244 J | MIG | | ECO |
| MANGANESE | 322 J | | | |
| MERCURY | 0.019 J | | | |
| NICKEL | 32.6 J | | DAF1 | ECO |
| ZINC | 68.9 J | | | ECO |

03SB21 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 149 J | | DAF1 | ECO |
| BERYLLIUM | 0.82 J | | | |
| CADMIUM | 0.42 | | DAF1 | ECO |
| CHROMIUM | 10.8 J | | DAF1 | ECO |
| COBALT | 14.6 J | | | ECO |
| COPPER | 8.7 J | | | ECO |
| IRON | 18600 J | | | |
| LEAD | 16.2 J | | | ECO |
| MANGANESE | 1390 J | | | |
| MERCURY | 0.031 J | | | |
| NICKEL | 14.8 J | | DAF1 | ECO |
| ZINC | 37.4 J | | | ECO |

03SB20 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 120 J | | DAF1 | ECO |
| BERYLLIUM | 0.75 J | | | |
| CHROMIUM | 7.7 J | | DAF1 | ECO |
| COBALT | 9.6 J | | | ECO |
| COPPER | 5.4 J | | | ECO |
| IRON | 8280 J | | | |
| LEAD | 11.3 J | | | ECO |
| MANGANESE | 1090 J | | | |
| MERCURY | 0.025 J | | | |
| NICKEL | 8.9 J | | DAF1 | |
| ZINC | 19.5 J | | | ECO |

03SB19 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 103 J | | DAF1 | ECO |
| BERYLLIUM | 0.78 J | | | |
| CADMIUM | 0.84 | | DAF1 | ECO |
| CHROMIUM | 15.5 J | | DAF1 | ECO |
| COBALT | 11.7 J | | | ECO |
| COPPER | 15.1 J | | | ECO |
| IRON | 20900 J | | | |
| LEAD | 14.7 J | | | ECO |
| MANGANESE | 260 J | | | |
| MERCURY | 0.038 | | | |
| NICKEL | 20.2 J | | DAF1 | ECO |
| ZINC | 56.7 J | | | ECO |

03SB24 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 150 J | | DAF1 | ECO |
| BERYLLIUM | 0.33 J | | | |
| CADMIUM | 4.4 | | DAF1 | ECO |
| CHROMIUM | 12.2 J | | DAF1 | ECO |
| COBALT | 7.4 J | | | ECO |
| COPPER | 34.5 J | | | ECO |
| IRON | 13500 J | | | |
| LEAD | 10200 J | R9RES MIG | | DC ECO |
| MANGANESE | 292 J | | | |
| MERCURY | 0.066 | | | |
| NICKEL | 14 J | | DAF1 | ECO |
| SILVER | 0.62 J | | | |
| ZINC | 211 J | | | ECO |

03SB22 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 118 J | | DAF1 | ECO |
| BERYLLIUM | 0.77 J | | | |
| CADMIUM | 0.83 | | DAF1 | ECO |
| CHROMIUM | 15.6 J | | DAF1 | ECO |
| COBALT | 11.6 J | | | ECO |
| COPPER | 23.1 J | | | ECO |
| IRON | 19700 J | | | |
| LEAD | 27.6 J | | | ECO |
| MANGANESE | 788 J | | | |
| MERCURY | 0.046 | | | |
| NICKEL | 17.7 J | | DAF1 | ECO |
| ZINC | 79.2 J | | | ECO |

03SB25 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 107 J | | DAF1 | ECO |
| BERYLLIUM | 1 | | | |
| CADMIUM | 0.48 | | DAF1 | ECO |
| CHROMIUM | 19 J | | DAF1 | ECO |
| COBALT | 18.1 J | | | ECO |
| COPPER | 9.1 J | | | ECO |
| IRON | 26900 J | R9RES | | |
| LEAD | 16 J | | | ECO |
| MANGANESE | 1530 J | | | |
| MERCURY | 0.021 J | | | |
| NICKEL | 19.2 J | | DAF1 | ECO |
| SILVER | 0.5 J | | | |
| ZINC | 36.7 J | | | ECO |

03SB23 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 420 J | | DAF1 | ECO |
| BERYLLIUM | 0.48 | | | |
| CADMIUM | 1.1 | | DAF1 | ECO |
| CHROMIUM | 11.2 J | | DAF1 | ECO |
| COBALT | 10.6 | | | ECO |
| COPPER | 53.7 J | | | ECO |
| IRON | 15500 J | | | |
| LEAD | 54.7 J | | | ECO |
| MANGANESE | 741 J | | | |
| MERCURY | 0.18 J | | DAF1 | ECO |
| NICKEL | 12.9 J | | DAF1 | |
| ZINC | 189 J | | | ECO |

03SB26 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 565 J | | DAF1 | ECO |
| BERYLLIUM | 0.55 | | | |
| CADMIUM | 1.2 | | DAF1 | ECO |
| CHROMIUM | 12.4 J | | DAF1 | ECO |
| COBALT | 13.8 | | | ECO |
| COPPER | 46.6 J | | | ECO |
| IRON | 17100 J | | | |
| LEAD | 66 J | | | ECO |
| MANGANESE | 1150 J | | | |
| MERCURY | 0.093 J | | | ECO |
| NICKEL | 13.6 J | | DAF1 | |
| ZINC | 191 J | | | ECO |

03SB43 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 75.7 J | | | ECO |
| BERYLLIUM | 0.54 | | | |
| CADMIUM | 0.56 | | DAF1 | ECO |
| CHROMIUM | 12.6 J | | DAF1 | ECO |
| COBALT | 6.9 | | | ECO |
| COPPER | 13.7 J | | | ECO |
| IRON | 12800 J | | | |
| LEAD | 20.6 J | | | ECO |
| MANGANESE | 451 J | | | |
| MERCURY | 0.03 J | | | |
| NICKEL | 12.8 J | | DAF1 | |
| ZINC | 44.8 J | | | ECO |

03SB40 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 113 J | | DAF1 | ECO |
| BERYLLIUM | 0.73 | | | |
| CADMIUM | 0.48 | | DAF1 | ECO |
| CHROMIUM | 13.8 J | | DAF1 | ECO |
| COBALT | 17.1 J | | | ECO |
| COPPER | 9.8 J | | | ECO |
| IRON | 24200 J | R9RES | | |
| LEAD | 15.7 J | | | ECO |
| MANGANESE | 1490 J | | | |
| MERCURY | 0.028 J | | | |
| NICKEL | 16 J | | DAF1 | ECO |
| ZINC | 42 J | | | ECO |

03SB42 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 118 J | | DAF1 | ECO |
| BERYLLIUM | 0.8 | | | |
| CADMIUM | 0.38 | | | ECO |
| CHROMIUM | 11.8 J | | DAF1 | ECO |
| COBALT | 17.5 J | | | ECO |
| COPPER | 8.9 J | | | ECO |
| IRON | 26800 J | R9RES | | |
| LEAD | 14.8 J | | | ECO |
| MANGANESE | 1500 J | | | |
| MERCURY | 0.026 J | | | |
| NICKEL | 14.1 J | | DAF1 | ECO |
| SILVER | 0.33 | | | |
| ZINC | 36.2 J | | | ECO |

03SB41 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 429 J | | DAF1 | ECO |
| BERYLLIUM | 0.52 | | | |
| CADMIUM | 1.3 | | DAF1 | ECO |
| CHROMIUM | 10.8 J | | DAF1 | ECO |
| COBALT | 12.6 | | | ECO |
| COPPER | 62 J | | | ECO |
| IRON | 15200 J | | | |
| LEAD | 83.5 J | MIG | | ECO |
| MANGANESE | 1160 J | | | |
| MERCURY | 0.13 J | | DAF1 | ECO |
| NICKEL | 13.5 J | | DAF1 | |
| ZINC | 230 J | | | ECO |

03SB45 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 311 J | | DAF1 | ECO |
| BERYLLIUM | 0.55 | | | |
| CADMIUM | 1.5 | | DAF1 | ECO |
| CHROMIUM | 10.2 J | | DAF1 | ECO |
| COBALT | 11.8 | | | ECO |
| COPPER | 54.9 J | | | ECO |
| IRON | 14300 J | | | |
| LEAD | 63.3 J | | | ECO |
| MANGANESE | 1020 J | | | |
| MERCURY | 0.16 J | | DAF1 | ECO |
| NICKEL | 14.5 J | | DAF1 | ECO |
| ZINC | 211 J | | | ECO |

03SB44 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 108 J | | DAF1 | ECO |
| BERYLLIUM | 0.62 | | | |
| CADMIUM | 0.59 | | DAF1 | ECO |
| CHROMIUM | 11.8 J | | DAF1 | ECO |
| COBALT | 13.5 J | | | ECO |
| COPPER | 12 J | | | ECO |
| IRON | 20200 J | | | |
| LEAD | 61.1 J | | | ECO |
| MANGANESE | 1270 J | | | |
| MERCURY | 0.028 J | | | |
| NICKEL | 15.3 J | | DAF1 | ECO |
| ZINC | 51.2 J | | | ECO |

03SB46 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 72.2 J | | | ECO |
| BERYLLIUM | 1.1 | | | ECO |
| CADMIUM | 0.4 | | | ECO |
| CHROMIUM | 28.8 J | | DAF1 | ECO |
| COBALT | 17.2 J | | | ECO |
| COPPER | 18 J | | | ECO |
| IRON | 49700 J | R9RES | | |
| LEAD | 17.3 J | | | ECO |
| MANGANESE | 1120 J | | | |
| MERCURY | 0.017 J | | | |
| NICKEL | 22.4 J | | DAF1 | ECO |
| SILVER | 0.32 J | | | |
| ZINC | 62.9 J | | | ECO |

03SB28 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 313 J | | DAF1 | ECO |
| BERYLLIUM | 0.75 | | | |
| CADMIUM | 0.82 | | DAF1 | ECO |
| CHROMIUM | 52.4 J | R9RES MIG | DAF1 | ECO |
| COBALT | 13.7 | | | ECO |
| COPPER | 41.7 J | | | ECO |
| IRON | 28400 J | R9RES | | |
| LEAD | 22.6 J | | | ECO |
| MANGANESE | 1470 J | | | |
| MERCURY | 0.26 J | | DAF1 | ECO |
| NICKEL | 21.5 J | | DAF1 | ECO |
| ZINC | 739 J | | DAF1 | ECO |

03SB47 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 112 J | | DAF1 | ECO |
| BERYLLIUM | 0.91 | | | |
| CADMIUM | 0.78 | | DAF1 | ECO |
| CHROMIUM | 19.9 J | | DAF1 | ECO |
| COBALT | 15.2 J | | | ECO |
| COPPER | 23.5 J | | | ECO |
| IRON | 30400 J | R9RES | | |
| LEAD | 16 J | | | ECO |
| MANGANESE | 1210 J | | | |
| MERCURY | 0.022 J | | | |
| NICKEL | 19 J | | DAF1 | ECO |
| ZINC | 43.9 J | | | ECO |

03SB27 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 167 J | | DAF1 | ECO |
| BERYLLIUM | 0.91 | | | |
| CADMIUM | 2.4 | | DAF1 | ECO |
| CHROMIUM | 288 J | R9RES MIG | DAF1 | ECO |
| COBALT | 13.6 | | | ECO |
| COPPER | 63.9 J | | | ECO |
| IRON | 23800 J | R9RES | | |
| LEAD | 36 J | | | ECO |
| MANGANESE | 837 J | | | |
| MERCURY | 0.17 J | | DAF1 | ECO |
| NICKEL | 24.1 J | | DAF1 | ECO |
| ZINC | 145 J | | | ECO |

03SB48 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 2040 J | MIG | DAF1 | ECO |
| BERYLLIUM | 0.55 | | | |
| CADMIUM | 0.58 | | DAF1 | ECO |
| CHROMIUM | 23 J | | DAF1 | ECO |
| COBALT | 6.7 J | | | ECO |
| COPPER | 14.4 J | | | ECO |
| IRON | 28800 J | R9RES | | |
| LEAD | 124 J | MIG | | ECO |
| MANGANESE | 423 J | | | |
| MERCURY | 0.075 J | | | ECO |
| NICKEL | 25.5 J | | DAF1 | ECO |
| ZINC | 79.7 J | | | ECO |

03SB32 (0 - 2) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 80 J | | | ECO |
| BERYLLIUM | 0.67 | | | |
| CADMIUM | 0.4 | | | ECO |
| CHROMIUM | 15.3 J | | DAF1 | ECO |
| COBALT | 12 J | | | ECO |
| COPPER | 7.9 J | | | ECO |
| IRON | 21100 J | | | |
| LEAD | 14.4 J | | | ECO |
| MANGANESE | 1020 J | | | |
| MERCURY | 0.02 | | | |
| NICKEL | 12.5 J | | DAF1 | |
| ZINC | 29.5 J | | | ECO |

03SB33 (0 - 1.1) R9RES MIG DAF1 DC ECO
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 81.3 J | | | ECO |
| CADMIUM | 0.56 | | DAF1 | ECO |
| CHROMIUM | 11.9 J | | DAF1 | ECO |
| COBALT | 3 J | | | ECO |
| COPPER | 6.7 J | | | ECO |
| IRON | 15300 J | | | |
| LEAD | 9.2 J | | | ECO |
| MANGANESE | 321 J | | | |
| NICKEL | 14.4 J | | DAF1 | ECO |
| ZINC | 48.2 J | | | ECO |

**Legend**

- Surface Soil Sample
- Building/Structure
- Storage Trailer
- Burn Pit/Burn Area
- SWMU (Estimated Boundary)
- Road, Bridge
- Surface Water
- Vegetation
- Miscellaneous

R9RES = EPA Region 9 Residential Preliminary Remediation Goal.
DC = IDEM Tier 1 Direct Contact Values.
MIG = IDEM Tier 1 Migration to Ground Water Values.
DAF1 = U.S. EPA SSL Migration to Ground Water DAF of 1.
ECO = EPA Region 5 Ecological Data Quality Level.

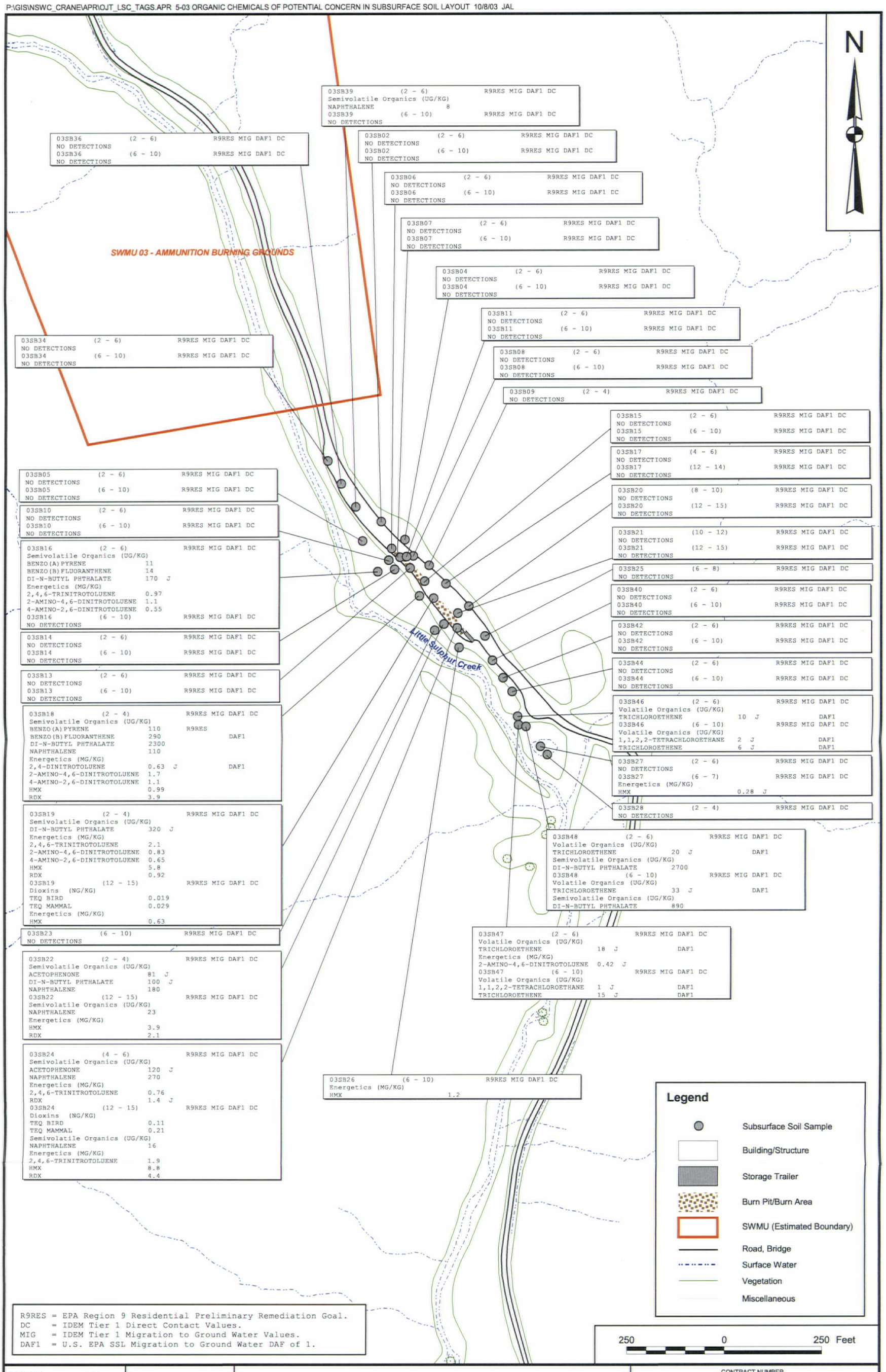
Note: MCL for Iron is the Secondary MCL.

| | |
|---|---|
| DRAWN BY A. JANOCHA | DATE 6/13/02 |
| CHECKED BY J. GOERDT | DATE 11/11/02 |
| CHECKED BY | DATE |
| SCALE AS NOTED | |

INORGANIC CHEMICALS OF POTENTIAL CONCERN
IN SURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

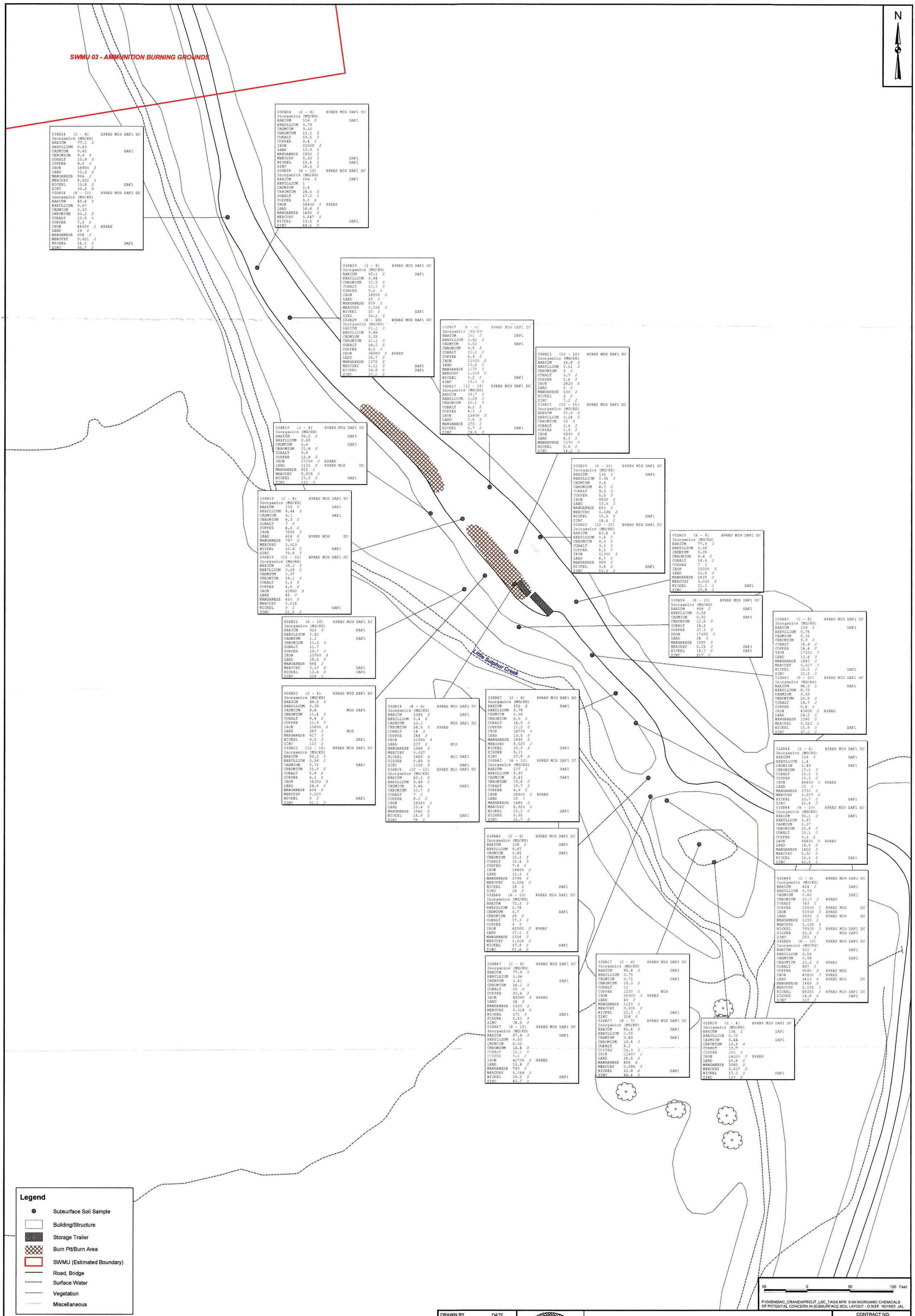
| | |
|---|---|
| CONTRACT NO. 3960 | |
| OWNER NO. CTO 159 | |
| APPROVED BY T. JOHNSTON | DATE 11/12/02 |
| DRAWING NO. FIGURE 5-2 | REV. 0 |

P:\GIS\NSWC_CRANE\APR\OJT_LSC_TAGS.APR 5-03 ORGANIC CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL LAYOUT 10/8/03 JAL




R9RES = EPA Region 9 Residential Preliminary Remediation Goal.
DC = IDEM Tier 1 Direct Contact Values.
MIG = IDEM Tier 1 Migration to Ground Water Values.
DAF1 = U.S. EPA SSL Migration to Ground Water DAF of 1.

| | | | |
|---|---|---|---|
| DRAWN BY A. JANOCHA | DATE 6/09/02 | ORGANIC CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK NSWC CRANE CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. GOERDT | DATE 11/11/02 | | APPROVED BY T. JOHNSTON — DATE 11/11/02 |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 5-3 — REV 0 |




03SB34 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 77.1 | J | | |
| BERYLLIUM | 0.43 | | | |
| CADMIUM | 0.62 | | | DAF1 |
| CHROMIUM | 8.9 | J | | |
| COBALT | 10.9 | J | | |
| COPPER | 8.5 | J | | |
| IRON | 16900 | J | | |
| LEAD | 12.2 | J | | |
| MANGANESE | 996 | J | | |
| MERCURY | 0.022 | J | | |
| NICKEL | 10.8 | J | | DAF1 |
| ZINC | 30.2 | J | | |

03SB34 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 40.4 | J | | |
| BERYLLIUM | 0.57 | | | |
| CADMIUM | 0.33 | | | |
| CHROMIUM | 20.2 | J | | |
| COBALT | 13.9 | J | | |
| COPPER | 7.3 | J | | |
| IRON | 44000 | J | R9RES | |
| LEAD | 16 | J | | |
| MANGANESE | 906 | J | | |
| MERCURY | 0.021 | J | | |
| NICKEL | 14.1 | J | | DAF1 |
| ZINC | 30.7 | J | | |

03SB36 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 116 | J | | DAF1 |
| BERYLLIUM | 0.79 | | | |
| CADMIUM | 0.33 | | | |
| CHROMIUM | 11.1 | J | | |
| COBALT | 15.5 | J | | |
| COPPER | 8.4 | J | | |
| IRON | 22500 | J | | |
| LEAD | 13.9 | J | | |
| MANGANESE | 1550 | J | | |
| MERCURY | 0.23 | J | | DAF1 |
| NICKEL | 14.4 | J | | DAF1 |
| ZINC | 34.3 | J | | |

03SB36 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 106 | J | | DAF1 |
| BERYLLIUM | 1 | | | |
| CADMIUM | 0.4 | | | |
| CHROMIUM | 24.5 | J | | |
| COBALT | 17.2 | J | | |
| COPPER | 9.5 | J | | |
| IRON | 34400 | J | R9RES | |
| LEAD | 16.6 | J | | |
| MANGANESE | 1480 | J | | |
| MERCURY | 0.047 | J | | |
| NICKEL | 19.2 | J | | DAF1 |
| ZINC | 44.5 | J | | |

03SB39 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 95.1 | J | | DAF1 |
| BERYLLIUM | 0.64 | | | |
| CHROMIUM | 10.2 | J | | |
| COBALT | 13.7 | J | | |
| COPPER | 9.2 | J | | |
| IRON | 16900 | J | | |
| LEAD | 15 | J | | |
| MANGANESE | 879 | J | | |
| MERCURY | 0.035 | J | | |
| NICKEL | 12 | J | | DAF1 |
| ZINC | 33.2 | J | | |

03SB39 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 81.2 | J | | |
| BERYLLIUM | 0.96 | | | |
| CADMIUM | 0.35 | | | |
| CHROMIUM | 21.2 | J | | |
| COBALT | 18.2 | J | | |
| COPPER | 8.5 | J | | |
| IRON | 36900 | J | R9RES | |
| LEAD | 16.7 | J | | |
| MANGANESE | 1370 | J | | |
| MERCURY | 0.21 | J | | DAF1 |
| NICKEL | 16.8 | J | | DAF1 |
| ZINC | 37.2 | J | | |

03SB17 (4 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 151 | J | | DAF1 |
| BERYLLIUM | 0.62 | J | | |
| CADMIUM | 0.53 | | | DAF1 |
| CHROMIUM | 9.5 | J | | |
| COBALT | 12.1 | J | | |
| COPPER | 4.6 | J | | |
| IRON | 11000 | J | | |
| LEAD | 12.6 | J | | |
| MANGANESE | 1270 | J | | |
| MERCURY | 0.019 | J | | |
| NICKEL | 9.2 | J | | DAF1 |
| ZINC | 18.3 | J | | |

03SB17 (12 - 14) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 38.7 | J | | |
| BERYLLIUM | 0.29 | J | | |
| CHROMIUM | 10.1 | J | | |
| COBALT | 6.2 | J | | |
| COPPER | 4.3 | J | | |
| IRON | 13900 | J | | |
| LEAD | 7.5 | J | | |
| MANGANESE | 378 | J | | |
| NICKEL | 8.7 | J | | DAF1 |
| ZINC | 29.5 | J | | |

03SB21 (10 - 12) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 10.8 | J | | |
| BERYLLIUM | 0.11 | J | | |
| CHROMIUM | 3 | J | | |
| COBALT | 3.7 | J | | |
| COPPER | 1.4 | J | | |
| IRON | 2620 | J | | |
| LEAD | 3 | J | | |
| MANGANESE | 130 | J | | |
| NICKEL | 3 | J | | |
| ZINC | 7.2 | J | | |

03SB21 (12 - 15) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 20.3 | J | | |
| BERYLLIUM | 0.24 | J | | |
| CHROMIUM | 10 | J | | |
| COBALT | 3.4 | J | | |
| COPPER | 3.8 | J | | |
| IRON | 8990 | J | | |
| LEAD | 4.3 | J | | |
| MANGANESE | 1070 | J | | |
| NICKEL | 5.8 | J | | |
| ZINC | 14.2 | J | | |

03SB18 (2 - 4) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 95.2 | J | | DAF1 |
| BERYLLIUM | 0.63 | | | |
| CADMIUM | 3.6 | | | DAF1 |
| CHROMIUM | 21.8 | J | | |
| COBALT | 9.9 | | | |
| COPPER | 12.6 | J | | |
| IRON | 27200 | J | R9RES | |
| LEAD | 1110 | J | R9RES MIG | DC |
| MANGANESE | 810 | J | | |
| MERCURY | 0.026 | J | | |
| NICKEL | 17.3 | J | | DAF1 |
| ZINC | 112 | J | | |

03SB20 (8 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 135 | J | | DAF1 |
| BERYLLIUM | 0.84 | J | | |
| CADMIUM | 0.4 | | | |
| CHROMIUM | 6.7 | J | | |
| COBALT | 9.3 | J | | |
| COPPER | 5.5 | J | | |
| IRON | 9530 | J | | |
| LEAD | 10.5 | J | | |
| MANGANESE | 450 | J | | |
| MERCURY | 0.026 | J | | |
| NICKEL | 10.3 | J | | DAF1 |
| ZINC | 24.4 | J | | |

03SB20 (12 - 15) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 42.4 | J | | |
| BERYLLIUM | 0.4 | J | | |
| CHROMIUM | 8.3 | J | | |
| COBALT | 3.5 | J | | |
| COPPER | 4.2 | J | | |
| IRON | 11300 | J | | |
| LEAD | 4.5 | J | | |
| MANGANESE | 809 | J | | |
| NICKEL | 9.4 | J | | DAF1 |
| ZINC | 13.3 | J | | |

03SB19 (2 - 4) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 100 | J | | DAF1 |
| BERYLLIUM | 0.44 | J | | |
| CADMIUM | 3.1 | | | DAF1 |
| CHROMIUM | 6.3 | J | | |
| COBALT | 7 | J | | |
| COPPER | 4.3 | J | | |
| IRON | 7200 | J | | |
| LEAD | 616 | J | R9RES MIG | DC |
| MANGANESE | 797 | J | | |
| MERCURY | 0.023 | | | |
| NICKEL | 10.6 | J | | DAF1 |
| ZINC | 70.8 | J | | |

03SB19 (12 - 15) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 39.3 | J | | |
| BERYLLIUM | 0.29 | J | | |
| CADMIUM | 0.37 | | | |
| CHROMIUM | 19.1 | J | | |
| COBALT | 5.3 | J | | |
| COPPER | 4.5 | J | | |
| IRON | 12800 | J | | |
| LEAD | 45 | J | | |
| MANGANESE | 400 | J | | |
| MERCURY | 0.016 | | | |
| NICKEL | 9 | J | | DAF1 |
| ZINC | 21.5 | J | | |

03SB25 (6 - 8) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 77.9 | J | | |
| BERYLLIUM | 0.58 | | | |
| CADMIUM | 0.35 | | | |
| CHROMIUM | 9.6 | J | | |
| COBALT | 14.6 | J | | |
| COPPER | 7 | J | | |
| IRON | 18300 | J | | |
| LEAD | 12.5 | J | | |
| MANGANESE | 1420 | J | | |
| MERCURY | 0.023 | J | | |
| NICKEL | 11.1 | J | | DAF1 |
| ZINC | 27.8 | J | | |

03SB26 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 989 | J | | DAF1 |
| BERYLLIUM | 0.59 | | | |
| CADMIUM | 0.82 | | | DAF1 |
| CHROMIUM | 12.8 | J | | |
| COBALT | 14.3 | | | |
| COPPER | 27.3 | J | | |
| IRON | 17300 | J | | |
| LEAD | 34 | J | | |
| MANGANESE | 1080 | J | | |
| MERCURY | 0.28 | J | | DAF1 |
| NICKEL | 18.7 | J | | DAF1 |
| ZINC | 217 | J | | |

03SB40 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 139 | J | | DAF1 |
| BERYLLIUM | 0.75 | | | |
| CADMIUM | 0.35 | | | |
| CHROMIUM | 9.9 | J | | |
| COBALT | 14.6 | J | | |
| COPPER | 16.4 | J | | |
| IRON | 17300 | J | | |
| LEAD | 12.6 | J | | |
| MANGANESE | 1440 | J | | |
| MERCURY | 0.027 | J | | |
| NICKEL | 15.5 | J | | DAF1 |
| ZINC | 32.5 | J | | |

03SB40 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 94.5 | J | | DAF1 |
| BERYLLIUM | 0.73 | | | |
| CADMIUM | 0.35 | | | |
| CHROMIUM | 21.8 | J | | |
| COBALT | 16.7 | J | | |
| COPPER | 8.6 | J | | |
| IRON | 43800 | J | R9RES | |
| LEAD | 16.2 | J | | |
| MANGANESE | 1390 | J | | |
| MERCURY | 0.022 | J | | |
| NICKEL | 15.9 | J | | DAF1 |
| ZINC | 37.2 | J | | |

03SB23 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 933 | J | | DAF1 |
| BERYLLIUM | 0.62 | | | |
| CADMIUM | 1.2 | | | DAF1 |
| CHROMIUM | 11.3 | J | | |
| COBALT | 11.7 | | | |
| COPPER | 19.7 | J | | |
| IRON | 13700 | J | | |
| LEAD | 28.5 | J | | |
| MANGANESE | 684 | J | | |
| MERCURY | 0.57 | J | | DAF1 |
| NICKEL | 13.6 | J | | DAF1 |
| ZINC | 204 | J | | |

03SB22 (2 - 4) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 69.5 | J | | |
| BERYLLIUM | 0.35 | | | |
| CADMIUM | 8.6 | | | MIG DAF1 |
| CHROMIUM | 11.4 | J | | |
| COBALT | 9.4 | J | | |
| COPPER | 12.9 | J | | |
| IRON | 10600 | J | | |
| LEAD | 387 | J | | MIG |
| MANGANESE | 817 | J | | |
| NICKEL | 9.5 | J | | DAF1 |
| ZINC | 122 | J | | |

03SB22 (12 - 15) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 58.3 | J | | |
| BERYLLIUM | 0.36 | J | | |
| CADMIUM | 0.75 | | | DAF1 |
| CHROMIUM | 15.9 | J | | |
| COBALT | 5.6 | J | | |
| COPPER | 6.1 | J | | |
| IRON | 18200 | J | | |
| LEAD | 26.8 | J | | |
| MANGANESE | 406 | J | | |
| MERCURY | 0.027 | | | |
| NICKEL | 9 | J | | DAF1 |
| ZINC | 31.1 | J | | |

03SB24 (4 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 1340 | J | | DAF1 |
| BERYLLIUM | 0.4 | J | | |
| CADMIUM | 12.1 | | | MIG DAF1 DC |
| CHROMIUM | 34.5 | J | R9RES | |
| COBALT | 14 | J | | |
| COPPER | 244 | J | | |
| IRON | 21000 | J | | |
| LEAD | 277 | J | | MIG |
| MANGANESE | 1060 | J | | |
| MERCURY | 0.037 | | | |
| NICKEL | 1600 | J | | MIG DAF1 |
| SILVER | 0.48 | J | | |
| ZINC | 1100 | J | | DAF1 |

03SB24 (12 - 15) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 60.2 | J | | |
| BERYLLIUM | 0.49 | J | | |
| CADMIUM | 0.46 | | | DAF1 |
| CHROMIUM | 10.7 | J | | |
| COBALT | 7 | J | | |
| COPPER | 9.2 | J | | |
| IRON | 18300 | J | | |
| LEAD | 23.6 | J | | |
| MANGANESE | 1060 | J | | |
| NICKEL | 14.9 | J | | DAF1 |
| ZINC | 78 | J | | |

03SB42 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 153 | J | | DAF1 |
| BERYLLIUM | 0.78 | | | |
| CADMIUM | 0.36 | | | |
| CHROMIUM | 8.5 | J | | |
| COBALT | 14.9 | J | | |
| COPPER | 10.2 | J | | |
| IRON | 16700 | J | | |
| LEAD | 13.5 | J | | |
| MANGANESE | 1680 | J | | |
| MERCURY | 0.027 | J | | |
| NICKEL | 15.9 | J | | DAF1 |
| SILVER | 0.11 | | | |
| ZINC | 37.9 | J | | |

03SB42 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 107 | J | | DAF1 |
| BERYLLIUM | 0.87 | | | |
| CADMIUM | 0.41 | | | DAF1 |
| CHROMIUM | 18.6 | J | | |
| COBALT | 19.7 | J | | |
| COPPER | 6.9 | J | | |
| IRON | 26500 | J | R9RES | |
| LEAD | 15 | J | | |
| MANGANESE | 1680 | J | | |
| MERCURY | 0.023 | J | | |
| NICKEL | 20.3 | J | | DAF1 |
| SILVER | 0.05 | | | |
| ZINC | 31.7 | J | | |

03SB44 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 119 | J | | DAF1 |
| BERYLLIUM | 1.4 | | | |
| CADMIUM | 0.49 | | | DAF1 |
| CHROMIUM | 27.5 | J | | |
| COBALT | 21.2 | J | | |
| COPPER | 10.3 | J | | |
| IRON | 44400 | J | R9RES | |
| LEAD | 20 | J | | |
| MANGANESE | 1730 | J | | |
| MERCURY | 0.027 | J | | |
| NICKEL | 23.7 | J | | DAF1 |
| ZINC | 41.4 | J | | |

03SB44 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 83.1 | J | | DAF1 |
| BERYLLIUM | 0.87 | | | |
| CADMIUM | 0.37 | | | |
| CHROMIUM | 20.4 | J | | |
| COBALT | 20.1 | J | | |
| COPPER | 9.3 | J | | |
| IRON | 56400 | J | R9RES | |
| LEAD | 18.5 | J | | |
| MANGANESE | 1450 | J | | |
| MERCURY | 0.02 | J | | |
| NICKEL | 19.9 | J | | DAF1 |
| ZINC | 43.9 | J | | |

03SB46 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 138 | J | | DAF1 |
| BERYLLIUM | 0.87 | | | |
| CADMIUM | 0.83 | | | DAF1 |
| CHROMIUM | 12.1 | J | | |
| COBALT | 15.4 | J | | |
| COPPER | 7.6 | J | | |
| IRON | 16400 | J | | |
| LEAD | 13.3 | J | | |
| MANGANESE | 1790 | J | | |
| MERCURY | 0.026 | J | | |
| NICKEL | 16 | J | | DAF1 |
| ZINC | 26 | J | | |

03SB46 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 72.3 | J | | |
| BERYLLIUM | 0.74 | | | |
| CADMIUM | 0.7 | | | DAF1 |
| CHROMIUM | 20 | J | | |
| COBALT | 17.3 | J | | |
| COPPER | 9 | J | | |
| IRON | 42000 | J | R9RES | |
| LEAD | 17.1 | J | | |
| MANGANESE | 1310 | J | | |
| MERCURY | 0.019 | J | | |
| NICKEL | 17.9 | J | | DAF1 |
| ZINC | 51.6 | J | | |

03SB48 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 614 | J | | DAF1 |
| BERYLLIUM | 0.26 | | | |
| CADMIUM | 0.63 | | | DAF1 |
| CHROMIUM | 32.7 | J | R9RES | |
| COBALT | 740 | J | | |
| COPPER | 22500 | J | R9RES MIG | DC |
| IRON | 50900 | J | R9RES | |
| LEAD | 3590 | J | R9RES MIG | DC |
| MANGANESE | 1200 | J | | |
| MERCURY | 0.025 | J | | |
| NICKEL | 79100 | J | R9RES MIG | DAF1 DC |
| SILVER | 33.9 | J | | MIG DAF1 |
| ZINC | 253 | J | | |

03SB48 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 822 | J | | DAF1 |
| BERYLLIUM | 0.56 | | | |
| CADMIUM | 0.86 | | | DAF1 |
| CHROMIUM | 32.3 | J | R9RES | |
| COBALT | 487 | J | | |
| COPPER | 9580 | J | R9RES MIG | |
| IRON | 49800 | J | R9RES | |
| LEAD | 3410 | J | R9RES MIG | DC |
| MANGANESE | 1440 | J | | |
| MERCURY | 0.025 | J | | |
| NICKEL | 48300 | J | R9RES MIG | DAF1 DC |
| SILVER | 16.6 | J | | DAF1 |
| ZINC | 157 | J | | |

03SB47 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 77.9 | J | | |
| BERYLLIUM | 0.96 | | | |
| CADMIUM | 0.41 | | | DAF1 |
| CHROMIUM | 24.1 | J | | |
| COBALT | 15 | J | | |
| COPPER | 92.6 | J | | |
| IRON | 40300 | J | R9RES | |
| LEAD | 34 | J | | |
| MANGANESE | 1320 | J | | |
| MERCURY | 0.018 | J | | |
| NICKEL | 171 | J | | DAF1 |
| SILVER | 0.51 | J | | |
| ZINC | 74.5 | J | | |

03SB47 (6 - 10) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 87.8 | J | | DAF1 |
| BERYLLIUM | 0.53 | | | |
| CADMIUM | 0.32 | | | |
| CHROMIUM | 19.4 | J | | |
| COBALT | 12.1 | J | | |
| COPPER | 9.6 | J | | |
| IRON | 42700 | J | R9RES | |
| LEAD | 13.6 | J | | |
| MANGANESE | 799 | J | | |
| MERCURY | 0.018 | J | | |
| NICKEL | 19.2 | J | | DAF1 |
| ZINC | 40.7 | J | | |

03SB27 (2 - 6) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 85.4 | J | | DAF1 |
| BERYLLIUM | 0.75 | | | |
| CADMIUM | 0.71 | | | DAF1 |
| CHROMIUM | 18.3 | J | | |
| COBALT | 12 | | | |
| COPPER | 1230 | J | MIG | |
| IRON | 35900 | J | R9RES | |
| LEAD | 49 | J | | |
| MANGANESE | 1150 | J | | |
| MERCURY | 0.035 | J | | |
| NICKEL | 22.7 | J | | DAF1 |
| ZINC | 126 | J | | |

03SB27 (6 - 7) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 85.4 | J | | DAF1 |
| BERYLLIUM | 0.59 | | | |
| CADMIUM | 0.48 | | | DAF1 |
| CHROMIUM | 18.4 | J | | |
| COBALT | 9.2 | | | |
| COPPER | 26.3 | J | | |
| IRON | 22600 | J | | |
| LEAD | 14.5 | J | | |
| MANGANESE | 495 | J | | |
| MERCURY | 0.098 | J | | |
| NICKEL | 13.8 | J | | DAF1 |
| ZINC | 66.4 | J | | |

03SB28 (2 - 4) R9RES MIG DAF1 DC
Inorganics (MG/KG)

| | | | | |
|---|---|---|---|---|
| BARIUM | 104 | J | | DAF1 |
| BERYLLIUM | 0.73 | | | |
| CADMIUM | 0.46 | | | DAF1 |
| CHROMIUM | 13.8 | J | | |
| COBALT | 13.7 | | | |
| COPPER | 255 | J | | |
| IRON | 26200 | J | R9RES | |
| LEAD | 20.8 | J | | |
| MANGANESE | 1060 | J | | |
| MERCURY | 0.027 | J | | |
| NICKEL | 17.2 | J | | DAF1 |
| ZINC | 137 | J | | |

R9RES = EPA Region 9 Residential Preliminary Remediation Goal.
DC = IDEM Tier 1 Direct Contact Values.
MIG = IDEM Tier 1 Migration to Ground Water Values.
DAF1 = U.S. EPA SSL Migration to Ground Water DAF of 1.

Note: MCL for Iron is the Secondary MCL.

P:\GIS\NSWC_CRANE\APR\OJT_LSC_TAGS.APR 5-04 INORGANIC CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL LAYOUT - D SIZE 10/15/03 JAL

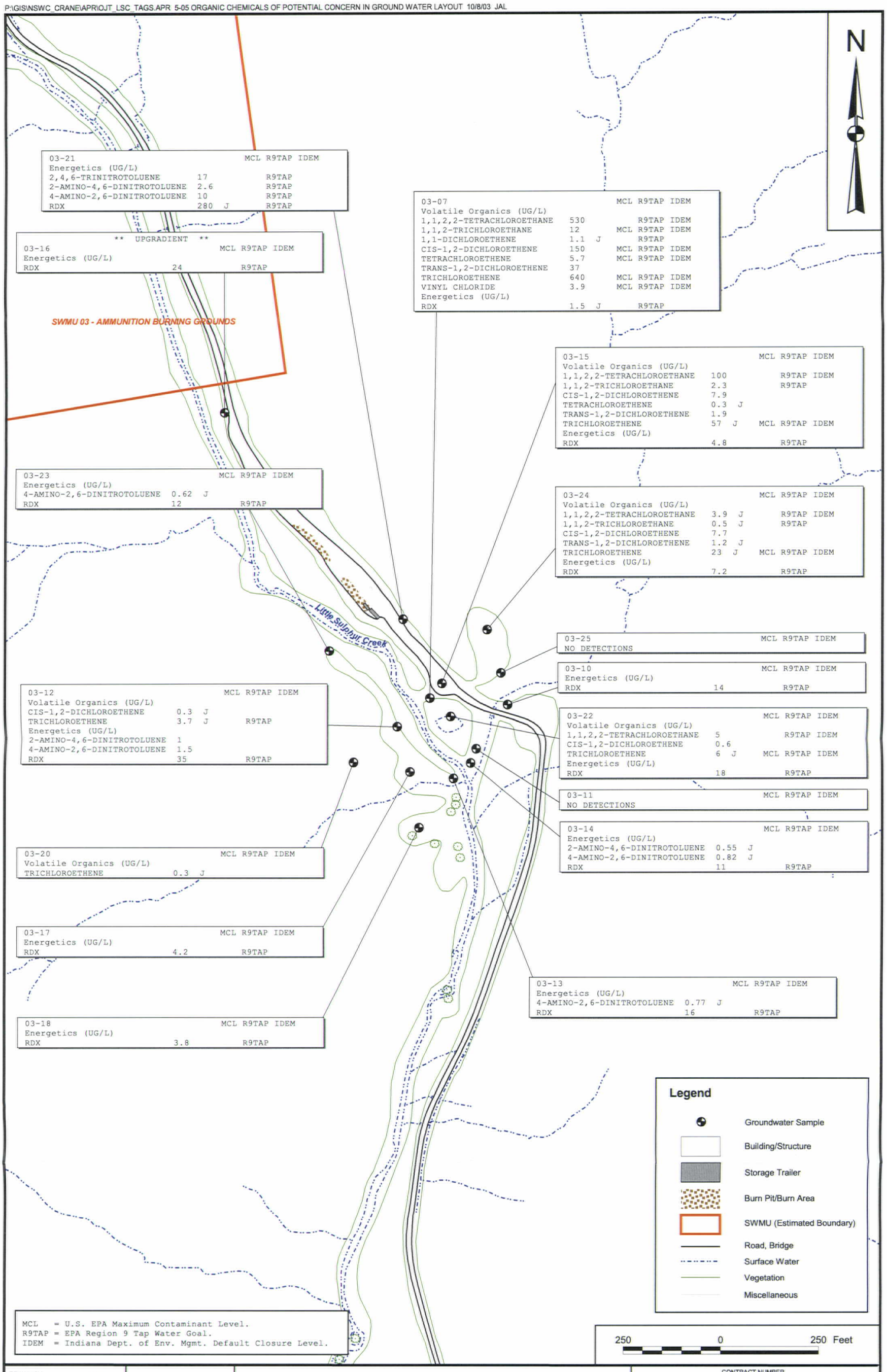
| | |
|---|---|
| DRAWN BY A. JANOCHA | DATE 6/18/02 |
| CHECKED BY J. GOERDT | DATE 11/11/02 |
| CHECKED BY | DATE |
| SCALE AS NOTED | |

INORGANIC CHEMICALS OF POTENTIAL CONCERN
IN SUBSURFACE SOIL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

| | |
|---|---|
| CONTRACT NO. 3960 | |
| OWNER NO. CTO 159 | |
| APPROVED BY T. JOHNSTON | DATE 11/11/02 |
| DRAWING NO. FIGURE 5-4 | REV. 0 |

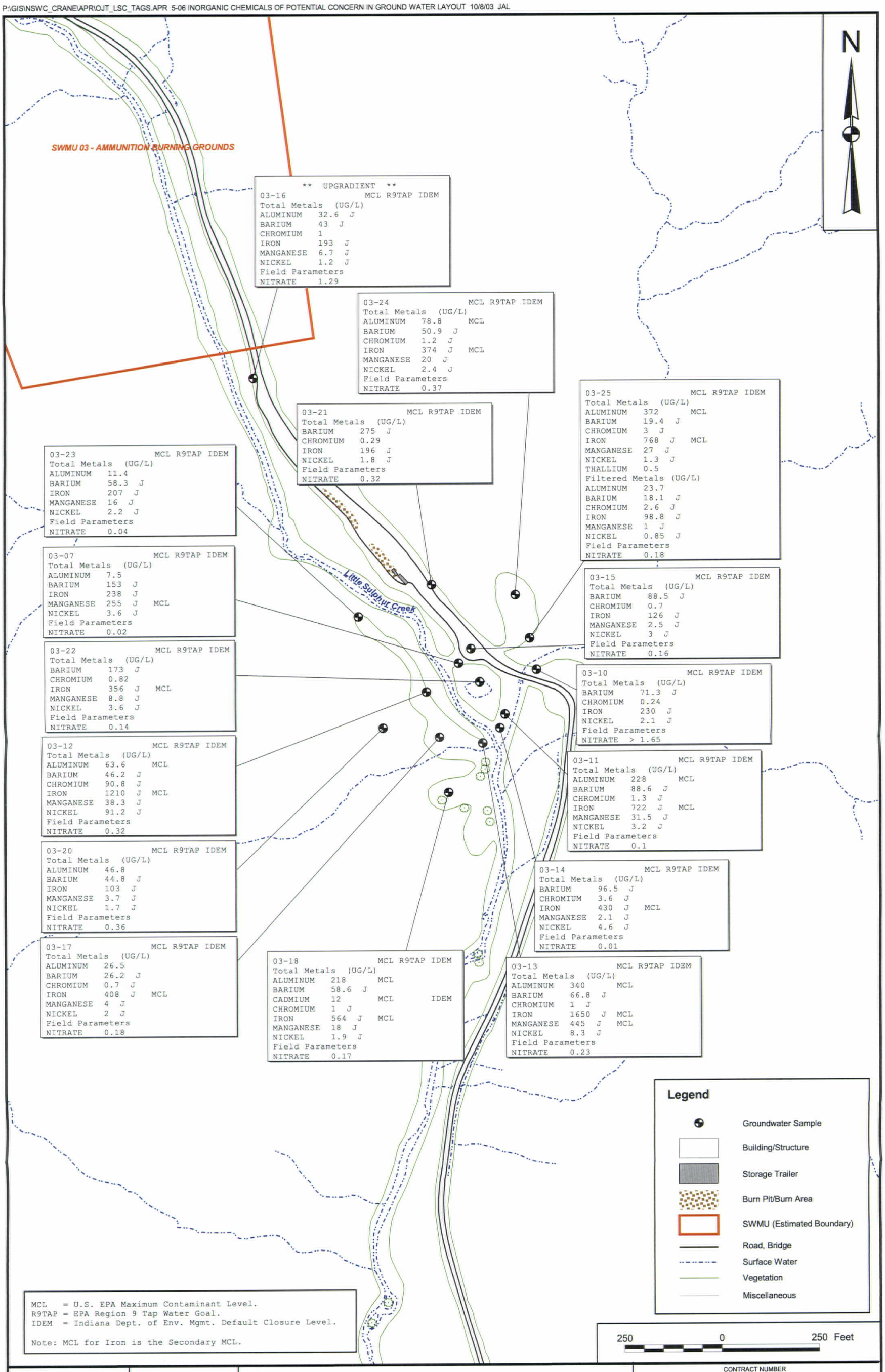
00915404X

P:\GIS\NSWC_CRANE\APR\OJT_LSC_TAGS.APR 5-05 ORGANIC CHEMICALS OF POTENTIAL CONCERN IN GROUND WATER LAYOUT 10/8/03 JAL




| | | | |
|---|---|---|---|
| DRAWN BY A. JANOCHA | DATE 6/12/02 | ORGANIC CHEMICALS OF POTENTIAL CONCERN IN GROUND WATER<br>SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK<br>NSWC CRANE<br>CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. GOERDT | DATE 11/11/02 | | APPROVED BY T. JOHNSTON — DATE 11/11/02 |
| COST/SCHEDULE-AREA | | | APPROVED BY — — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 5-5 — REV 0 |

P:\GIS\NSWC_CRANE\APR\OJT_LSC_TAGS.APR 5-06 INORGANIC CHEMICALS OF POTENTIAL CONCERN IN GROUND WATER LAYOUT 10/8/03 JAL

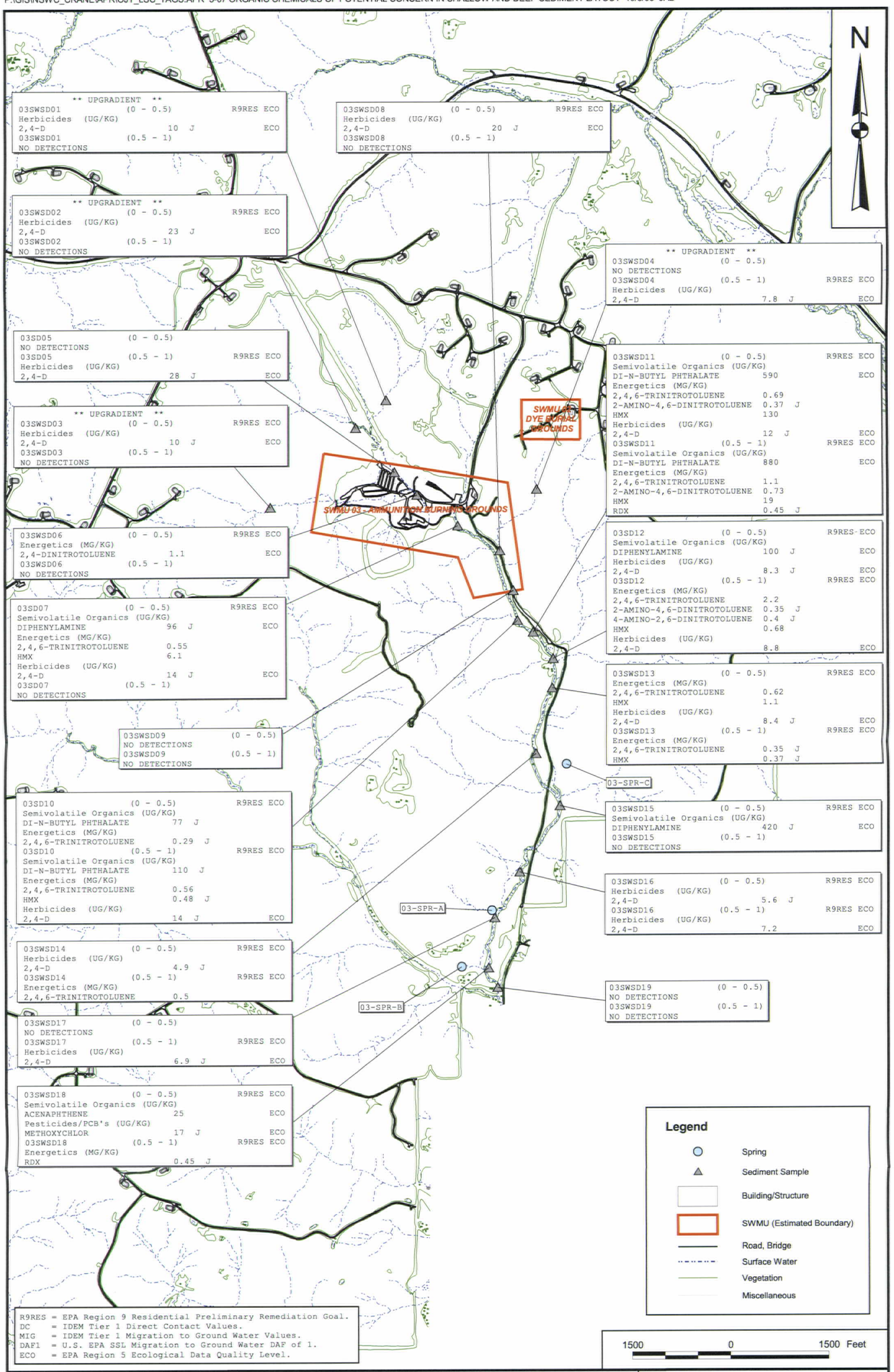



MCL = U.S. EPA Maximum Contaminant Level.
R9TAP = EPA Region 9 Tap Water Goal.
IDEM = Indiana Dept. of Env. Mgmt. Default Closure Level.

Note: MCL for Iron is the Secondary MCL.

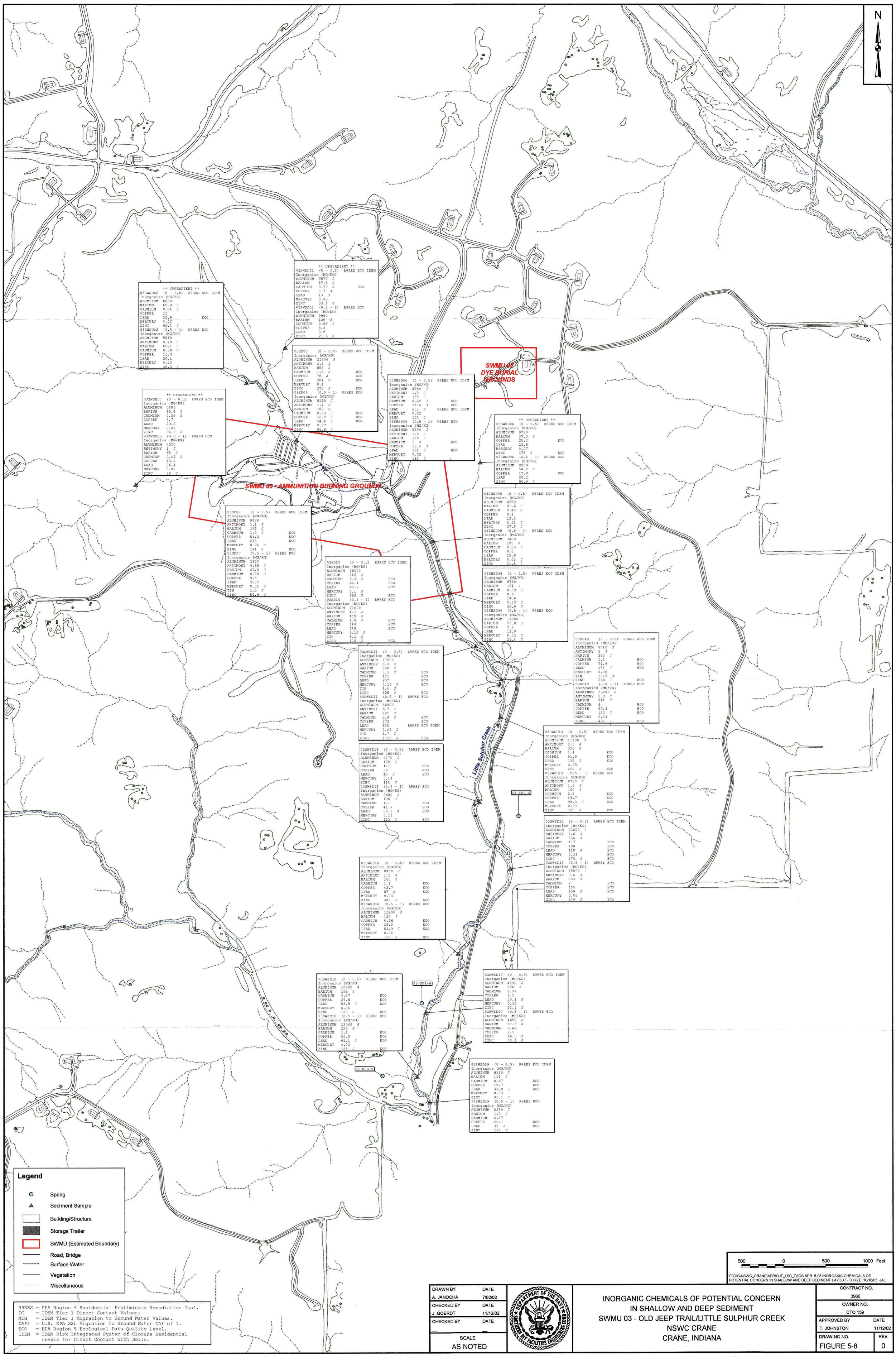
| | | | |
|---|---|---|---|
| DRAWN BY A. JANOCHA | DATE 6/12/02 | INORGANIC CHEMICALS OF POTENTIAL CONCERN IN GROUND WATER<br>SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK<br>NSWC CRANE<br>CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. GOERDT | DATE 11/11/02 | | APPROVED BY T. JOHNSTON — DATE 11/12/02 |
| COST/SCHEDULE-AREA | | | APPROVED BY — — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 5-6 — REV 0 |

P:\GIS\NSWC_CRANE\APR\OJT_LSC_TAGS.APR 5-07 ORGANIC CHEMICALS OF POTENTIAL CONCERN IN SHALLOW AND DEEP SEDIMENT LAYOUT 10/8/03 JAL

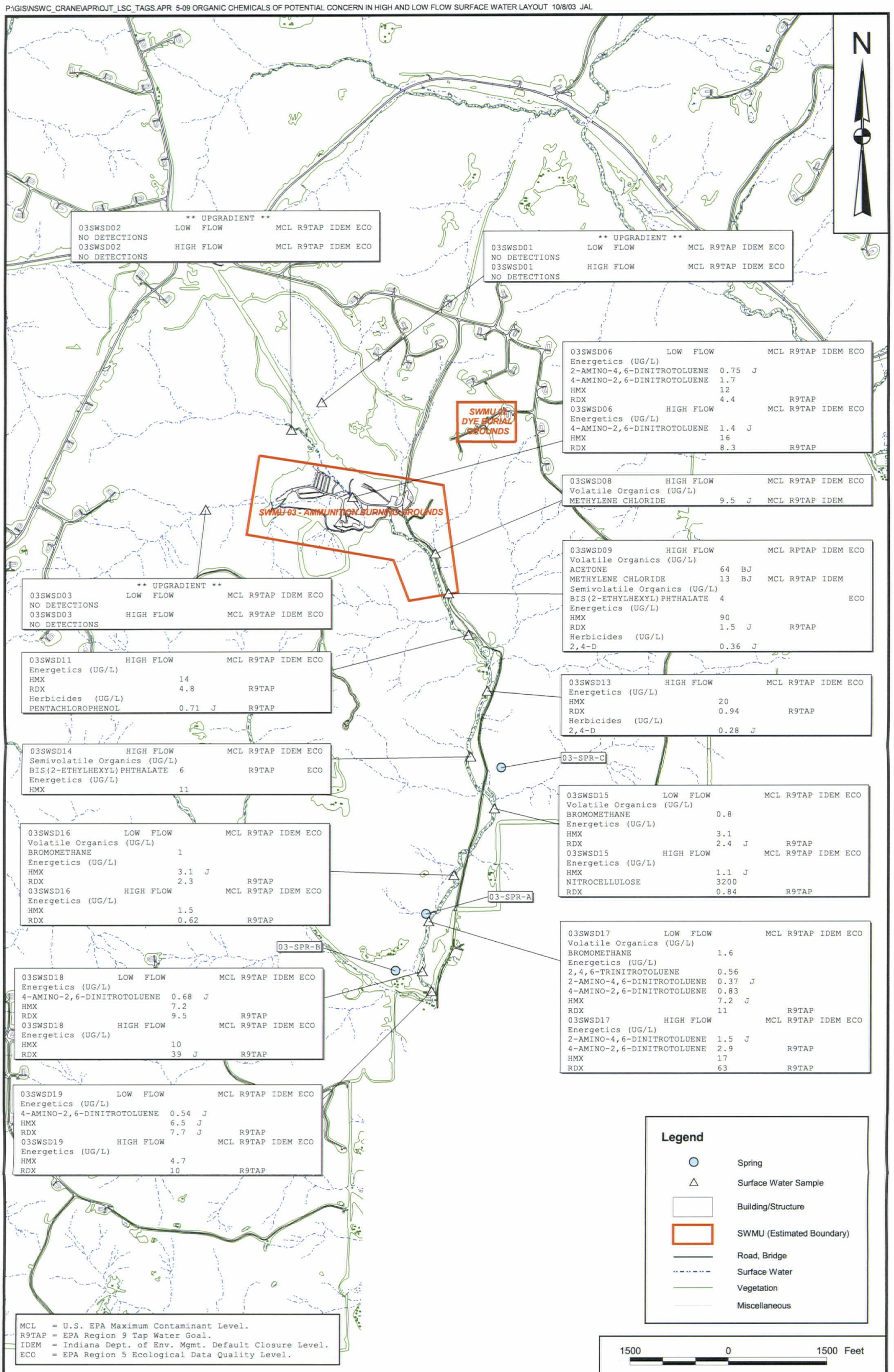



R9RES = EPA Region 9 Residential Preliminary Remediation Goal.
DC = IDEM Tier 1 Direct Contact Values.
MIG = IDEM Tier 1 Migration to Ground Water Values.
DAF1 = U.S. EPA SSL Migration to Ground Water DAF of 1.
ECO = EPA Region 5 Ecological Data Quality Level.

| | | | |
|---|---|---|---|
| DRAWN BY A. JANOCHA | DATE 6/09/02 | ORGANIC CHEMICALS OF POTENTIAL CONCERN IN SHALLOW AND DEEP SEDIMENT SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK NSWC CRANE CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. GOERDT | DATE 11/11/02 | | APPROVED BY T. JOHNSTON — DATE 11/12/02 |
| COST/SCHEDULE-AREA | | | APPROVED BY — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 5-7 — REV 0 |


N
SWMU 02 DYE BURIAL GROUNDS
SWMU 03 - AMMUNITION BURNING GROUNDS
Little Sulphur Creek
03-SPR-C
03-SPR-A
03-SPR-B
** UPGRADIENT **
03SWSD02 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 6650
BARIUM 65.8 J
CADMIUM 0.54 J
COPPER 12
LEAD 32.9 ECO
MERCURY 0.02
ZINC 62.4 J
03SWSD02 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 5910
ANTIMONY 0.79 J
BARIUM 45.1 J
CADMIUM 0.38 J
COPPER 11.8
LEAD 20.1
MERCURY 0.03
ZINC 36.3 J
** UPGRADIENT **
03SWSD01 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 9570 J
BARIUM 57.8 J
CADMIUM 0.79 J ECO
COPPER 7.7 J
LEAD 13 J
MERCURY 0.03
ZINC 33.1 J
03SWSD01 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 9960
BARIUM 129 J
CADMIUM 0.56 J
COPPER 8.3
LEAD 3.6
ZINC 21.6 J
03SD05 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 21500 J
ANTIMONY 3.5 J
BARIUM 853 J
CADMIUM 1.8 J ECO
COPPER 78 J ECO
LEAD 204 J ECO
MERCURY 0.1
ZINC 206 J ECO
03SD05 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 8140 J
ANTIMONY 1.1 J
BARIUM 152 J
CADMIUM 0.63 J ECO
COPPER 16.2 J ECO
LEAD 34.6 J ECO
MERCURY 0.07
ZINC 55.6 J
** UPGRADIENT **
03SWSD03 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 5480
BARIUM 45.4 J
CADMIUM 0.32 J
COPPER 8.7
LEAD 20.2
MERCURY 0.05
ZINC 36.2 J
03SWSD03 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 7820
ANTIMONY 1 J
BARIUM 65 J
CADMIUM 0.48 J
COPPER 12.1
LEAD 26.4
MERCURY 0.03
ZINC 58 J
03SWSD06 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 8780 J
ANTIMONY 1.9 J
BARIUM 189 J
CADMIUM 0.62 J ECO
COPPER 27.4 J ECO
LEAD 653 J R9RES ECO IDEM
MERCURY 0.02
ZINC 100 J
03SWSD06 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 5790 J
ANTIMONY 1.2 J
BARIUM 138 J
CADMIUM 1 J ECO
COPPER 12.5 J
LEAD 181 J ECO
MERCURY 0.02
ZINC 111 J
** UPGRADIENT **
03SWSD04 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 9720
BARIUM 37.3 J
COPPER 25.3 ECO
LEAD 23.6
MERCURY 0.07
ZINC 176 J ECO
03SWSD04 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 8950
BARIUM 54.2 J
COPPER 17.8 ECO
LEAD 20.2
ZINC 80.9 J
03SD07 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 9870
ANTIMONY 1.1 J
BARIUM 194 J
CADMIUM 1.2 J ECO
COPPER 51.3 ECO
LEAD 215 ECO
MERCURY 0.04 J
ZINC 194 J ECO
03SD07 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 3150
ANTIMONY 0.85 J
BARIUM 47.5 J
CADMIUM 0.39 J
COPPER 9.5
LEAD 26.5
MERCURY 0.05 J
TIN 1.5 J
ZINC 54.6 J
03SWSD08 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 6250
BARIUM 91.6 J
CADMIUM 0.42 J
COPPER 8.1
LEAD 13.3
MERCURY 0.03 J
ZINC 27.5 J
03SWSD08 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 7420
BARIUM 105 J
CADMIUM 0.55 J
COPPER 8.8
LEAD 15.8
MERCURY 0.03 J
ZINC 31.5 J
03SD10 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 16400
BARIUM 342 J
CADMIUM 1.3 J ECO
COPPER 60.1 ECO
LEAD 93.2 ECO
MERCURY 0.1 J
ZINC 192 J ECO
03SD10 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 21000
ANTIMONY 4.1 J
BARIUM 419 J
CADMIUM 1.8 J ECO
COPPER 148 ECO
LEAD 149 ECO
MERCURY 0.12 J
TIN 4.1 J
ZINC 412 J ECO
03SWSD09 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 6780
BARIUM 104 J
CADMIUM 0.59 J
COPPER 8.6
LEAD 14.6
MERCURY 0.03 J
ZINC 36.9 J
03SWSD09 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 11000
BARIUM 55.8 J
COPPER 7.9
LEAD 11.8
MERCURY 0.03 J
ZINC 21.4 J
03SWSD11 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 17900
ANTIMONY 3.3 J
BARIUM 500 J
CADMIUM 3.5 J ECO
COPPER 115 ECO
LEAD 257 ECO
MERCURY 0.18 J ECO
TIN 4.4 J
ZINC 308 J ECO
03SWSD11 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 56900
ANTIMONY 6.7 J
BARIUM 981 J
CADMIUM 2.9 J ECO
COPPER 273 ECO
LEAD 445 R9RES ECO IDEM
MERCURY 0.08 J
TIN 1.7 J
ZINC 1120 J ECO
03SD12 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 8740 J
ANTIMONY 2 J
BARIUM 353 J
CADMIUM 1.4 ECO
COPPER 71.9 ECO
LEAD 184 J ECO
MERCURY 0.06
TIN 13.8 J
ZINC 260 J ECO
03SD12 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 17200 J
ANTIMONY 2.3 J
BARIUM 744 J
CADMIUM 4 ECO
COPPER 89.3 ECO
LEAD 122 J ECO
MERCURY 0.13
ZINC 421 J ECO
03SWSD13 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 11100 J
ANTIMONY 2.5 J
BARIUM 326 J
CADMIUM 1.4 ECO
COPPER 91.9 ECO
LEAD 139 J ECO
MERCURY 0.08
ZINC 229 J ECO
03SWSD13 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 8720 J
ANTIMONY 1.6 J
BARIUM 180 J
CADMIUM 2.5 ECO
COPPER 49.7 ECO
LEAD 98.3 J ECO
MERCURY 0.03
ZINC 185 J ECO
03SWSD14 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 6770 J
BARIUM 139 J
CADMIUM 1.1 ECO
COPPER 29 ECO
LEAD 43 J ECO
MERCURY 0.14
ZINC 114 J
03SWSD14 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 6680 J
BARIUM 196 J
CADMIUM 1.1 ECO
COPPER 41.9 ECO
LEAD 59.3 J ECO
MERCURY 0.13
ZINC 133 J ECO
03SWSD15 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 23200 J
ANTIMONY 7.6 J
BARIUM 334 J
CADMIUM 1.7 ECO
COPPER 198 ECO
LEAD 118 J ECO
MERCURY 0.31 ECO
ZINC 270 J ECO
03SWSD15 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 15500 J
ANTIMONY 3.4 J
BARIUM 353 J
CADMIUM 2 ECO
COPPER 105 ECO
LEAD 159 J ECO
MERCURY 0.05
ZINC 319 J ECO
03SWSD16 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 8950 J
ANTIMONY 1.6 J
BARIUM 165 J
CADMIUM 1.1 ECO
COPPER 43.7 ECO
LEAD 87 J ECO
MERCURY 0.03
ZINC 385 J ECO
03SWSD16 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 12900 J
BARIUM 126 J
CADMIUM 0.96 ECO
COPPER 33.3 ECO
LEAD 53.9 J ECO
MERCURY 0.04
ZINC 136 J ECO
03SWSD18 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 10900 J
BARIUM 166 J
CADMIUM 0.87 ECO
COPPER 29.6 ECO
LEAD 53.5 J ECO
MERCURY 0.04
ZINC 133 J ECO
03SWSD18 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 12500 J
BARIUM 228 J
CADMIUM 1.6 ECO
COPPER 52.8 ECO
LEAD 61.1 J ECO
MERCURY 0.03
ZINC 186 J ECO
03SWSD17 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 4590 J
BARIUM 124 J
CADMIUM 0.37
COPPER 9.2
LEAD 20.1 J
MERCURY 0.02
ZINC 41.1 J
03SWSD17 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 4650 J
BARIUM 57.3 J
CADMIUM 0.47
COPPER 9.5
LEAD 16.5 J
ZINC 50.1 J
03SWSD19 (0 - 0.5) R9RES ECO IDEM
Inorganics (MG/KG)
ALUMINUM 6190 J
BARIUM 114 J
CADMIUM 0.67 ECO
COPPER 19.7 ECO
LEAD 33.8 J ECO
MERCURY 0.03
ZINC 91.1 J
03SWSD19 (0.5 - 1) R9RES ECO
Inorganics (MG/KG)
ALUMINUM 5250 J
BARIUM 112 J
CADMIUM 0.57
COPPER 20.1 ECO
LEAD 37 J ECO
ZINC 113 J
Legend
Spring
Sediment Sample
Building/Structure
Storage Trailer
SWMU (Estimated Boundary)
Road, Bridge
Surface Water
Vegetation
Miscellaneous
R9RES = EPA Region 9 Residential Preliminary Remediation Goal.
DC = IDEM Tier 1 Direct Contact Values.
MIG = IDEM Tier 1 Migration to Ground Water Values.
DAF1 = U.S. EPA SSL Migration to Ground Water DAF of 1.
ECO = EPA Region 5 Ecological Data Quality Level.
IDEM = IDEM Risk Integrated System of Closure Residential Levels for Direct Contact with Soils.
500 0 500 1000 Feet
P:\GIS\NSWC_CRANE\APR\OJT_LSC_TAGS.APR 5-08 INORGANIC CHEMICALS OF POTENTIAL CONCERN IN SHALLOW AND DEEP SEDIMENT LAYOUT - D SIZE 10/16/03 JAL
DRAWN BY A. JANOCHA DATE 7/02/02
CHECKED BY J. GOERDT DATE 11/12/02
CHECKED BY DATE
SCALE AS NOTED
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
INORGANIC CHEMICALS OF POTENTIAL CONCERN
IN SHALLOW AND DEEP SEDIMENT
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA
CONTRACT NO. 3960
OWNER NO. CTO 159
APPROVED BY T. JOHNSTON
DATE 11/12/02
DRAWING NO. FIGURE 5-8
REV. 0

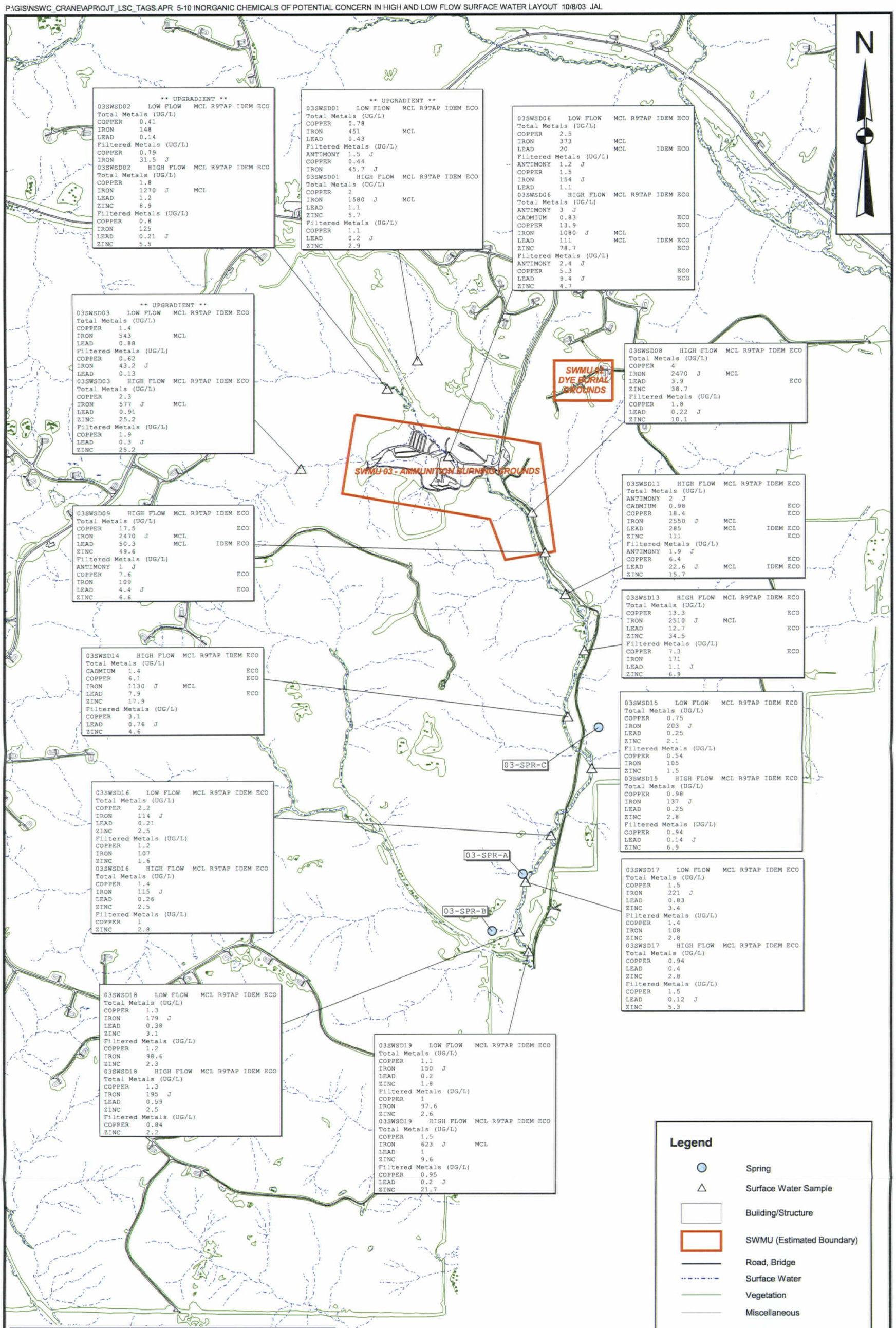
P:\GIS\NSWC_CRANE\APR\OJT_LSC_TAGS.APR 5-09 ORGANIC CHEMICALS OF POTENTIAL CONCERN IN HIGH AND LOW FLOW SURFACE WATER LAYOUT 10/8/03 JAL




MCL = U.S. EPA Maximum Contaminant Level.
R9TAP = EPA Region 9 Tap Water Goal.
IDEM = Indiana Dept. of Env. Mgmt. Default Closure Level.
ECO = EPA Region 5 Ecological Data Quality Level.

| | | | |
|---|---|---|---|
| DRAWN BY A. JANOCHA | DATE 6/06/02 | ORGANIC CHEMICALS OF POTENTIAL CONCERN IN HIGH AND LOW-FLOW SURFACE WATER SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK NSWC CRANE CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. GOERDT | DATE 11/11/02 | | APPROVED BY T. JOHNSTON — DATE 11/12/02 |
| COST/SCHEDULE-AREA | | | APPROVED BY — — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 5-9 — REV 0 |

P:\GIS\NSWC_CRANE\APR\OJT_LSC_TAGS.APR 5-10 INORGANIC CHEMICALS OF POTENTIAL CONCERN IN HIGH AND LOW FLOW SURFACE WATER LAYOUT 10/8/03 JAL




MCL = U.S. EPA Maximum Contaminant Level.
R9TAP = EPA Region 9 Tap Water Goal.
IDEM = Indiana Dept. of Env. Mgmt. Default Closure Level.
ECO = EPA Region 5 Ecological Data Quality Level.

| | | | |
|---|---|---|---|
| DRAWN BY A. JANOCHA | DATE 6/10/02 | INORGANIC CHEMICALS OF POTENTIAL CONCERN IN HIGH AND LOW-FLOW SURFACE WATER<br>SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK<br>NSWC CRANE<br>CRANE, INDIANA | CONTRACT NUMBER 3960 |
| CHECKED BY J. GOERDT | DATE 11/13/02 | | APPROVED BY T. JOHNSTON — DATE 11/13/02 |
| COST/SCHEDULE-AREA | | | APPROVED BY — — DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE 5-10 — REV 1 |

# 6.0 CHEMICAL FATE AND TRANSPORT ANALYSIS

Knowledge of a contaminant's potential to migrate and persist in an environmental medium is important when evaluating the potential for a chemical to elicit an adverse human health or ecological effect. This section contains information on chemical properties and degradation potential of the COPCs and on the environmental conditions of the site and hydrological considerations that are likely affecting contaminant fate and transport at the OJT site and the LSC watershed. Section 6.1 contains a general discussion of the various chemical and physical properties of COPCs detected at the OJT site and LSC. Section 6.2 reviews the potential for chemical compounds to biodegrade or undergo other transformations. Section 6.3 presents a discussion of transport pathways where migration and attenuation might be occurring and how spatial and temporal variations in hydrologic conditions might be affecting transport. Section 6.4 presents an overall summary of contaminant migration in the LSC watershed.

In Section 4.0, a total of 60 different chemicals were identified as COPCs in the four different media within the OJT site and LSC (Table 4-26). Many of these chemicals were only detected in a few samples in one medium above the screening level. For example, acetone, methylene chloride, and bromomethane were detected at low concentrations in a few ground water, surface water, and sediment samples; however, these VOCs were not detected in any of the 40 soil samples analyzed for VOCs. Eight SVOCs and two herbicides were also identified as COPCs (Table 4-26); however, their presence and concentrations at OJT or within the watershed are very limited. Based on the concentration levels and the frequencies of detection in the different environmental media, nine energetic compounds and eight chlorinated VOCs (not including methylene chloride) are listed in Table 4-19 and are considered to be true site-related contaminants that are significant. In addition, 17 metals and nitrate may be site-related contaminants and are also of potential concern. The remainder of this section focuses on the energetic compounds, the chlorinated VOCs (except methylene chloride), and the inorganic COPCs listed in Table 4-26.

## 6.1 CHEMICAL AND PHYSICAL PROPERTIES AFFECTING COPC MOBILITY

Table 6-1 presents physical and chemical properties of the organic COPCs detected at OJT/LSC. These properties can be used to estimate the environmental mobility and fate of site contaminants. The properties that are discussed include the following:

- Specific gravity
- Vapor pressure
- Water solubility

- Octanol/water partition coefficient
- Organic carbon partition coefficient
- Henry's Law constant
- Bioconcentration factor
- Mobility index

Empirically determined literature values of the water solubility, octanol/water partition coefficient, organic carbon partition coefficient, vapor pressure, Henry's Law constant, bioconcentration factor, and specific gravity are presented, when available. Calculated values, which were obtained using approximation methods, are presented when literature values are not available. A discussion of the environmental significance of each of these parameters follows.

### 6.1.1 Specific Gravity

Specific gravity is the ratio of the weight of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a given temperature. Its primary use is to determine whether a chemical will have a tendency to float or sink in water if it is present as a pure chemical or at very high concentrations. Chemicals with a specific gravity greater than 1, including halogenated aliphatics, PAHs, phthalate esters, explosives, and pesticides, will tend to sink. Chemicals with a specific gravity less than 1 (e.g., ketones) will tend to float. This parameter becomes important only when the chemicals are at very high concentrations and are liquid when they are in pure phase. None of the COPCs are at concentrations in ground water or surface water that are great enough to suspect that there is a non-aqueous phase liquid (NAPL) present at the OJT site or in LSC.

### 6.1.2 Vapor Pressure

Vapor pressure provides an indication of the rate at which a chemical volatilizes from both soil and water. It is of primary importance at environmental interfaces such as surface soil/air and surface water/air. Volatilization from stream sediments could also be significant under low-flow conditions (i.e., during summer months and drought conditions) when the sediments are exposed to the atmosphere in a dry creek bed. Volatilization is a significant process that causes loss of VOCs from the surface water, particularly during hot summer weather and turbulent high-flow conditions. Volatilization is not as important when evaluating contaminated ground water and subsurface soils that are not exposed to the atmosphere. Vapor pressures for ketones and halogenated aliphatics are generally many times greater than vapor pressures for PAHs, phthalate esters, and dioxins/furans. Some of the energetic compounds (i.e., 2,4-DNT and TNT) have moderate values of vapor pressure, so they too can be subject to a small

rate of volatilization. Chemicals with higher vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures. Volatilization is a significant loss process for VOCs in surface water or surface soil. Volatilization is not significant for inorganics. Surface soils and surface waters at OJT/LSC do not contain high concentrations of VOCs. Therefore, volatilization from soil is not likely to be an important loss mechanism at this site.

### 6.1.3 Water Solubility

The rate at which a chemical is leached from a waste deposit or contaminated soils by infiltrating precipitation is proportional to its water solubility. More soluble chemicals are more readily leached than less soluble chemicals. The water solubilities presented in Table 6-1 indicate that the VOCs (ketones and halogenated aliphatics) and the energetic compounds are usually several orders of magnitude more water soluble than pesticides, the dioxins/furans, and some of the PAHs. Chemicals with high solubilities have a tendency to migrate at a relatively rapid rate while in solution.

### 6.1.4 Henry's Law Constant

Both the vapor pressure and the water solubility are of use in determining volatilization rates from surface water bodies and from ground water. The ratio of these two parameters (Henry's Law constant) is used to calculate the equilibrium chemical concentrations in the vapor (air) phase versus the liquid (water) phase for the dilute solutions commonly encountered in environmental settings. In general, chemicals having a Henry's Law constant of less than $1 \times 10^{-5}$ atm-m$^3$/mole, such as pesticides and dioxins, should volatilize very little and should be present only in minute amounts in the atmosphere or soil gas. For chemicals with a Henry's Law constant greater than $5 \times 10^{-3}$ atm-m$^3$/mole, such as many of the halogenated aliphatics, volatilization and diffusion in soil gas could be significant.

### 6.1.5 Octanol/Water Partition Coefficient

The octanol/water partition coefficient ($K_{ow}$) is a measure of the equilibrium partitioning of chemicals between octanol and water. A linear relationship between the $K_{ow}$ and the uptake of chemicals by fatty tissues of animal and human receptors (the bioconcentration factor) has been established (Lyman et al., 1990). It is also useful in characterizing the sorption of compounds by organic soils where experimental values are not available. Pesticides, dioxins, and aromatic compounds lacking functional groups that enhance water solubility are several orders of magnitude more likely to partition to fatty tissues than the more soluble VOCs. The $K_{ow}$ is also used to estimate bioconcentration factors in aquatic organisms.

### 6.1.6 Organic Carbon-Water Partition Coefficient

The organic carbon partition coefficient ($K_{oc}$) indicates the tendency of a chemical to adhere to organic matter contained in soils. Nitrogen-containing compounds, such as TNT, 2ADNT, 4ADNT, HMX, and RDX, have relatively low $K_{oc}$ values and tend to be fairly mobile in the environment. Chemicals with high $K_{oc}$s generally have low water solubilities and vice versa. This parameter may be used to infer the relative rates at which the more mobile chemicals (e.g., ketones and halogenated aliphatics) are transported in the ground water. Chemicals such as most pesticides, PAHs, and dioxins/furans are relatively immobile in the soil and are preferentially bound to the soil. These compounds are not subject to ground water transport to the extent that compounds with higher water solubilities are. However, these immobile chemicals can be transported by erosional processes when they are present in surface soils or sediments. Several factors affect the measured value of $K_{oc}$. For example, values of $K_{oc}$ usually decrease with increasing temperature. The fine silt and clay fraction of soil and sediments may have a greater tendency to adsorb chemicals because they often have a greater concentration of organic matter (hence, a greater number of adsorption sites per unit volume).

### 6.1.7 Soil-Water Distribution Coefficient

The soil-water distribution coefficient ($K_d$) is a measure of the equilibrium distribution of a chemical in soil/water systems. The $K_d$ of organic chemicals is a function of both the $K_{oc}$ and the fraction of organic carbon ($f_{oc}$) in the soil.

$$K_d = K_{oc} * f_{oc}$$

The degree to which organic chemicals sorb to soils is very important when assessing migration potential. If a chemical tends to sorb strongly to soil, then there is much less probability that the chemical will reach ground water and affect ground water quality. The presence and mobility of energetic compounds in soils at numerous federal facilities have been investigated and reported in scientific literature and U.S. EPA and USACE reports. The $K_d$ values estimated or measured for energetic compounds at a few of these sites are summarized in Table 6-2.

For the OJT, low concentrations of PAHs were detected in surface and subsurface soils (Tables 4-11 and 4-13), but none were detected in the 16 ground water samples (Table 4-14). Although ground water samples were not analyzed for dioxins/furans, it is even less likely that dioxins/furans could migrate a short distance vertically downward to the water-table surface. Chemicals that migrate slowly through

saturated or unsaturated soils have a relatively long time period where they can be subjected to biodegradation processes before they reach a surface water body.

As a consequence of low migration potential, there is a very low probability that chemicals with very high $K_d$ values (i.e., PAHs and dioxins/furans) will reach surface water bodies via ground water flow. However, if PAHs and dioxins/furans are present at the ground surface, eroded, and transported in surface runoff with soil particles (as a sorbed phase), then there is potential for the compounds to reach LSC. PAHs, one pesticide, and herbicide compounds were detected in LSC sediments (Tables 4-15 and 4-16), but very few of these compounds were detected in the creek water (Tables 4-17 and 4-18). Only two herbicides (pentachlorophenol and 2,4-D) have been identified as COPCs in surface water (Table 4-26). None of the other herbicides, pesticides, or PAHs have been identified as COPCs in surface water. The only means by which these compounds are present or transported in the creek is via the sediment (i.e., sorbed phase).

A total of 38 sediment samples collected from LSC were analyzed for TOC. Values of TOC ranged from less than 1,000 to 34,000 mg/kg. TOC is also expressed as $f_{oc}$ in sediment. For the LSC sediments, the $f_{oc}$ values ranged from less than 0.1 to 3.4 percent (average is 0.88 percent). This amount of organic carbon in the sediments provides a relatively large capacity for sorption of organic compounds.

### 6.1.8 Bioconcentration Factor

The bioconcentration factor represents the ratio of aquatic-animal-tissue concentration to water concentration. The ratio is both contaminant- and species-specific. When site-specific values are not measured, literature values are used or the BCF is derived from the octanol/water coefficient. Many of the pesticides, dioxins, and PAHs will bioconcentrate at levels three to five orders of magnitude greater than those concentrations found in the water, but VOCs and energetic compounds are not as readily bioconcentrated.

### 6.1.9 Mobility Index

The mobility index (MI) is a quantitative assessment of mobility that uses water solubility (S), vapor pressure (VP), and the $K_{oc}$ (Laskowski, et al., 1983). It is defined as

$$MI = \log ((S*VP)/K_{oc})$$

A scale to evaluate MI, as presented by Ford and Gurba (1984), as follows:

| Relative MI | Mobility Description |
|---|---|
| > 5 | extremely mobile |
| 0 to 5 | very mobile |
| -5 to 0 | slightly mobile |
| -10 to –5 | immobile |
| < -10 | very immobile |

Of the organic chemicals detected at OJT/LSC, chlorinated solvents and ketones generally have MIs greater than 5 and are considered extremely mobile. Lighter molecular weight PAHs, such as naphthalene, have MIs ranging from -5 to 0 and are considered slightly mobile. Heavier molecular weight PAHs [e.g., benzo(a)pyrene] and dioxins/furans are classified as very immobile, with MIs less than -10. The MIs of phthalate esters detected at OJT/LSC range from -0.7 to -7.5 and therefore are classified as slightly mobile to immobile. The MIs for organic COPCs detected at OJT/LSC are presented in Table 6-1.

### 6.1.10 Inorganic COPCs

The solubility and mobility of inorganics are strongly influenced by their valence state(s) and mineral forms present in soils (e.g., silicates, hydroxides, oxides, carbonates, etc.). The solubility of a metal also depends on pH, Eh (redox potential), temperature, and other ionic species in solution (the Debye-Huckel theory). Nearly all metals are more soluble at lower water pH values (e.g., less than 5.0). Iron, manganese, and chromium are metals that have more than one valence and are more soluble in the reduced valence states. As a result, these metals are more soluble under reducing conditions. The solubility products reported in the literature vary with the type of complex formed, but generally it can be noted that, for example, cadmium and copper complexes are more soluble than lead and nickel complexes.

The $K_d$ for inorganic constituents is the ratio of the concentration adsorbed on soil surfaces to the concentration in water. $K_d$s for metals vary over several orders of magnitude because the $K_d$ is dependent on the size and charge of the ion and the soil properties governing exchange sites on soil surfaces. Relative mobilities of inorganic COPCs, as a function of environmental conditions in soil, are presented in Table 6-3. This table provides the relative mobilities in a qualitative fashion, in part because environmental conditions are seldom characterized well enough to permit more detail.

## 6.2 CHEMICAL PERSISTENCE AND DEGRADATION PROCESSES

Degradation and other transformation processes that affect the COPCs are discussed in this section, including hydrolysis, biodegradation, photolysis, and oxidation/reduction reactions. Biodegradation rates for some of the more important OJT/LSC organic compounds in soils and ground water, obtained from scientific literature and U.S. EPA and USACE publications, are summarized in Table 6-4.

### 6.2.1 Ketones

Hydrolysis is generally not a significant fate process for this class of chemicals. Acetone has a high vapor pressure and, once released to the atmosphere, photolysis and reaction with hydroxyl radicals result in an average half-life of 22 days (Howard, 1990).

### 6.2.2 Halogenated Aliphatics

Photolysis and oxidation reactions are not considered to be significant degradation mechanisms for this class of compounds (Mabey et al., 1982). Limited hydrolysis of saturated aliphatics (i.e., alkanes) may occur, but it does not appear to be a significant degradation mechanism for unsaturated species (i.e., alkenes) (Mabey et al., 1982).

Six of the chlorinated VOCs detected in soil and ground water samples from the OJT area are chlorinated ethene compounds: tetrachloroethene (PCE), TCE, three dichloroethene (DCE) isomers (1,1-DCE, cis-1,2-DCE, and trans-1,2-DCE), and vinyl chloride Generally, PCE and TCE are sold and used as cleaning solvents, and the DCE compounds and vinyl chloride are considered to be biodegradation products of PCE and TCE. TCE can also be a biodegradation product of PCE. In general, soil microbes strip off chlorine atoms from the ethene chain via reductive dechlorination, one chlorine atom at a time (Aziz et al., 2000):

$$\text{PCE} \rightarrow \text{TCE} \rightarrow \text{DCE} \rightarrow \text{vinyl chloride}$$

The dechlorination of TCE typically produces much more cis-1,2-DCE than either 1,1-DCE or trans-1,2-DCE (Aziz et al., 2000). At the OJT site, TCE was detected frequently (nine of 40 samples) and PCE was detected infrequently (two out of 40 samples) in surface and subsurface soils (Tables 4-11 and 4-13). Cis-1,2-DCE was also detected infrequently (three times), and 1,1-DCE, trans-1,2-DCE, and vinyl chloride were not detected at all in the 40 vadose zone soil samples (Tables 4-11 and 4-13). These data suggest that TCE was the primary chlorinated solvent spilled or disposed at the OJT area and that some biodegradation to cis-1,2-DCE is occurring in the soils. In ground water, TCE was the most frequently

detected (six of 15 wells) and detected at the highest concentration (640 µg/L, well 03-07) of all the chlorinated aliphatics (Table 4-14). Cis-1,2-DCE was detected in five wells, with a maximum concentration of 150 µg/L in well 03-07. Trans-1,2-DCE, 1,1-DCE, and vinyl chloride were also detected in well 03-07, with concentrations ranging from 1.1 to 37 µg/L. The increased presence of cis-1,2-DCE and the first appearance of trans-1,2-DCE, 1,1-DCE, and vinyl chloride in ground water suggest that biodegradation of the chlorinated ethene compounds is occurring around well 03-07 and farther downgradient toward well 03-24.

Two chlorinated ethane compounds were detected in OJT soils: 1,1,2,2-tetrachloroethane (1,1,2,2-PCA) and 1,1,1-trichloroethane (1,1,1-TCA) (Tables 4-11 and 4-13). Although detected in nine out of 40 soil samples, 1,1,1-TCA was not detected in any of the 16 ground water samples collected. Presumably, 1,1,1-TCA is being sequentially biodegraded to 1,1-DCA, chloroethane, and ethane before it reaches the water table although these compounds were not detected in soils or ground water. This pathway for biodegradation is described by Aziz et al. (2000).

1,1,2,2-PCA was only detected in two of the 40 soil samples. However, it was detected in four of 15 ground water samples collected. The maximum 1,1,2,2-PCA concentration in ground water (530 µg/L, well 03-07) was the second highest VOC concentration detected in ground water. 1,1,2-TCA, a biodegradation product of 1,1,2,2-PCA (Lorah et al., 1997), was not detected in any of the OJT soil samples; however, it was detected in three of the 15 ground water samples (maximum concentration = 12 µg/L, well 03-07). This provides evidence that the 1,1,2,2-PCA is biodegrading to 1,1,2-TCA just before and/or after it reaches the water table surface. In addition, the 1,1,2-TCA is also biodegrading to either 1,2-dichloroethane and/or vinyl chloride (Lorah et al., 1997).

Thus, the original chlorinated VOCs spilled at the OJT site were apparently TCE, 1,1,1-TCA, and 1,1,2,2-PCA. Biodegradation of these compounds by soil microbes has apparently resulted in the reduction in overall chlorinated VOC mass at the site and the formation of five or more chlorinated daughter products.

Among the chlorinated aliphatic compounds detected in ground water, TCE was detected at the highest concentration (well 03-07, 640 µg/L). Between adsorption and biodegradation in the ground water flow system and dilution in the creek, none of the chlorinated aliphatic compounds were detected in LSC except TCE. It was detected in only one surface water sample (03SW17) under low-flow conditions (Table 4-17). Creek sample site 03SW17 is located just downstream of where discharges from Springs A and A' enter the creek. TCE has been measured in discharges from these springs in the past (Murphy, 1994; Krothe, 2002). So, it appears that the TCE measured in the creek originated from ABG and

migrated to the creek via these two springs. With additional dilution in the creek and volatilization of TCE from the creek to the atmosphere, TCE was not detected in any samples collected from sampling locations downstream of 03SWSD17.

### 6.2.3 PAHs

PAHs released to soil are much more likely to bind to soil and be transported via erosion and surface water runoff than to go into solution. PAHs are subject to slow degradation via aerobic bacteria but may be relatively persistent in the absence of microbial populations or macronutrients such as phosphorus and nitrogen.

Land-spreading applications have indicated that PAHs are highly amenable to microbial degradation in soil (ATSDR, 1997). The rate of degradation is influenced by temperature, pH, oxygen concentrations, initial chemical concentrations, and moisture. Photolysis, hydrolysis, and oxidation are not important fate processes for the degradation of PAHs in soil (ATSDR, 1997).

The most important fates of PAHs in water are photo-oxidation, chemical oxidation, and biodegradation. PAHs do not contain functional groups that are susceptible to hydrolytic action, and hydrolysis is considered to be an insignificant degradation mechanism. The rate of photodegradation is influenced by water depth, turbidity, and temperature. Benzo(a)pyrene and chrysene are reported to be resistant to photodegradation. PAHs may also be metabolized by microbes under oxygenated conditions (ATSDR, 1997).

PAHs were not detected in any ground water samples collected from the OJT area (Table 4-14) and were not detected in any of the surface water samples (Tables 4-17 and 4-18). PAH compounds were only detected in five or fewer soil samples from the OJT area and four or fewer LSC sediment samples.

### 6.2.4 Dioxins as 2,3,7,8-TCDD

2,3,7,8-TCDD is usually released to the environment primarily through emissions from the incineration of residential, municipal, and chemical wastes, in exhaust from automobiles and diesel vehicles, and from the improper disposal of certain chlorinated chemical wastes. If released to the atmosphere, vapor-phase TCDD may be degraded by reaction with hydroxyl radicals and direct photolysis. Particulate-phase TCDD may be physically removed from air by wet and dry deposition. If released to water, TCDD will predominantly be associated with sediments and suspended material as a sorbed phase. TCDD near the water's surface may experience some photodegradation. Volatilization from the water column may be

important, but adsorption to sediment will limit the overall rate by which TCDD is removed from the creek. The persistence half-life of TCDD in lakes has been estimated to be in excess of 1.5 years.

Photodegradation on terrestrial surfaces may be an important transformation process. Volatilization from soil surfaces during warm conditions may also be a major removal mechanism. The persistence half-life of TCDD on soil surfaces may vary from less than 1 year to 3 years, but half-lives in soil interiors may be as long as 12 years. Screening studies have shown that TCDD is generally resistant to biodegradation.

Dioxins and furans were detected in several surface and subsurface soil samples collected from the OJT area (Tables 4-10 and 4-12). The pattern of contaminant distribution suggest that these chemicals were dispersed during burning operations at the OJT. Although ground water and surface water samples were not analyzed for dioxins/furans, it is assumed that these compounds are not present in ground water because their mobility is so low. It is possible that these compounds might be present in creek sediments due to soil erosion and transport in surface runoff.

### 6.2.5 Energetic Compounds

Nine different nitrogen-containing explosives (i.e., energetic compounds) were detected in soil, ground water, surface water, and sediment samples collected from OJT/LSC. All nine of these compounds have been identified as COPCs for the OJT area and LSC (Table 4-19).

Numerous laboratory studies and past site investigations at Department of Defense facilities have yielded information on the biodegradation of energetic compounds. TNT in soils, ground water, and surface water can degrade biotically or abiotically and can degrade under a fairly wide range of pH and Eh conditions (Price et al., 1997; Brannon et al., 1998; Talmage et al., 1999). The two most common degradation products found in soils and ground water have been 2ADNT and 4ADNT (Li et al., 1981; Daun et al., 1998; Pennington et al., 1999a,b,c). These compounds subsequently degrade to diaminonitrotoluene compounds and other less reactive compounds. 2ADNT and 4ADNT have been found in surface and subsurface soils collected at the ABG (Albertson et al., 1998) and in surface and subsurface soils collected at the OJT area (see Section 5.0). 2ADNT and 4ADNT have also been detected in ground water samples collected at the ABG area, particularly wells 03C08P2 and 03C20 (TtNUS, 2001d), ground water samples collected from the OJT area, particularly well 03-21 (Table 4-14 and Figure 5-5), and Spring A (TtNUS, 2001d). Thus, there is ample evidence that microbial biodegradation of TNT is occurring in soils and the ground water system. Recent research by the USACE (May et al., 2002) suggests that plant uptake and phytoremediation may also be removing and degrading TNT from the soils at ABG.

Scientific studies have also shown that 2,4-DNT, HMX, and RDX are also degraded in soils and ground water (Table 6-4). Recent research by the USACE (May et al., 2002) suggests that plant uptake and phytoremediation may also be removing, degrading, and volatilizing RDX from the soils at ABG.

### 6.2.6 Inorganics

Metals are highly persistent environmental contaminants. They do not biodegrade. However, their valence state and ionic form can readily change based on pH and Eh conditions, biotic uptake and assimilation into living organisms, and decay and decomposition of dead plant matter. The major fate mechanisms for metals are adsorption to the soil matrix or precipitation as a mineral coating, uptake and bioaccumulation in plants, or transport through the hydrologic system.

Nitrate can be present in soils, ground water, and surface water as a result of degradation of nitrogen-containing energetic compounds. In this investigation, nitrate was found in only one monitoring well (03-10) at a concentration, 1.65 mg/L, that was above the background concentration found in well 03-16 (1.29 µg/L). For this reason, nitrate was identified as a COPC for ground water (Tables 4-14 and 4-19). The other 14 monitoring wells had nitrate concentrations less than the background concentration. Thus, there does not appear to be a significant amount of nitrate in the ground water in the vicinity of the OJT as a result of the degradation of energetics. The greatest concentrations of nitrate detected in LSC were 0.2 mg/L under low-flow conditions (site 03SWSD17) and 1.44 mg/L under high-flow conditions (site 03SWSD06). These values are less than the background creek water values, so nitrate is not a COPC in surface water. Hence, there does not appear to be a significant amount of nitrate that is being produced in the watershed as a result of biodegradation of energetic compounds.

## 6.3 CONTAMINANT TRANSPORT PATHWAYS

A contaminant transport pathway represents the physical path or the mechanism by which a contaminant moves or might move from one location (i.e., the source area) to another. A transport pathway may also involve a phase change for the contaminant (e.g., a contaminant is absorbed to soil, volatilizes to soil gas in the vadose zone, and then migrates into basements as a gas). In addition, contaminant transport pathways typically imply that the contaminant is migrating to a new location, which may result in an unacceptable human health or ecological risk at the contaminant destination. The determination of whether a pathway is currently causing a risk or could potentially cause a future risk depends on the combination of chemical characteristics, the existence of a potential pathway, the physical site conditions, and the potential for exposure to occur now or in the future.

This section presents a brief overview of contaminant fate and transport pathways that exist at OJT/LSC. Based on the evaluation of existing conditions at OJT/LSC, the following potential contaminant transport pathways may exist at the site:

- Leaching of soil contaminants to ground water.
- Migration of ground water contaminants within the aquifer.
- Mixing of ground water (i.e., spring discharges and creekbed seepage) with surface water in LSC.
- Erosion and runoff of contaminated particles from soil and deposition in surface water bodies (i.e., LSC).
- Leaching of contaminants from creek sediment to surface water.
- Migration of contaminants in surface water to downstream areas as dissolved or sorbed phases.
- Volatilization from soil, ground water, or surface water.

### 6.3.1 Leaching of Soil Contaminants to Ground Water

Contaminants that adhere to soil particles or have accumulated in soil pore spaces at the OJT site can leach and migrate vertically to the ground water as a result of infiltration of precipitation. The rate and extent of this leaching are influenced by the amount of precipitation, rate of infiltration, the physical and chemical properties of the soil, the physical and chemical properties of the contaminant, and the depth of the water table.

Currently, there are no SVOCs or herbicides detected in ground water whose concentrations are greater than risk-based screening levels. Because of their extremely low mobility, it is assumed that dioxins/furans are also not present in ground water above relevant RBSLs. During the selection of COPCs in soil (Section 4.2), the maximum detected concentrations of individual soil contaminants were compared against SSLs. The SSLs (for protection of ground water) are derived from assumptions regarding aquifer hydraulic conductivity, hydraulic gradient, infiltration rate, mixing zone height, aquifer thickness, source area size, and chemical-specific soil-water $K_d$s. These SSLs for protection of ground water are used to conservatively estimate whether a chemical could potentially leach from soil, migrate to ground water, and increase the ground water concentration to be greater than the pertinent RBSL for ground water.

Based on the above information, eight chlorinated VOCs, energetic compounds, metals, and nitrate are presumably leaching from surface and near-surface soils in the OJT area. Hence, there is a soil-to-ground water migration pathway present at the site for these chemicals.

There is no measurable migration of dioxins/furans, SVOCs, or herbicides to the ground water. However, the soil-to-ground water SSLs indicate that such an exposure pathway is possible. For the OJT site, the SSLs for protection of ground water were exceeded (in at least one soil sample) for all the dioxins/furan compounds, one PAH [benzo(b)fluoranthene], one energetic compound (2,4-DNT), and eight metals (Table 4-14). Some of these chemicals, therefore, could eventually reach the water-table surface and affect ground water quality in the OJT area in the future. In the case of the SVOCs, the dioxins/furans, and the metals, the potential impacts in the future are very improbable, because the $K_d$ values for these chemicals are so large.

### 6.3.2 Migration of Ground Water Contaminants to Little Sulphur Creek

Two primary groups of contaminants were detected in the ground water within the OJT area. Eight chlorinated VOCs comprise the first group. These were detected above human health screening levels in four different wells [03-07, 03-12, 03-15, and 03-24 (Figure 5-5)]. The wells are aligned from southwest to the northeast, and the highest concentrations were detected in well 03-07 in 2001 and in past sampling events It is assumed that the highest concentrations of these VOCs are located in close proximity of 03-07 and that vadose zone soil at this location is the source of the VOCs. Ground water near well 03-07 is flowing primarily to the northeast toward well 03-24 (Figures 1-19 and 1-20). By the time the ground water reaches 03-24, the number of detectable chlorinated VOCs decreases from eight to five, and the concentrations of all the detected VOCs decreases approximately one to two orders of magnitude (Figure 5-5). This large reduction in concentrations occurs over a travel distance of less than 250 feet. A recent dye tracer study (Jock and Krothe, June 2002) performed in the OJT area showed that dye injected in well 03-24 traveled 0.3 mile (about 1,600 feet) and first arrived at Spring C in 7 hours. This dye test supports the conclusion that a karst conduit runs from north (near well 03-24) to south and discharges at Spring C. This supposition is discussed further in Section 1.3.4. A map showing a rough approximation of where this eastern karst conduit is located is presented in Figure 1-18. Thus, hydrologic evidence and the results of a dye tracer test strongly suggest that most of the small chlorinated VOC plume present in the OJT area is entering this karst conduit, traveling rapidly southward, and discharging to LSC via Spring C. At Spring C, virtually no chlorinated VOCs were detected during the ABG RFI for ground water (Murphy, 1994) or the subsequent quarterly monitoring events (e.g., TtNUS, 2001d). A single compound (TCE) was detected at 4 µg/L in a single sample collected from Spring C on April 1, 1991 (Murphy, 1994). However, TCE has not been detected again in this spring in the past 11 years. It is believed that the chlorinated VOCs are not being detected in Spring C because:

- Their concentrations are relatively low in ground water at well 03-24, before entering the karst conduit (concentrations detected at 0.5 to 23 µg/L, Figure 5-5).

- A large amount of ground water is entering the conduit, resulting in substantial dilution (total flow rate can be 10,000 gpm or higher).

- The rapid velocity and turbulent flow in the karst conduit cause a significant amount of volatilization to occur.

Hence, if the chlorinated VOCs from OJT are reaching Spring C and LSC, they are at such a dilute concentration that they are not detectable.

Potentiometric contours of ground water in the OJT area (Figures 1-19 and 1-20) indicate that a ground water ridge lies beneath and adjacent to LSC. Ground water flows in two directions away from the ridge: to the east-northeast and to the south-southwest. As stated above, the source of the chlorinated VOCs lies near 03-07 and most of the ground water contaminated with chlorinated VOCs is migrating northeastward toward well 03-24 and the eastern karst ground water conduit. However, two wells (03-12 and 03-20) located on the southwest side of LSC are also contaminated with chlorinated VOCs, but at very low concentrations (Figure 5-5). These data indicate that a small portion of the VOC-contaminated ground water originating from near 03-07 is flowing south-southwest. The contaminated ground water proceeds in this direction for about 500 to 1,000 feet before it reaches the western karst conduit system, and then proceeds southward to Springs A and A' (Figure 1-18).

The second primary group of contaminants detected in ground water at the OJT is the energetic compounds. Four of these compounds have been identified as COPCs for ground water (TNT, 2ADNT, 4ADNT, and RDX). RDX and HMX are the energetic compounds that have the lowest $K_d$ values and the greatest relative mobilities among the energetics (Table 6-3). These two energetic compounds have been detected in the Spring C discharge in the past. For example, RDX and HMX were detected at 0.72 and 0.51 µg/L on September 13, 1999 (TtNUS, 2001d). Therefore, it is concluded that ground water containing energetic compounds in the OJT area enters the eastern karst conduit, travels rapidly southward with dilution along the way, and discharges from Spring C.

Ground water samples collected from the western side of LSC showed very minor concentrations of TCE, cis-1,2-DCE, 2-ADNT, and 4-ADNT. Well 03-12 also had a moderate concentration of RDX (35 µg/L). The ground water near these wells is flowing southwestward (Figures 1-19 and 1-20) toward the western

karst conduit (Figure 1-18). In the conduit, the contaminants that originate from the OJT area mix with contaminants that originate from the ABG and flow rapidly southward to Springs A and A'.

The concentrations of VOCs and energetics detected in Spring A are greater than concentrations detected in ground water on the western side of LSC, west of the OJT (e.g., well 03-12). Therefore, it is assumed that the majority of the contaminant mass flowing through the western karst conduit originates from the ABG, not the OJT area. In other words, the OJT is contributing only a very small portion of the energetic compounds traveling through the western karst conduit.

Some ground water containing contaminants may be migrating through the karst system and discharging to LSC via different avenues (i.e., smaller springs or diffuse seepage). However, it appears that the eastern and western karst conduits are capturing a very large portion of the ground water flow in the BC-BC aquifer. The regional ground water potentiometric map (Figure 1-18) also shows that ground water in the BC-BC aquifer throughout the watershed is eventually flowing toward LSC at the southern end of the watershed. The flow rate through the karst conduits is so quick that there is no time for microbial biodegradation to occur. However, contaminants in the aquifer at locations away from the conduits are subjected to biodegradation during their slow rate of travel.

### 6.3.3 Migration of Contaminants from Surface Soil to Surface Water

Rainfall, snowmelt, and surface water runoff that come in direct contact with surface soils can leach contaminants from the soils and transport them to LSC. Soil particles containing sorbed contaminants can also be dislodged from the soil surface and be physically transported to the creek via overland runoff. The OJT area is located directly adjacent to LSC, so there is some potential for contaminants to reach the creek as dissolved phase and particulates in overland runoff. However, the topography in the immediate area of OJT is very flat, and the area is also heavily vegetated with trees, bushes, and weeds. Hence, the amount of overland runoff from this site should be very small.

Surface water samples were collected under low-flow and high-flow conditions from LSC at sampling locations shown in Figures 1-5 and 1-7. Surface water sampling point 03SWSD08 is located on the southeastern side of the ABG area, downstream of any ABG treatment activities and upstream of OJT. Sampling point 03SWSD11 is the first surface water sampling station downstream of the OJT. A comparison of analytical results for high-flow samples from these two stations indicates that the concentrations of both total and dissolved antimony, copper, lead, and zinc increased dramatically in LSC water between these two sampling stations (Figure 5-10). These data suggest that overland runoff from the OJT area is contributing these contaminants to the creek water as dissolved phase and sorbed to

suspended sediments. However, the high-flow water sample collected from station 03SWSD13, which is located about 1,200 feet downstream of 03SWSD11, had much lower concentrations of these metals than found at 03SWSD11. At 03SWSD14, located 800 feet farther downstream, the concentrations of these four metals under high-flow conditions were similar to those found upstream of OJT at 03SWSD08 (Figure 5-10. Thus, the OJT area may be creating an increase in antimony, copper, lead, and zinc (total and dissolved) in LSC water as it passes the OJT area; however, the increase diminishes quickly and disappears in the downstream direction. Concentrations of antimony in surface soils at OJT were not found to be greater than background concentrations (Table 4-10), so overland flow from the OJT area should not be influencing the antimony concentration in the creek water. Although the increases in metal concentrations in the creek water near the OJT area during high flow could be attributable to overland runoff from the OJT area, the increases could also be due in part to a temporary suspension and entrainment of creekbed sediments in the water column of the creek during the storm event.

The kind of comparison made above for the high-flow event is not possible to make under low-flow conditions, because sampling stations 03SWSD08, 03SWSD011, 03SWSD13, and 03SWSD014 (the surface water sampling stations closest to the OJT area) were all dry during that sampling event.

### 6.3.4 Transport of Contaminants via Surface Water

Surface water is normally flowing in some of the small channels uphill of the ABG (i.e., the headwaters of LSC) and the channels leading through the ABG. At the eastern end of the ABG, advanced karst development has caused the Beech Creek Limestone and the overlying Big Clifty Sandstone to collapse in the geologic past. In this area, LSC percolates into the ground and disappears from view. It is actually flowing down the LSC valley; however, the flow is in the subsurface through the collapse rubble and alluvium. During normal flow conditions (i.e., between storm events), LSC does not reappear above ground until it reaches Spring C. At that location, the creek bottom is at an elevation that is approximately equal to the base of the Beech Creek Limestone. At this point, ground water in the collapse breccia and ground water in the karst conduits start to emerge at the land surface and provide baseflow to the stream (i.e., the stream becomes a gaining stream south of Spring C). During major storm events, surface water flow can occur from the headwaters all the way southward to the facility property line.

LSC receives all surface runoff and all ground water flow that leaves the ABG and OJT areas. Thus, if contaminants are migrating from these two sites, then they would have to appear in LSC dissolved in the water or sorbed to the sediment. Sediment transport in the creek can be as suspended sediment or as bedload (i.e., sediment traveling on the creek bed itself, rather than suspended in water).

Five energetic compounds and two metals (lead, iron) were identified as COPCs in the creek water during low-flow conditions (Table 4-26). By the time the creek reached the southernmost sampling points on the facility property (03SWSD19), the only contaminant remaining above screening levels was RDX (7.7 µg/L). During high-flow conditions, five energetic compounds and five metals (antimony, cadmium, copper, lead, and zinc) were identified as COPCs in the creek water (Table 4-26). By the time the creek reached the southernmost sampling point on the facility property (03SWSD19), the contaminant remaining above screening levels was again RDX (10.0 µg/L). Thus, transport of contaminants from the ABG and OJT areas to the creek appears to be occurring via the springs, diffuse ground water seepage, and possibly overland runoff. However, VOCs present in the creek water, if any, are volatilizing from the creek surface to the atmosphere before the creek reaches the property line. Any metals that were present upstream in the water column (dissolved and sorbed to suspended solids) are presumably retained on sediment and deposited on the creek bed to a large extent. Transport of metals off site in the creek water is not a significant process.

The distribution of contaminants found in Little Sulfur Creek sediments indicates that very similar levels of VOCs, PAHs, explosives, herbicides, and metals were found in shallow (depth of 0 to 6 inches) versus deep sediments (depth of 6 to 12 inches). The chemicals detected in sediments that were identified as COPCs include nine metals, six energetic compounds, and three SVOCs (Table 4-26). In most cases, the maximum concentrations detected in the sediments were only slightly greater than screening levels. Hence, there does not appear to be a significant amount of contaminants residing in the LSC sediments. By the time the sediment reaches the southern end of the watershed near the property line (03SWSD19), no chemicals were detected in the sediment that exceeded human health screening criteria and only three metals (cadmium, copper, and lead) and no organics were detected that exceeded ecological screening criteria (Figures 5- and 5-8). Thus, the export of contaminants from NSWC Crane via LSC sediment load appears to be very small, although transport rates do increase during high-flow events.

## 6.4 SUMMARY OF CONTAMINANT MIGRATION

The chlorinated VOC concentrations detected in soils at the OJT area are relatively minor; it appears that the chlorinated solvents have leached out of or volatilized from the soils in the past and only a small mass of these contaminants still resides in the soils. However, a larger quantity of energetic compounds still resides in the soils. In addition, small residual quantities of other VOCs and SVOCs (e.g., PAHs) were detected in the surface and near-surface soils. Because the SVOCs, dioxins/furans, and herbicides have relatively low solubilities and very high $K_d$ values, their mobility in subsurface soils is very limited. In the case of the OJT area, these compounds were not detected at all in ground water. The energetic compounds and the chlorinated VOCs were the only compounds that were at sufficiently high concentrations in the soils and low

enough $K_d$ values to have any effect on ground water quality. There is a small distinct plume in the OJT area ground water that contains the chlorinated VOCs. This area includes three wells (03-07, 03-15, and 03-24) that lie along the southwest-northeastern axis of the plume and three wells that lie on the periphery of the plume (03-12, 03-20, and 03-22). Well 03-07 contained the greater concentrations of chlorinated VOCs during this investigation, as well as during a previous sampling event in September 1994 (Murphy, 1996). This indicates that the source of the TCE, 1,1,2,2-PCA, and some of the other VOCs is located close to well 03-07. Some of the other chlorinated VOCs (e.g., cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, vinyl chloride) are the degradations products of the primary contaminants. Hence, degradation of these compounds is occurring in the shallow ground water system and possibly in the vadose zone soils as well.

Energetic compounds were detected in 13 of the 16 monitoring wells sampled in the OJT area during this investigation (Figure 5-5), including the background well 03-21 located northwest of the OJT area in the direction of the ABG. The greatest concentrations of energetics at the OJT area were found in well 03-21, which is located along Jeep Trail 25 and southeast of the burn pit. Thus, it appears that the burn pit may have been a source of some of the energetics detected in ground water; however, there also appears to be a plume of energetic contaminants that have moved southeastward into the OJT area along LSC; these energetic compounds in ground water (e.g. wells 03-21, 03-23) originated from upvalley in the ABG.

The ground water in the ABG and OJT does not move rapidly through the areas because the hydraulic conductivities are generally less than 4 feet/day (Table 1-2). However, there are at least two karst conduit systems, one on each side of the creek, that draw ground water from beneath the two sites and transfer the water quickly southward toward the springs. The results of dye tracer studies indicate that contaminated ground water in the Big Clifty/Beech Creek/collapse breccia aquifer at the ABG and OJT areas enters karst conduits, and travels rapidly southward, and exits the ground water system via Springs A, A', C, and several very minor seeps. Ground water from these seeps and springs immediately enters LSC.

The chlorinated VOCs traveling from the OJT area to Spring C through the eastern karst conduit are volatilized and diluted. They do not reach the outlet of Spring C in measurable concentrations. The energetic compounds travel through the eastern karst conduit and are greatly diluted, but not volatilized, during migration through the conduit.

Little Sulphur Creek receives dissolved contaminants from the ground water system via springs, seeps, and diffuse seepage through the streambed. During significant rainstorm and snowmelt events, the flow rates in the springs rise rapidly (Figure 1-21) in response to a rapid influx of water into the karst conduits. Because of the rapidity with which the flow rates increase, the water entering the conduits during the storm events is likely a combination of surface water entering the conduits directly and some ground

water that travels through macropores or preferential pathways in the soil and/or bedrock. In any case, water enters both of the conduits quickly and travels through the conduits quickly. The spring discharges can become quite turbid during these peak flow events, indicating that the surface water and/or ground water entering the conduits are bringing in eroded soil particles with them and transporting them to the creek. Therefore, at least some of the contaminants transported to the stream are sorbed to the suspended sediment during peak flow events.

LSC is perennial south of Spring C, because of the large amount of ground water that is entering the creek as springs and baseflow. The ground water entering LSC comes from both sides of the creek and drains a substantial portion of the watershed. The large amount of total seepage into the creek appears to dilute the contaminants that are migrating from a small portion of the watershed. If present at all, the VOCs are likely volatilizing from the shallow, turbulent creek. Organic compounds (e.g., PAHs), if present in the water column, are probably sorbing to sediment and gradually biodegrading in the creek bed. Metals with high $K_d$ values, if present, are also sorbing to the sediment and removed from the creek water.

By the time the creek reaches the southern end of the watershed near the facility property line, the concentrations of contaminants in the creek water and sediments are the lowest or almost the lowest for the entire watershed. There are no contaminants in the creek water or the creek sediments at 03SWSD19 that exceed human health screening criteria. There are no contaminants in the creek water and only three metals in the sediments at 03SWSD19 that exceed ecological screening criteria (Figures 5-7 through 5-10).

Reiterating the discussions concerning hydrology and hydrogeology in Section 1.0, all ground water in the watershed, including the contaminanted ground water, flows toward Little Sulphur Creek and discharges to the creek primarily as springs. The potentiometric map of the BC-BC aquifer (Figure 1-18) indicates the regional flow southward and toward the creek. There is no indication that ground water flow or contaminants are leaving the watershed via ground water flow (i.e., interwatershed transfers). The same is true for surface runoff and overland flow. All runoff and surface transport of contaminants from the treatment/disposal areas end up in LSC Therefore, any migration of contaminants in the watershed eventually end up in LSC by the time it reaches the facility property line.

TABLE 6-1

PHYSICAL AND CHEMICAL CHARACTERISTICS OF ORGANIC CHEMICALS OF POTENTIAL CONCERN
SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical | Specific Gravity (@ 20/4°C)[1] | Vapor Pressure (mm Hg @ 20°C)[1] | Water Solubility (mg/L @ 20°C)[1] | Octanol/Water Partition Coefficient[1] | Organic Carbon Partition Coefficient[2] | Henry's Law Constant (atm-m$^3$/mole)[1] | Bioconcentration Factor (mg/kg/mg/L)(2) | Mobility Index log((solubility*VP)/$K_{oc}$) |
|---|---|---|---|---|---|---|---|---|
| **KETONES** | | | | | | | | |
| Acetone | 0 7899 | 2 66E+2 (25°C) | Miscible | 5 75E-01 | 7 08E+03[3] | 4 276E-5 (25°C) | 3 81E-1[4] | NA |
| Acetophenone | 1 033 | 4 40E-01 | 6 13E+03 | 3 80E+01 | 2 14E+01 | 1 07E-5 (25°C) | 1 20E+01 | 2 10E+00 |
| **HALOGENATED ALIPHATICS** | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | 1 60 (15/4°C) | 6 50E+01 | 2 77E+02 | 2 45E+02 | 9 33E+01 | 3 45E-04 | 3 90E+01 | 2 29E+00 |
| 1,1,2-Trichloroethane | 1 4397 | 2 50E+01 | 4 42E+02 | 1 12E+02 | 5 01E+01 | 9 13E-04 | 1 90E+01 | 2 34E+00 |
| 1,1-Dichloroethene | 1 218 | 5 91E+2 (25°C) | 2 1E+2 (25°C) | 3 02E+01 | 5 89E+01[3] | 2 286E-2 (25°C) | 5 30E+01 | 3 32E+00 |
| Bromomethane | 1 73 (0/0°C) | 1 824E+3 (25°C) | 9 00E+02 | 1 10E+00 | 2 10E+00 | 6 24E-03 | 4 70E+00 | 5 89E+00 |
| cis-1,2-Dichloroethene | 1 2837 | 2 02E+2 (25°C) | 8 00E+02 | 1 58E+02 | 3 55E+01[3] | 4 08E-3 (24 8°C) | 1 4E+1[5] | 3 66E+00 |
| Methylene chloride | 1 3266 | 4 29E+2 (25°C) | 1 67E+4 (25°C) | 1 78E+01 | 1 17E+01[3] | 3 19E-3 (25°C) | 6 00E+00 | 5 79E+00 |
| Tetrachloroethene | 1 6227 | 1 9E+1 (25°C) | 1 5E+2 (25°C) | 3 39E+02 | 1 55E+02[3] | 2 685E-2 (25°C) | 2 52E+02 | 1 26E+00 |
| trans-1,2-Dichloroethene | 1 2565 | 3 31E+02 | 6 30E+03 | 1 17E+22 | 5 25E+01 | 9 38E-03 | 4 80E+01 | 4 60E+00 |
| Trichloroethene | 1 4624 | 7 10E+01 | 1 10E+03 | 5 13E+02 | 1 66E+02 | 1 03E-02 | 9 70E+01 | 2 67E+00 |
| Trichlorofluoromethane | 1 494 | 8 03E+02 | 1 10E+03 | 3 39E+02 | 1 58E+02 | 2 39E+00 | 4 70E+01 | 3 75E+00 |
| Vinyl chloride | 0 9106 | 2 58E+03 | 1 1E+3 (25°C) | 3 98E+00 | 1 86E+01[3] | 2 78E-2 (25°C) | 5 70E+00 | 5 18E+00 |
| **POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs)** | | | | | | | | |
| Anthracene | 1 283 (25/4°C) | 1 95E-4 (25°C) | 1 29E+0 (25°C) | 2 82E+04 | 2 95E+04[3] | 8 6E-5 (25°C) | 4 70E+03 | -8 07E+00 |
| Benzo(a)anthracene | 1 274 | 5 00E-09 | 1E-2 (24°C) | 4 07E+05 | 3 98E+05[3] | 6 60E-07 | 5 30E+04 | -1 59E+01 |
| Benzo(b)fluoranthene | NA | 5 00E-07 | 1 2E-3 (25°C) | 3 72E+06 | 1 23E+06[3] | 1 20E-05 | 1 40E+05 | -1 53E+01 |
| Benzo(k)fluoranthene | NA | 9 59E-11 | 5 5E-4 (25°C) | 6 92E+06 | 1 23E+06[3] | 1 04E-03 | 1 40E+05 | -1 94E+01 |
| Benzo(g,h,i)perylene | NA | 1 00E-10 | 2 6E-4 (25°C) | 1 70E+07 | 1 60E+06 | 1 4E-7 (25°C) | 3 50E+05 | -1 98E+01 |
| Benzo(a)pyrene | 1 351 | 5 00E-09 | 3 8E-3 (25°C) | 9 55E+05 | 1 02E+06[3] | 4 9E-7 (25°C) | 1 40E+05 | -1 67E+01 |
| Chrysene | 1 274 (20°C) | 6 3E-9 (25°C) | 6E-3 (25°C) | 4 07E+05 | 3 98E+05[3] | 1 05E-6 (25°C) | 5 30E+04 | -1 60E+01 |
| Dibenzo(a,h)anthracene | 1 282 | 1 00E-10 | 5E-4 (25°C) | 9 33E+05 | 3 80E+06[3] | 7 3E-8 (25°C) | 6 90E+05 | -1 99E+01 |
| Fluoranthene | 1 252 | 5 0E-6 (25°C) | 2 65E-1 (25°C) | 2 14E+05 | 1 07E+05[3] | 6 5E-6 (25°C) | 1 20E+04 | -1 09E+01 |
| Indeno(1,2,3-cd)pyrene | NA | 1E-10 (25°C) | 6 20E-02 | 4 57E+07 | 3 47E+06[3] | 6 95E-8 (25°C) | 3 50E+05 | -1 77E+01 |
| 2-Methylnaphthalene | 1 0058 | 1E+1 (105°C) | 2 6E+1 (25°C) | 7 24E+03 | 7 27E+2[6] | 4 99E-4 (25°C) | 5 1E+2[4] | -4 47E-01 |
| Naphthalene | 1 162 | 8 2E-2 (25°C) | 3E+1 (25°C) | 2 34E+03 | 2 00E+03[3] | 4 83E-4 (25°C) | 4 20E+02 | -2 91E+00 |
| Phenanthrene | 0 980 (4°C) | 1E+0 (118 2°C) | 8 16E-1 (21°C) | 2 88E+04 | 1 40E+04 | 3 93E-5 (25°C) | 4 70E+03 | -4 23E+00 |
| Pyrene | 1 271 (23/4°C) | 2 5E+0 (200°C) | 1 6E-1 (26°C) | 1 51E+05 | 1 05E+05 (3) | 5 1E-6 (25°C) | 1 20E+04 | -5 42E+00 |
| Acenaphthene | 1 07 | 5 00E-03 | 4 24E+02 | 8 32E+03 | 7 08E+03 | 1 55E-04 | 1 10E+03 | -3 52E+00 |
| Acenaphthylene | 1 02 | 2 30E-02 | 1 61E+01 | 1 17E+04 | 2 00E+03 | 1 14E-04 | 3 80E+02 | -3 73E+00 |
| Fluorene | 1 202 | 1 00E+01 | 1 98E+00 | 1 62E+04 | 1 38E+04 | 6 36E-05 | 3 80E+03 | -2 84E+00 |
| **PHTHALATE ESTERS** | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 0 99 (20/20°C) | 1 2E+0 (200°C) | 4E-1 (25°C) | 2 00E+05 | 1 51E+07[3] | 3 00E-07 | 2 30E+08 | -7 50E+00 |
| **DIOXINS/FURANS(9)** | | | | | | | | |
| TCDDs | NA | 1 4E-8 (25°C) | 3 3E-4 (25°C) | 3 2E+06 | 1 1E+02 - 3 2E+08 | 1 70E-05 | 5 4E+03 - 7 9E+05 | -1 66E+01 |
| PeCDDs | NA | 5 6E-10 (25°C) | 1 18E-04 | 4 0E+06 | 7 1E+04 - 2 4E+06 | 2 60E-06 | 1 90E+05 | -1 88E+01 |
| HxCDDs | NA | 4 4E-11 (25°C) | 4 4E-6 (25°C) | 2 0E+07 | 1 0E+05 - 1 3E+07 | 1 10E-05 | 1 7E+03 - 1 0E+05 | -2 18E+01 |
| HpCDDs | NA | 3 2E-11 (25°C) | 2 40E-06 | 1 0E+08 | 3 0E+05 - 6 3E+07 | 1 26E-05 | 5 1E+02 - 4 8E+04 | -2 28E+01 |
| OCDD | NA | 8 25E-13 (25°C) | 7 4E-8 (25°C) | 1 6E+08 | 8 3E+05 - 7 9E+07 | 6 75E-06 | 7 9E+01 - 1 3E+04 | -2 61E+01 |
| TCDFs | NA | 2 5E-8 (25°C) | 4 2E-4 (22 7°C) | 1 6E+06 | 1 6E+05 - 3 2E+07 | 1 40E-05 | 2 5E+03 - 6 6E+04 | -1 73E+01 |
| PeCDFs | NA | 2 7E-9 (25°C) | 2 4E-4 (22 7°C) | 2 5E+06 | 3 9E+05 - 2 5E+07 | 5 00E-06 | 5 0E+03 - 1 4E+05 | -1 87E+01 |
| HxCDFs | NA | 2 8E-10 (25°C) | 1 3E-5 (22 7°C) | 1 0E+07 | 2 50E+07 | 1 10E-05 | 8 90E+04 | -2 18E+01 |
| HpCDFs | NA | 4 7E-11 (25°C) | 1 4E-6 (22 7°C) | 2 5E+07 | 1 0E+05 - 7 9E+07 | 1 40E-05 | 2 90E+04 | -2 26E+01 |
| OCDF | NA | 3 75E-12 (25°C) | 1 16E-6 (25°C) | 1 0E+08 | 1 0E+06 - 2 5E+07 | 1 88E-06 | 5 9E+02 - 7 9E+03 | -2 41E+01 |

TABLE 6-1

PHYSICAL AND CHEMICAL CHARACTERISTICS OF ORGANIC CHEMICALS OF POTENTIAL CONCERN
SWMU 03 – OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical | Specific Gravity (@ 20/4°C)[1] | Vapor Pressure (mm Hg @ 20°C)[1] | Water Solubility (mg/L @ 20°C)[1] | Octanol/Water Partition Coefficient[1] | Organic Carbon Partition Coefficient[2] | Henry's Law Constant (atm-m$^3$/mole)[1] | Bioconcentration Factor (mg/kg/mg/L)(2) | Mobility Index log((solubility*VP)/$K_{oc}$) |
|---|---|---|---|---|---|---|---|---|
| **EXPLOSIVES** | | | | | | | | |
| 2,4,6-Trinitrotoluene | 1 654 (20/4°C) | 2 0E-01[7] | 1 24E+02 | 1 00E+00 | 1 00E+00 | 1 37E-05 | 3 3E+01[4] | 1 39E+00 |
| 2,4-Dinitrotoluene | 1 32E+00 | 1 1E+00[7] | 2 70E+02[3] | 1 02E+02[3] | 9 55E+01[3] | 9 28E-08[3] | 1 9E+01[4] | 4 93E-01 |
| 2-Amino-4,6-dinitrotoluene | NA | 5 30E-08 | 2 80E+03 | 1 15E+01 | 4 00E+00 | 3 95E-09 | NA[8] | -4 43E+00 |
| 4-Amino-2,6-dinitrotoluene | NA | NA[8] | NA[8] | NA[8] | NA[8] | NA[8] | NA[8] | NA |
| HMX | NA | NA[8] | NA[8] | 3 89E+00 | 3 80E+00 | | 1 7E+00[4] | NA |
| RDX | 1 82 | NA[8] | 5 98E+01 | 7 41E+00 | 7 89E+01 | 6 30E-08 | 1 92E+02[4] | NA |
| **HERBICIDES** | | | | | | | | |
| Pentachlorophenol | NA | 1 10E-4 (25°C)[7] | 1 4E+1 (25°C)[7] | 5 12E+00[7] | 5 92E+02[10] | 2 45E-8 (25°C) | 1 09E+02 [11] | -5 58E+00 |

COPC - Chemicals of potential concern
NA - Not available

1 US EPA, 1992
2 Mabey et al , 1982
3 US EPA, 1996b Soil Screening Guidance
4 Lyman et al , 1990 Eq 5-2
5 Lyman et al , 1990, Equation 5-3
6 Lyman et al , 1990 Equation 4-5
7 Syracuse Research Corporation Online Database Interactive Physical Properties Database Demo www esc syrres com/efdb htm Web site last update October 17, 2001
8 Howard, 1989 Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume 1
9 US EPA, 2000c Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds EPA/600/P-00/001BC Draft Final Report Part I, Volume 3 National Center for Environmental Assessment Washington, DC
10 ORNL Risk Assessment Information System
11 US EPA, 1999g Screening Level Ecological Risk Assessment Protocol for Hazardous Waster Combustion Facilities, Appendix C Media-to-Receptor Bioconcentration Factors (BCFs)

**TABLE 6-2**

**PARTITION COEFFICIENTS OF ENERGETIC COMPOUNDS**
**SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

| COMPOUND | Kd (1) (L/kg) | REFERENCE |
|---|---|---|
| RDX | 0.21 - 0.33 (0.30) | Pennington et al., 1999c |
| | 0.80 - 4.15 (2.67) | Sikka et al., 1980 |
| | 1.4, 4.2 (2.8) | Spanggord et al., 1980b |
| | 0.2 - 7.8 (4.05) | Hale et al., 1979 |
| | (2.17) | Layton et al., 1987 |
| | 0.101, 0.284 (0.19) | AMEC, 2001 |
| | 1.57, 1.59 (1.58) | Xue, Iskandar, and Selim, 1995 |
| | 0.12 - 2.37 (0.89) | Ainsworth et al., 1993 |
| | 0.95, 0.97 (0.96) | Singh et al., 1998 |
| | 0.2 - 7.8 | Townsend and Meyers, 1996 |
| | 6.38 | Sheremata et al., 2001 |
| | 0.29 | Price et al., 2000 |
| | 0.42 | May et al., 2002 |
| TNT | 2.0 - 11.0 (4.0) | Pennington and Patrick, 1990 |
| | 5.5 - 22.2 (14.6) | Sikka et al., 1980 |
| | 5.5 - 19.3 | Spanggord et al., 1980a |
| | 1.1, 2.5 (1.8) | AMEC, 2001 |
| | 0.08 - 0.33 (0.23) | Pennington et al., 1999c |
| | 2.58 | May et al., 2002 |
| 2ADNT | 3.7, 4.9 (4.3) | Pennington and Patrick, 1990 |
| | 2.42 | May et al., 2002 |
| 4ADNT | 2.42 | May et al., 2002 |

1 Individual values or range of values listed in column; average value shown in parentheses.

**TABLE 6-3**

**RELATIVE MOBILITIES OF METALS AS A FUNCTION OF ENVIRONMENTAL CONDITIONS (Eh,pH)**
**SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

| | Environmental Conditions | | | |
|---|---|---|---|---|
| Relative Mobility | Oxidizing | Acidic | Neutral/Alkaline | Reducing |
| Very High | | | Se | |
| High | Se, Zn | Se, Zn, Cu, Ni, Hg,Ag | | |
| Medium | Cu, Ni, Hg, Ag, As, Cd | As, Cd | As, Cd | |
| Low | Pb, Ba, Se | Pb, Ba, Be | Pb, Ba, Be | |
| Very Low | Fe, Cr | Cr | Cr, Zn, Cu, Ni, Hg, Ag | Cr, Se, Zn, Cu, Ni, Hg, Pb, Ba, Be, Ag |

Notes:

As = Arsenic
Ag = Silver
Ba = Barium
Be = Beryllium
Cd = Cadmium
Cr = Chromium
Cu = Copper
Fe = Iron
Hg = Mercury
Ni = Nickel
Pb = Lead
Se = Selenium
Zn = Zinc
Eh = Standard Redox Potential

Source: Swartzbaugh et al., 1992.

TABLE 6-4

BIODEGRADATION CHARACTERISTICS OF ORGANIC CHEMICALS OF POTENTIAL CONCERN
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

| COMPOUND | Half-life[1] (years) | Reference |
|---|---|---|
| RDX | 36<br>0.88 - 10.7+ (10.6) | DuBois and Baytos, 1991<br>Pennington et al., 1999c |
| TNT | 1.0<br>0.1<br>0.88 - 10.7+ (4.1)<br>1.11 | DuBois and Baytos, 1991<br>Cataldo et al., 1989<br>Pennington et al., 1999c<br>May et al., 2002 |
| 2ADNT | < 0.05<br>< 0.05 | Funk et al., 1993<br>Alvarez et al., 1995 |
| 4ADNT | - | - |

1 Individual values or range of values listed in column; average value shown in parentheses.

# 7.0 HUMAN HEALTH RISK ASSESSMENT

This section presents the HHRA for the OJT and LSC at NSWC Crane. The objective of the risk assessment is to determine whether detected concentrations of chemicals within the study areas pose a significant threat to potential human receptors under current and/or future land use. The potential risks to human receptors are estimated based on the assumption that no actions are taken to control contaminant releases.

## 7.1 INTRODUCTION

The following current U.S. EPA and the IDEM risk assessment guidance documents were used to develop the framework for the HHRA:

- Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A). (U.S. EPA, 1989a).
- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. Washington, D.C. OSWER Directive 9285.6-03 (U.S. EPA, 1991).
- Supplemental Guidance to RAGS: Calculating the Concentration Term. OSWER Publication No. 9285.7-081 (U.S. EPA, 1992b).
- Distribution of Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, D.C. (U.S. EPA, 1993a).
- Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response, Washington, D.C. EPA/540/R-95/128 (U.S. EPA, 1996b).
- Exposure Factors Handbook. Office of Health and Environmental Assessment, Washington, D.C. EPA/600/P-95/002Fa (U.S. EPA, 1997d).
- RISC (Risk-Integrated System of Cleanups). Technical Resource Guidance Document. Indiana Department of Environmental Management, Office of Environmental Response (IDEM, 2001).

- Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) (U.S. EPA, 1998a).

- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim, EPA/540/R/99/005, Office of Emergency and Remedial Response, Washington, D.C. (U.S. EPA, 2001).

This HHRA also follows the methodology and decision rules presented in the QAPP (TtNUS, 2001b).

An HHRA consists of five components: data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. Sections 7.2 through 7.6 contain detailed discussions of the five components of the HHRA. A schematic diagram of the general risk assessment process is provided as Figure 7-1.

Three major aspects of chemical contamination and environmental fate and transport must be considered to evaluate potential risks· Contaminants with toxic characteristics must be found in environmental media; potential exposure points must exist; and human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the factors listed above is absent for a site, the exposure route is regarded as incomplete, and no potential risks will be considered to exist for human receptors.

## 7.2 DATA EVALUATION

Data evaluation, the first component of an HHRA, is a medium-specific task involving the compilation and evaluation of analytical data. The main objective of the data evaluation is to develop a medium-specific list of COPCs, which are used to quantitatively determine potential human health risks for site media.

### 7.2.1 Data Usability

Data collected from the field investigation were used to assess risks to potential human receptors. All analytical data used in the quantitative estimation of potential risks were subject to a data quality evaluation. A discussion of the data validation protocol is provided in Section 3.1 of this report. A data quality report is included in Section 3.0 that provides information on precision, accuracy, representativeness, completeness, and comparability of the analytical data.

Fixed-based laboratory analytical results only for the targeted analytes for the investigation were used in the quantitative risk evaluation. Typically, unfiltered results for ground water and surface water are used to assess risks associated with those media. Field measurements and data regarded as unreliable (i.e., qualified as "R" during the data validation process) were not used in the quantitative risk assessment.

### 7.2.2 Selection of Chemicals of Potential Concern

Chemicals that were retained as COPCs and evaluated in this HHRA were identified in Section 4.2 and summarized in Table 4-19.

## 7.3 EXPOSURE ASSESSMENT

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

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

### 7.3.1 Conceptual Site Model

This section discusses the conceptual site model (CSM) for the OJT/LSC. A CSM model facilitates consistent and comprehensive evaluation of the potential risks to human health by creating a framework for identifying the pathways by which human receptors may come in contact with contaminated media resulting from the source area. A CSM depicts the relationships among the following elements, which are necessary for defining complete exposure pathways:

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

Physical site characteristics, results of previous site investigations, hazard identification (detected chemicals of interest based on the previous investigations), and current and future land use scenarios also were considered during the development of the site-specific CSM. Details on the site background, physical setting, previous investigations, and hazard identification were presented in Section 1.0. The site-specific CSM for the OJT/LSC is presented in Figure 7-2 in this section.

The elements of the CSM (contaminant source, release mechanisms, transport/migration pathways, exposure routes, and potential receptors) establish the manner and degree to which a potential receptor may be exposed to chemicals present at the site. The degree of risk incurred by a potential receptor varies according to the means of exposure, the duration of exposure, and the specific chemical to which the receptor is exposed. An exposure, however long in duration, does not necessarily result in an "unacceptable" health or environmental risk, although risks generally increase with increased frequency and/or duration of exposure.

The elements of the CSM, including how they pertain to the OJT/LSC, are presented in Sections 7.3.1.1 through 7.3.1.3.

#### 7.3.1.1 Site Sources of Contamination

Based on the site investigations, the following parameters are among the site-related chemical contaminants known to be present or potentially present in environmental media within the study area:

- Explosives (e.g., TNT and HMX) and their degradation products (e.g.,2-ADNT).
- Metals (e.g., lead).
- Chlorinated VOCs including but not limited to 1,1,2,2-trichloroethane, 1,2-dichloroethene, trichloroethene, and vinyl chloride.

#### 7.3.1.2 Potential Contaminant Release Mechanisms and Transport Pathways

Past activities at the OJT/LSC appears to have resulted in contaminant releases to the surrounding environment. A summary of the contaminant release mechanisms that may have occurred at the OJT/LSC is as follows:

- Transport of surface soil contaminants to the subsurface soils and ground water via infiltration, percolation, and migration within the ground water aquifer.

- Recharge of ground water via surface waters. The study area in the vicinity and immediately downgradient of the ABG is a ground water recharge area. LSC is a "losing stream" just below the ABG.

- Discharge of ground water to surface water and sediments as noted at Spring A, B, and C located downstream of the source areas. LSC becomes a "gaining stream" downstream of the OJT in the vicinity of Spring C, which feeds LSC.

- Overland runoff of surface waters and sediments from the ABG and the OJT toward and into LSC. (On-site surface soil contaminants at the OJT may also migrate to off-site soils as a result of overland flow of surface waters.)

A discussion of potential contaminant transport pathways was presented in Section 6.0.

#### 7.3.1.3 Potential Current and Future Receptors of Concern and Exposure Pathways

NSWC Crane is an active naval base and will remain active for the foreseeable future. The ABG is an active and RCRA-permitted open burning ordnance treatment unit, and there are no plans to close the unit. In contrast, the OJT is no longer used as a treatment area and is likely to be used for military (non-disposal) purposes in the future. However, for purposes of completeness, the baseline risk assessment considers receptor exposure under residential, industrial, and recreational land use scenarios. Based on current and potential future land use, the following potential receptors may be exposed to contaminated environmental media within the study area:

- Trespassers – A plausible receptor under current or future land use. Although access to the base is controlled, once inside the base, access to the study area is not limited by any physical constraints (this is particularly true for the OJT). In addition, hunting activities are permitted at the base. Because the study area is relatively remote and surrounded by forested areas, hunters (particularly adolescents) may trespass within the study area. This receptor may be exposed to potentially contaminated surface soil (0 to 2 feet bgs) (incidental ingestion; dermal contact), air (inhalation), surface water (incidental ingestion; dermal contact), and sediments (incidental ingestion; dermal contact) in the intermittent streams. However, because of the intermittent nature of surface water in some portions of LSC, exposure to surface water is likely to be very limited for those portions (e.g., the section adjoining the OJT). Direct contact with ground water (except where ground water has discharged to LSC) or subsurface soils is not anticipated for this receptor. Potential risks to hunters

from ingestion of game species that were caught on-site will be qualitatively evaluated in Section 7.6, Uncertainty Analysis.

- Maintenance Workers – A plausible receptor under future land use. This includes adult military or civilian personnel assigned duties infrequently within the study area (e.g., grounds keeping activities, storm sewer and drainage maintenance). This receptor could be exposed to surface soils (incidental ingestion; dermal contact; and inhalation of fugitive dust and volatile emissions), surface water (dermal contact), and sediments (incidental ingestion; dermal contact). Direct contact with ground water or subsurface soils is not anticipated for this receptor. While maintenance workers might incidentally ingest soil or sediment that has adhered to their hands through unintentional hand to mouth activity, it is unlikely that they would incidentally ingest significant quantities of surface water. Consequently, incidental ingestion of surface water is not evaluated for a maintenance worker. There are currently no maintenance workers assigned to the OJT or to LSC.

- Construction Workers – A plausible receptor under future land use. No construction activities are currently planned for the study area. Additionally, the shallow depth to ground water in some sections of the study area would likely preclude excavation and construction. However, excavation and construction are plausible in other sections of the study area. Consequently, this receptor could be exposed to surface and subsurface soils (incidental ingestion; dermal contact; and inhalation of fugitive dust and volatile emissions), and ground water (dermal contact and inhalation of volatile emissions). Routine exposure to surface water and sediments is not expected for the construction worker.

- Occupational Worker – A plausible receptor under future land use for the OJT. (It should be noted that base workers are currently assigned to the ABG.) This includes adult military or civilian personnel assigned to routine daily work tasks. This receptor could be exposed to surface soil (incidental ingestion; dermal contact; and inhalation of fugitive dust and volatile emissions). It is anticipated that this receptor would not be routinely exposed to subsurface soils, surface waters, or sediments. Conservatively, it will be assumed that the occupational worker may be exposed to ground water (ingestion; dermal contact). (It should be noted that a public water supply is not currently available within the study area.) This receptor is expected to be exposed on a more frequent basis than the maintenance or construction worker. (It should be noted that water is currently supplied via a well in the Beaver Bend aquifer. This well is tested regularly and is not in the path of the contaminant migration.)

- Recreational Users – A plausible receptor under future land use. If NSWC Crane were to close, the most likely scenario is that the property would be converted to a park. A recreational user may be

exposed to potentially contaminated surface soil (0 to 2 feet bgs) (incidental ingestion; dermal contact; and inhalation of fugitive dust and volatile emissions), and surface water (incidental ingestion; dermal contact) and sediments (incidental ingestion; dermal contact) in LSC. Conservatively, it will be assumed that the recreational user may be exposed to ground water (ingestion; dermal contact; and inhalation of volatile emissions). (A public water supply is not currently available within the study area.) Surface water in the vicinity of the OJT is intermittent and exposure is expected to be very limited. Direct contact with subsurface soils is not anticipated for this receptor. NSWC Crane is not expected to close because principal base operations, the demilitarization of munitions, are critical to the support of the U.S. Naval fleet.

- On-Site Residents – An unlikely receptor under future land use. Although this scenario is highly unlikely, a future residential scenario is typically evaluated in a risk assessment for decision-making purposes. For example, the need for deed restrictions at a site may be eliminated prior to site closure if minimal risks are estimated for residential receptors. It is assumed that a hypothetical resident may be exposed to surface soils (incidental ingestion; dermal contract; and inhalation of fugitive dust and volatile emissions), ground water (ingestion, dermal contact, and inhalation of volatile emissions), surface water (ingestion; dermal contact; and inhalation of volatile emissions), and sediment (incidental ingestion; dermal contact).

- Off-Base Residents – Off-base residents do exist downgradient of the study area. It is assumed that an off-base resident may be exposed to surface water (ingestion; dermal contact; and inhalation of volatile emissions). Although this is a conservative and unlikely scenario. As discussed in Section 1.3.4, on-site shallow ground water flows to LSC; therefore, off-base residents are exposed to shallow ground water via surface water. Off-base residents may also be exposed to site sediment that has been transported off site, although such exposures are expected to be less than those experienced by future on-site residents.

These receptors are similar to the following receptors evaluated in the Current Contamination Conditions Risk Assessment (TtNUS, 1999):

- Base personnel and families (current land use)
- SWMU workers (current land use)
- Park employees (future land use)
- Park visitors (future land use)
- On-SWMU residents (future land use)

- Off-facility residents (current land use)

Table 7-1 provides a site-specific listing of all exposure pathways considered and the basis for inclusion or exclusion of each exposure pathway for each receptor. Table 7-2 provides a site-specific summary of the potential receptors and exposure routes that are addressed quantitatively in the HHRA.

### 7.3.2 Central Tendency Exposure vs. Reasonable Maximum Exposure

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

To provide a full characterization of potential exposure, both RME and CTE were evaluated in the HHRA for the OJT/LSC at NSWC Crane. The available guidance (U.S. EPA, 1993a) concerning the evaluation of CTE is limited. Therefore, professional judgment is used when defining CTE conditions for a particular receptor at a site.

### 7.3.3 Exposure Point Concentrations

The exposure point concentration (EPC), which is calculated for COPCs only, is a reasonable maximum estimate of the chemical concentration that is likely to be contacted over time by a receptor and is used to calculate estimated exposure intakes. The 95 percent upper confidence limit (UCL) on the arithmetic mean, which is based on the distribution of a data set, is considered to be the best estimate of the exposure concentration for data sets with 10 or more samples (U.S. EPA, 1992b). The 95 percent UCL is used as the exposure concentration to assess RME and CTE risks (U.S. EPA, 1993a). For data sets with fewer than 10 samples, the UCL is considered to be a poor estimate of the mean, and the exposure concentration is defined as the maximum detected concentration. For soils, sediments, and surface waters, the EPC is affected significantly by the spatial distribution of contaminants and the potential for a receptor to be exposed to the measured chemical concentrations in various locations. For ground water, it is assumed that receptors access the ground water via wells that are fixed in their location in the study area.

Conventional statistical methods (i.e., the Shapiro-Wilk W-Test) were used to determine the distribution and UCL of a particular data set (Gilbert, 1987; U.S. EPA, 1992b). If the results of the Shapiro-Wilk W-Test were inconclusive, the data was assumed to be log normally distributed. Nondetected data points

were utilized; in general, one-half the sample-specific detection limit represented these analytical results in the statistical analysis. If the calculated 95 percent UCL exceeded the maximum detected concentration, then the maximum detected concentration was selected as the exposure concentration.

The following paragraphs discuss the exposure units that were evaluated and the guidelines used to calculate the medium-specific exposure point concentration.

The OJT exposure unit (EU) includes the two treatment sub-units (the burn pit and the burn area; each treatment unit is approximately 100 feet by 30 feet separated by 30 feet) and the area immediately beyond (i.e., within 10 feet of) the presumed extent of contamination. As discussed in the work plan (TtNUS, 2001b), the size of the study area was approximately 1 acre and this 1-acre study area was considered the EU for soils. Surface soil were defined as soils in the 0 to 2 foot bgs interval; subsurface soil included all soil from a depth of 2 feet to bedrock. A 1-acre EU area was considered a reasonable size based on the current and anticipated land use for the study area (i.e., military/industrial) and the rural nature of the area surrounding the base (i.e., farmland). As discussed in Section 1, the size of the study area was extended during the field investigation to approximately 6 acres. The entire study area was still used as the EU for all the receptors exposed to soil. In addition, exposures to hypothetical future on-site residents exposed to soil were also evaluated using the 1 acre as specified in the work plan. The location of the 1-acre EU was determined by selecting the 1-acre area within the 6-acre study area that had the highest concentrations of the COPCs. The location of the 1-acre EU is shown on Figure 1-7. This area is believed to be the area where the majority of treatment occurred. The uncertainty associated with the EUs for future on-site residents is discussed in the uncertainty analysis presented in Section 7.6.

The EPC for a receptor hypothetically using or otherwise exposed to ground water underlying the OJT study area was the arithmetic average of all the wells sampled as part of this investigation. The entire ground water database was used to calculate the EPC because COPCs were identified in all of the ground water wells. This deviates from the QAPP where it was proposed that the EPC for ground water would be based on the arithmetic average of all wells located in the concentrated area of the plume. The uncertainty associated with calculating the EPC for ground water using all the wells will be discussed in the uncertainty analysis.

Based on anticipated receptor activity for maintenance workers, trespassers, and recreational users, the entire proposed LSC study area (i.e., upgradient of the ABG to the confluence with Johnson Hollow Creek) is the most plausible EU for surface water and sediment exposure.

The surface water flow in LSC below the ABG but above Spring C is intermittent and, consequently, cannot be evaluated as a reliable domestic water supply resource for future on-site residents. In contrast, there is year-around ground-water-to-surface-water flow at Springs A, B, and C. It is likely that a future on-site resident would use one spring as a domestic water supply as opposed to using all springs. Therefore, the maximum detected concentrations in surface water samples collected downstream of Springs A, B, and C (03SWSD15, 03SWSD16, 03SWSD17, 03SWSD18, and 03SWSD19) were used to evaluate domestic water use by future on-site residents.

Surface water samples collected at the southern boundary of the site (03SWSD19) were used to evaluate domestic water use by current and future off-site residents.

EPCs for COPCs for surface soil, surface/subsurface soil, ground water, surface water, and sediment are summarized in Table 7-3. RAGS Part D tables for the EPCs are presented in Appendix G.

### 7.3.4 Chemical Intake Estimation

The methodologies and techniques used to estimate exposure intakes are presented here. Intakes for the identified potential receptor groups are calculated using current U.S. EPA risk assessment guidance (U.S. EPA, 1989a and 2001) and presented in the risk assessment spreadsheets (Appendix G). Risk assessment spreadsheets are appended to the site-specific risk assessments as support documentation.

Noncarcinogenic intakes were estimated using the concept of an average daily exposure. Carcinogenic intakes are calculated as an incremental lifetime average daily exposure, which assumed a life expectancy of 70 years. Equations used to calculate estimated intakes are provided below. Exposure factors and assumptions regarding exposure are presented in Table 7-4. Overall the exposure assumptions presented in this section are the same as those presented in the QAPP except that some values have been updated to reflect current U.S. EPA guidance (e.g., U.S. EPA, 2001).

#### 7.3.4.1 Inhalation of Air and Fugitive Dust/Volatile Emissions

As mentioned previously in Section 4.2, a qualitative evaluation of exposure (i.e., comparison of maximum site soil concentrations to U.S. EPA generic SSLs for chemical transfers from soil to air) was used to identify whether a quantitative analysis of the inhalation exposure pathway was warranted. As shown in Tables 4-11 and 4-13, the concentrations of all chemicals detected in soil at the OJT/LSC are less than the inhalation SSLs. Therefore, a quantitative evaluation of inhalation risks from soil is not

required and was not performed. The potential risks associated with the inhalation pathway are regarded as minimal.

#### 7.3.4.2 Dermal Contact with Soil/Sediment

Direct physical contact with soil (and sediment) may result in the dermal absorption of chemicals. Exposures associated with the dermal route were estimated in the following manner (U.S. EPA, 2001):

$$Intake_{si} = \frac{(C_{si})(SA)(AF)(ABS)(CF)(EF)(ED)}{(BW)(AT)}$$

where: $Intake_{si}$ = amount of chemical "i" absorbed during contact with soil/sediment (mg/kg/day)

$C_{si}$ = concentration of chemical "i" in soil/sediment (mg/kg)

SA = skin surface area available for contact ($cm^2$/day)

AF = skin adherence factor ($mg/cm^2$)

ABS = absorption factor (dimensionless)

CF = conversion factor ($1 \times 10^{-6}$ kg/mg)

EF = exposure frequency (days/yr)

ED = exposure duration (yr)

BW = body weight (kg)

AT = averaging time (days);
for noncarcinogens, AT = ED x 365 days/yr;
for carcinogens, AT = 70 yrs x 365 days/yr

Exposed surface areas of body available for dermal contact are determined on a receptor-specific basis since they correspond with assumed human activities and clothing worn during exposure events. Current guidance (U.S. EPA, 2001; U.S. EPA, 1997b) was used to develop the default assumptions concerning the amount of skin surface area available for contact for a receptor. To maintain consistency from project to project, input parameters previously used for other NSWC Crane risk assessments [e.g., Brown & Root (B&R) Environmental, 1997] were also reviewed when developing the exposed surface areas. The rationales used to select the skin areas are as follows:

- For construction workers, maintenance workers, and occupational workers exposed to soil, the surface area available for soil contact is assumed to be the head, hands, and forearms. The skin

surface area is 3,300 $cm^2$ for the CTE and the RME. These values represent the 50th percentile areas for the head, hands, and forearms (U.S. EPA, 2001).

- For adolescent trespassers, 25 percent of the total body surface area for an adolescent (aged 6 to 16) was assumed to be available for surface soil and/or sediment contact. The RME value (3,280 $cm^2$) was derived from the 95th percentile surface area data and the CTE value (3,100 $cm^2$) was derived from the 50th percentile data, as provided in Table 6-6 of the Exposure Factors Handbook (U.S. EPA, 1997d).

- For adult recreational users assumed to be exposed to surface soil and sediment, the exposed surface area available for contact is 9,070 $cm^2$ for the RME and CTE scenarios. This value represents the 50th percentile areas for the arms, hands, lower legs, and feet (U.S. EPA, 1997b). For a small child recreational user (0 to 6 years old), it was assumed that 50 percent of the body surface area was exposed to surface soil and sediment (i.e., 3,300 $cm^2$, respectively) (this value represents the 50th percentile areas presented in Table 6-6 of the Exposure Factors Handbook) (U.S. EPA, 1997d).

- For adult residents exposed to surface soil/sediment, the exposed surface area available for contact was the U.S. EPA recommended value of 5,700 $cm^2$ for the RME and CTE scenarios (U.S. EPA, 2001). This value assumes that the adult resident is wearing a short-sleeved shirt, shorts, and shoes; therefore, the exposed skin surface is limited to the head, hands, forearms, and lower legs. For a child resident, the recommended value of 2,800 $cm^2$ was used as the exposed skin surface area for the RME and CTE scenarios (U.S. EPA, 2001). This value assumes that the child resident is wearing a short-sleeved shirt, shorts, and no shoes; therefore, the exposed skin surface area is limited to the head, hands, forearms, lower legs, and feet.

The following values of soil adherence factors provided in RAGS Part E (U.S. EPA, 2001) were used to evaluate risks from exposure to soil and sediment.

- Construction workers - 0.3 $mg/cm^2$ for the RME and 0.1 $mg/cm^2$ for the CTE (U.S. EPA, 2001).

- Maintenance workers and occupational workers - 0.2 $mg/cm^2$ for the RME and 0.02 $mg/cm^2$ for the CTE (U.S. EPA, 2001).

- Adolescent trespassers - 0.2 $mg/cm^2$ for the RME and 0.04 $mg/cm^2$ for the CTE (U.S. EPA, 2001).

- Child recreational users and child residents - 0.2 mg/cm$^2$ for the RME and 0.04 mg/cm$^2$ for the CTE (U.S. EPA, 2001).

- Adult recreational users and adult residents - 0.07 mg/cm$^2$ for the RME and 0.01 mg/cm$^2$ for the CTE (U.S. EPA, 2001).

For the constituents identified as COPCs in soil and sediment, the following absorption factors were used (U.S. EPA, 2001):

- PAHs - 0.13
- Dioxins/furans - 0.03
- Arsenic - 0 03
- Cadmium - 0.001
- Semivolatile organics - 0.1

As indicated in RAGS Part E, absorption factors for other metals have not been developed due to insufficient data to support a default value. Therefore, risks from dermal absorption of metals (other than arsenic and cadmium) from soil were not quantified in this risk assessment. The uncertainty associated with the omission of these constituents is discussed in the uncertainty analysis.

#### 7.3.4.3 Incidental Ingestion of Soil/Sediment

Incidental ingestion of soil (and sediment) by potential receptors coincides with dermal exposure. Exposures associated with incidental ingestion were estimated in the following manner (U.S. EPA, 1989a):

$$Intake_{si} = \frac{(C_{si})(IR_s)(FI)(EF)(ED)(CF)}{(BW)(AT)}$$

where: $Intake_{si}$ = intake of contaminant "i" from soil or sediment (mg/kg/day)
$C_{si}$ = concentration of contaminant "i" in soil or sediment (mg/kg)
$IR_s$ = ingestion rate (mg/day)
FI = fraction ingested from contaminated source (dimensionless)
EF = exposure frequency (days/yr)
ED = exposure duration (yr)
CF = conversion factor (1 x $10^{-6}$ kg/mg)

BW = body weight (kg)
AT = averaging time (days);
for noncarcinogens, AT = ED x 365 days/yr;
for carcinogens, AT = 70 yrs x 365 days/yr

The same exposure frequencies and durations used in the estimation of dermal intakes were used to estimate exposure via incidental ingestion. Default values of 1.0 (RME) and 0.5 (CTE) were used for the fraction of soil ingested from the source. Sediment ingestion rates were the same as those assumed for soil ingestion except that, for the resident, the proposed sediment ingestion rate was assumed to be 50 percent of the proposed soil ingestion rate.

#### 7.3.4.4 Dermal Contact with Ground Water/Surface Water

The same equation is used to estimate intakes for dermal contact with ground water and surface water. Direct contact with ground water at the OJT/LSC is limited to exposure that would occur under a residential, recreational, typical industrial (occupational), and construction scenarios. Hypothetical future on-base residential receptors were assumed to use ground water for domestic purposes (i.e., bathing, showering, washing dishes), that can result in a dermal exposure. It is also assumed that off-base residents may use the surface water resource for domestic purposes, although this is a conservative and unlikely scenario. Short-term dermal exposure was assumed to occur for the construction worker during excavation activities and for the hypothetical recreational user or occupational worker receptors that may occasionally use restroom facilities (supplied by ground water pumped from the underlying aquifer) while working or recreating. It should be noted that neither facilities nor ground water supply wells exist at the OJT/LSC at this time. Such facilities currently exist at the ABG. Dermal contact with surface water may also occur while receptors are involved in certain activities such as landscaping (maintenance worker), trespassing, or recreational sport (hiking, biking, etc.) or if off-base residents use off-site springs feeding LSC as a domestic water supply.

The following equation was used to assess exposures resulting from dermal contact with water (U.S. EPA, 2001):

$$DAD_{wi} = \frac{(DA_{event})(EV)(ED)(EF)(A)}{(BW)(AT)}$$

where: $DAD_{wi}$ = dermally absorbed dose of chemical "i" from water (mg/kg/day)
$DA_{event}$ = absorbed dose per event (mg/cm$^2$-event)
EV = event frequency (events/day)

| | | |
|---|---|---|
| ED | = | exposure duration (yr) |
| EF | = | exposure frequency (days/yr) |
| A | = | skin surface area available for contact ($cm^2$) |
| BW | = | body weight (kg) |
| AT | = | averaging time (days); |
| | | for noncarcinogens, AT = ED x 365 days/yr; |
| | | for carcinogens, AT = 70 yrs x 365 days/yr |

Ground water or surface water exposure for hypothetical future on-base or off-base residential receptors using the ground water/surface water as a domestic water supply was assumed to occur on a daily basis. Exposure to ground water for construction workers, recreational users, or typical occupational workers and exposure to surface water for maintenance workers, trespassers, and recreational users was also assumed to occur each day the receptor visits the study area. Dermal intakes for residents assumed total body exposure. For construction workers, trespassers, occupational workers, maintenance workers, and recreational users, the exposed surface area of the body available for contact was based on assumed activities and was similar to the assumptions outlined for dermal contact with soil and sediment. Table 7-4 summarizes the exposure parameters that were used in this HHRA.

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

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

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

| | | | |
|---|---|---|---|
| where: | $t_{event}$ | = | duration of event (hr/event) |
| | $t^*$ | = | time it takes to reach steady-state conditions (hr) |
| | $K_p$ | = | permeability coefficient from water through skin (cm/hr) |
| | $C_{wi}$ | = | concentration of chemical "i" in water (mg/L) |
| | $\tau$ | = | lag time (hr) |
| | $\pi$ | = | constant (dimensionless; equal to 3.141592654) |
| | CF | = | conversion factor (0.001 $L/cm^3$) |

| | | |
|---|---|---|
| B | = | Dimensionless ratio of the permeability of the stratum corneum relative to the permeability across the viable epidermis. |
| FA | = | Chemical specific fraction absorbed (dimensionless) |

Values for the chemical-specific parameters ($t_{event}$, $t^*$, $K_p$, $\tau$, FA, and B) were obtained from RAGS Part E, the current dermal guidance (U.S. EPA, 2001), and are presented in Table 7-5. If no published values were available for a particular compound, they were calculated using equations provided in the cited guidance.

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

$$DA_{event} = (K_p)(C_{wi})(t_{event})$$

In general, the recommended default value of 0.001 was used for the dermal permeability of inorganic constituents. For most metals, dermal absorption is not a significant pathway because penetration through the skin is minimal.

#### 7.3.4.5 Incidental/Direct Ingestion of Ground Water/Surface Water

Residents may be exposed to ground water or surface water via direct ingestion. Maintenance workers, trespassers, and recreational users may incidentally ingest surface water while at the site. Intakes associated with ingestion of water were evaluated using the following equations (U.S. EPA, 1989a):

$$Intake_{wi} = \frac{(C_{wi})(IR_w)(EF)(ED)}{(BW)(AT)}$$

| | | | |
|---|---|---|---|
| where: | $Intake_{wi}$ | = | intake of chemical "i" from water (mg/kg/day) |
| | $C_{wi}$ | = | concentration of chemical "i" in water (mg/L) |
| | $IR_w$ | = | direct contact ingestion rate for ground water (L/day) |
| | $IR_w$ | = | incidental ingestion rate for surface water (L/day) = (CR)(ET) |
| | CR | = | contact rate for surface water (L/hr) |
| | ET | = | exposure time for surface water (hr/day) |
| | EF | = | exposure frequency (days/yr) |
| | ED | = | exposure duration (yr) |
| | BW | = | body weight (kg) |

AT = averaging time (days);
for noncarcinogens, AT = ED x 365 days/yr;
for carcinogens, AT = 70 yrs x 365 days/yr

The same exposure times, frequencies, and durations used to assess dermal exposure to water were used to estimate intakes for ingestion of water.

#### 7.3.4.6 Inhalation of Volatiles in Ground Water

Ground water or surface water exposure may also result in an inhalation exposure if the water resource is used as a domestic water supply. This exposure route was evaluated for residential receptors only who may be exposed while showering, bathing, washing dishes, etc. Inhalation exposures were estimated using a mass transfer model, developed specifically for this exposure route, in combination with an air intake estimation model. The mass transfer model accounts for inhalation that occurs during a shower and after a shower while the receptor remains in the closed bathroom. The method employed was as follows (U.S. EPA, 1989a; Foster and Chrostowski, 1987):

$$Intake_{si} = (S)(IR_{sh})(K)(EF)(ED) \ / \ (BW)(AT)(R_a)(CF)$$

$$K = D_s + \frac{\exp(-R_a \ x \ D_t)}{R_a} - \frac{\exp[R_a \ x \ (D_s - D_t)]}{R_a}$$

where: $Intake_{wi}$ = intake of chemical "i" from water via inhalation (mg/kg/day)
$S$ = volatile chemical generation rate (µg/m$^3$-min-shower)
$IR_{sh}$ = inhalation rate (L/min)
$K$ = mass transfer coefficient (min)
$EF$ = exposure frequency (showers/yr)
$ED$ = exposure duration (yrs)
$BW$ = body weight (kg)
$AT$ = averaging time or period of exposure (days)
$R_a$ = air exchange rate (min$^{-1}$)
$CF$ = conversion factor (1 x 10$^{+6}$ µg-L/mg-m$^3$)
$D_s$ = shower duration (min)
$D_t$ = total time in bathroom (min)

The volatile chemical generation rate were estimated using the Foster and Chrostowski mass transfer model, which is based on two-phase film theory. The model employs contaminant-specific mass transfer coefficients, Henry's Law constants, droplet diameter, drop time, viscosity, temperature, etc. For metals at the OJT/LSC, volatilization is not a significant pathway because these substances do not vaporize at room temperature.

Exposures for construction workers associated with the inhalation route are estimated in the following manner (U.S. EPA, 1989a):

$$Intake_{ai} = \frac{(C_{ai})(IR_a)(ET)(EF)(ED)}{(BW)(AT)}$$

where: $Intake_{ai}$ = intake of chemical "i" from air via inhalation (mg/kg/day)

$C_{ai}$ = concentration of chemical "i" in air (mg/m$^3$)

$IR_a$ = inhalation rate (m$^3$/hr)

ET = exposure time (hours/day)

EF = exposure frequency (days/yr)

ED = exposure duration (yr)

BW = body weight (kg)

AT = averaging time (days);
for noncarcinogens, AT = ED x 365 days/yr;
for carcinogens, AT = 70 yr x 365 days/yr

Construction workers may be exposed to COPCs that have volatilized from ground water when excavation exposes the shallow water table. Ambient air concentrations resulting from the volatilization of COPCs from ground water to outdoor air were calculated by using the following equation from American Society for Testing and Materials Standard Guide for Risk-Based Corrective Action (ASTM, 1997). The air concentration was calculated as follows:

$$C_{air} = VF_{gw\ amb}\ C_{gw}$$

where: $C_{air}$ = chemical concentration in indoor air, mg/m$^3$

$VF_{gw,amb}$ = volatilization factor from ground water to indoor air, L/m$^3$

$C_{gw}$ = chemical concentration in ground water, mg/L

The volatilization factor, $VF_{gw,amb}$, was calculated as follows:

$$VF_{gw\ amb} = \frac{1}{\left[\frac{DF_{amb}\ L_{GW}}{D^{eff}_{ws}}\right] \cdot \frac{1}{H'}}\ 10^3\ \frac{L}{m^3}$$

and

$$DF_{amb} = \frac{U_{air}\ W \cdot d_{air}}{A}$$

| | | | |
|---|---|---|---|
| where: | $VF_{gw,amb}$ | = | volatilization factor for ground water, ($L/m^3$) |
| | $H'$ | = | Henry's law constant, chemical specific, ($cm^3$-$H_2O$)/($cm^3$-air) |
| | $L_{GW}$ | = | depth to ground water, (cm) |
| | | = | $h_v + h_{cap}$ |
| | $h_v$ | = | thickness of vadose zone, (cm) |
| | $h_{cap}$ | = | thickness of capillary fringe; (cm) |
| | $D^{eff}_{ws}$ | = | effective diffusion coefficient between ground water and surface soil, chemical specific, ($cm^2$/sec) |
| | $DF_{amb}$ | = | dispersion factor for outdoor air, (cm/sec) |
| | $U_{air}$ | = | wind speed above ground surface in mixing zone, (cm/sec) |
| | $d_{air}$ | = | ambient air mixing zone, (cm) |
| | $W$ | = | width of source parallel to ground water flow direction, (cm) |
| | $A$ | = | source-zone area, ($cm^2$) |

Because exposure to constituents that have volatilized from ground water is a result of direct exposure, the depth to ground water is simply ($L_{gw}$) defined as the thickness of the capillary fringe ($h_{cap}$).

The effective diffusion coefficient between ground water and surface soil, $D^{eff}_{ws}$ is calculated as follows:

$$D^{eff}_{ws} = \frac{L_{gw}}{(h_v / D^{eff}_s) + (h_{cap} / D^{eff}_{cap})}$$

| | | | |
|---|---|---|---|
| where: | $D^{eff}_{cap}$ | = | effective diffusion through capillary fringe, chemical specific, $cm^2$/sec |
| | $D^{eff}_s$ | = | effective diffusion in soil based on vapor-phase concentration, chemical specific, $cm^2$/sec |

It was assumed that excavation would occur to the water table; therefore, the thickness of the vadose zone was set equal to 0 and the thickness of the capillary fringe was set equal to 0.1 cm. Because $h_v$ is

equal to zero, this equation reduces to show that the effective diffusion between ground water and surface soil ($D^{eff}_{ws}$) is equal to the effective diffusion through the capillary fringe ($D^{eff}_{cap}$).

The effective diffusion through the capillary fringe, $D^{eff}_{cap}$, is calculated as follows:

$$D^{eff}_{cap} = D^{air} \frac{\theta^{3.33}_{acap}}{\theta^2_T} + D^{wat} \cdot \frac{1}{H} \cdot \frac{\theta^{3.33}_{wcap}}{\theta^2_T}$$

where: $D^{air}$ = diffusion coefficient in air, chemical specific, $cm^2/sec$

$D^{wat}$ = diffusion coefficient in water, chemical specific, $cm^2/sec$

$\theta_{acap}$ = volumetric air content in capillary fringe soils, 0.038 $cm^3$-air/$cm^3$-soil

$\theta_{wcap}$ = volumetric water content in capillary fringe soils, 0.342 $cm^3$-$H_2O$/$cm^3$-soil

$\theta_T$ = total soil porosity, 0.38 $cm^3/cm^3$-soil

Input assumptions for the volatilization from ground water to outdoor air model are presented in Table 7-6. Site-specific values are used whenever possible. Model default values are used when they are believed to be representative of site conditions. Chemical properties were obtained from the Soil Screening Guidance: User's Guide (U.S. EPA, 1996b) and are presented in Table 7-7.

#### 7.3.4.7 Summary of Exposure Parameters

A summary of the exposure input parameters for all exposure pathways is presented in Table 7-4 for the identified potential receptor groups at the OJT/LSC. In general, standard default parameters (U.S. EPA, 1991, 1997d, and 2001), which combine mid-range and upper-end exposure factors, were used to assess RME conditions. CTE scenarios were assessed primarily by the use of mid-range exposure factors presented in current risk assessment guidance (U.S. EPA, 1989a and 1993a).

### 7.3.5 Exposure to Lead

The equations and methodology presented in the previous section cannot be used to evaluate exposure to lead because of the absence of published dose-response parameters. Exposure to lead was assessed using the following models:

- The latest version of the U.S. EPA's IEUBK Model for lead (U.S. EPA, 2002a). This model is typically used to evaluate lead exposure assuming a residential land use scenario.

The U.S. EPA's Technical Review Workgroup (TRW) Model for Lead (U.S. EPA, 1996d). This model is typically used to evaluate lead exposure assuming a non-residential land use scenario.

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

For the OJT/LSC, the IEUBK Model for lead was used to address exposure to lead in children when detected ground water and surface water concentrations exceed the 15 µg/L federal action level promulgated under the Safe Drinking Water Act and when detected soil and sediment concentrations exceed the OSWER soil screening level of 400 mg/kg for residential land use (U.S. EPA, 1994c). Average chemical concentrations, as well as default parameters for some input parameters, were used. Estimated blood-lead levels and probability density histograms are presented as support documentation for this analysis and are included in Appendix G.

Non-residential adult exposure to lead in soil was evaluated using the U.S. EPA's Technical Review Workgroup Model for Lead (U.S. EPA, 1996d). In this model, adult exposure to lead in soil is addressed by an evaluation of the relationship between the site soil lead concentration and the blood-lead concentration in the developing fetuses of adult women. The adult lead model generates a spreadsheet for each exposure scenario evaluated (i.e., industrial and recreational). The output of the spreadsheet is the probability that the blood-lead concentrations in the fetus exceed 10 µg/L. The probability that the fetal blood-lead level would exceed 10 µg/L was calculated in accordance with the following EPA guidelines:

- Use of the TRW Interim Adult Lead Methodology in Risk Assessment, Memorandum from Pat Van Leeuwen (Region 5 Superfund Program) and Paul White (ORD/NCEA) to Mark Maddaloni, Chair, TRW Adult Lead Subgroup, April 7, 1999.

- Frequently Asked Questions (FAQs) on the Adult Lead Model, Technical Review Workgroup for Lead, Guidance Document, April 1999, Rev. 0.

No models are currently available to evaluate the periodic exposure of adolescent trespassers to lead. Therefore, the results of the IEUBK Model for children were used to qualitatively assess exposure and risk for this receptor.

## 7.4 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to identify the potential health hazards and adverse effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects will be defined for the identified COPCs. Quantitative toxicity values determined during this component of the risk assessment were integrated with outputs of the exposure assessment to characterize the potential for the occurrence of adverse health effects for each receptor group.

The toxicity value used to evaluate noncarcinogenic health effects is the reference dose (RfD). Carcinogenic effects are quantified using the cancer slope factor (CSF).

### 7.4.1 Toxicity Criteria

Oral and inhalation RfDs and CSFs used in the HHRA for the OJT and LSC were obtained from the following primary literature sources:

- Integrated Risk Information System (IRIS) (U.S. EPA, 2002b)
- Health Effects Assessment Summary Tables (HEAST) (U.S. EPA, 1997c)
- National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center

Although RfDs and CSFs can be found in several toxicological sources, U.S. EPA's IRIS on-line database is the preferred source of toxicity values. This database is continuously updated and values presented have been verified by U.S. EPA RfD and Carcinogenic Risk Assessment Verification Endeavor (CRAVE) work groups. The U.S. EPA Region 9 PRG tables and Region 3 RBC tables were also used as a source of toxicity criteria. The RfDs and CSFs for the constituents selected as COPCs for OJT/LSC are presented in Tables 7-8 through 7-11.

#### 7.4.1.1 Toxicity Criteria for Dermal Exposure

RfDs and CSFs found in literature may be expressed as administered doses; therefore, these values are considered to be inappropriate for estimating the risks associated with dermal routes of exposure. Oral

dose-response parameters based on administered doses must be adjusted to absorbed doses before the comparison to estimated dermal exposure intakes is made.

The adjustment to an absorbed dose was made using chemical-specific absorption efficiencies published in RAGS Part E (U.S. EPA, 2001) and the following equations:

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

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

where: $ABS_{GI}$ = absorption efficiency in the gastrointestinal tract

#### 7.4.1.2 Toxicity Criteria for Carcinogenic Effects of PAHs

Limited toxicity values are available to evaluate the carcinogenic effects from exposure to PAHs. The most extensively studied PAH is benzo(a)pyrene, which is classified by the U.S. EPA as a known human carcinogen. Although CSFs are available for benzo(a)pyrene, insufficient data are available to calculate CSFs for other carcinogenic PAHs Toxic effects for these chemicals were evaluated using the concept of estimated orders of potential potency, as presented in current U.S. EPA guidance (U.S. EPA, 1993b). These parameters are based on the carcinogenicity of benzo(a)pyrene and are available for select carcinogenic PAHs. The equivalent oral CSF for these chemicals is derived by multiplying the CSF for benzo(a)pyrene by the order of potential potency. The orders of potential potency used in this HHRA are as follows:

| Compound | TEF |
|---|---|
| Benzo(a)pyrene | 1.0 |
| Benzo(a)anthracene | 0.1 |
| Benzo(b)fluoranthene | 0.1 |
| Benzo(k)fluoranthene | 0.01 |
| Chrysene | 0.001 |
| Dibenzo(a,h)anthracene | 1.0 |
| Indeno(1,2,3-cd)pyrene | 0.1 |

#### 7.4.1.3 Toxicity Criteria for Carcinogenic Effects of Dioxins/Furans

Similar to the concept of estimated orders of potential potency for PAHs, chlorinated dibenzo-p-dioxins (CDDs) and -dibenzofurans (CDFs) were evaluated using TEFs relative to the toxicity of TCDD (U.S. EPA, 1989b). Based on a variety of approaches that generate toxicities relative to 2,3,7,8-TCDD, U.S.

EPA developed TEFs for other dioxins/furans from structure-activity relationships and the available toxicological information. The TEFs are applied to the dioxin/furan congeners to calculate an equivalent 2,3,7,8-TCDD concentration. TEFs that were used in the HHRA are presented in Section 4.2.1.

#### 7.4.1.4 Toxicity Criteria for Chromium

Toxicity criteria are available for different forms of chromium, which is considered to be more toxic in the hexavalent state. Because there is no evidence to suggest that hexavalent chromium is present at the OJT/LSC as a contaminant, speciation analyses were not performed for the OJT/LSC. However, risks associated with this chemical are assessed by conservatively assuming that 100 percent of the reported total chromium result is attributable to hexavalent chromium.

### 7.4.2 Toxicity Profiles

Toxicological profiles for each COPC are presented in Appendix G. These brief profiles present a summary of the current available literature on the carcinogenic and noncarcinogenic health effects associated with human exposure to COPCs.

## 7.5 RISK CHARACTERIZATION

This section provides a characterization of the potential human health risks associated with the potential exposures to COPCs at the OJT/LSC. Section 7.5.1 outlines the methods used to quantitatively estimate the type and magnitude of potential risks for human receptors. A summary of the risk characterization for the OJT/LSC is provided in Section 7.5.2.

### 7.5.1 Quantitative Analysis

Quantitative estimates of risk were calculated according to risk assessment methods outlined in U.S. EPA guidance (U.S. EPA, 1989a). Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as ILCRs, based on CSFs. Noncarcinogenic risk estimates are presented in the form of HQs that are determined through a comparison of intakes with published RfDs.

ILCR estimates are generated for each COPC using estimated exposure intakes and published CSFs, as follows:

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

If the above equation resulted in an ILCR greater than 0.01, the following equation was used:

$$ILCR = 1-[exp(-Estimated\ Exposure\ Intake)(CSF)]$$

A ILCR of $1 \times 10^{-6}$ indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons.

As mentioned previously, noncarcinogenic risks were assessed using the concept of HQs and HIs. The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows:

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

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

#### 7.5.1.1 Comparison of Quantitative Risk Estimates to Benchmarks

To interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates are compared to typical benchmarks. Calculated ILCRs are interpreted using the U.S. EPA's target range ($10^{-4}$ to $10^{-6}$), and HIs are evaluated using a value of 1.0.

U.S. EPA has defined the range of $10^{-4}$ to $10^{-6}$ as the ILCR target range for hazardous waste facilities addressed under CERCLA and RCRA. Individual or cumulative ILCRs greater than $1 \times 10^{-4}$ are generally considered to be "unacceptable" by the U.S. EPA. (Risk management decisions are necessary when the ICR is within $1 \times 10^{-4}$ to $1 \times 10^{-6}$.)

An HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity, target organ effects associated with exposure to COPCs are segregated. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) are regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1.0, but no adverse health effects are anticipated if the COPCs do not affect the same target organ or exhibit the same critical effect.

### 7.5.2 Results of the Risk Characterization

This section contains a summary of the results of the risk characterization for the OJT/LSC. Quantitative risk estimates for potential human receptors are developed for those chemicals identified as COPCs. Uncertainties associated with the risk estimates are discussed in Section 7.6. The methodology used to calculate the risks presented in this section is provided in Sections 7.3 and 7.4. Potential cancer risks and HIs were calculated for current adolescent trespassers and off-site residents and future construction workers, maintenance workers, occupational workers, child recreational users, adult recreational users, and off-site residents under the RME and CTE scenarios and are summarized in Tables 7-12 and 7-13, respectively. Potential HIs and ILCRs for future on-site residents are summarized in Tables 7-14 and 7-15, respectively. Sample calculations are presented in Appendix G, and the results of the risk assessment in RAGS Part D format are included in Appendix G.

#### 7.5.2.1 Noncarcinogenic Risks – RME

Cumulative HIs for the adolescent trespasser, off-site child and adult resident, construction worker, maintenance worker, and adult recreational user under the RME scenario are less than or equal to unity (1), indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

HIs for the potable use of ground water by occupational worker (HI = 2), child recreational user (HI = 2), future on-site child resident (HI = 21), and future on-site adult resident (HI = 6) exceed unity. Trichloroethene was the major contributor to the HI for the occupational worker (HQ = 2), child recreational user (HQ = 2), and future on-site adult resident (HQ = 5) ingesting ground water. Trichloroethene and 2-amino-4,6-dinitrotoluene were the major contributors to the HI for the future on-site child resident ingesting ground water.

HIs for domestic use of surface water by future on-site child residents (HI = 9) and future on-site adult residents (HI = 3) exceeded unity. 2-Amino-4,6-dinitrotoluene (HQ = 2), 4-amino-2,6-dinitroluene (HQ = 5), and RDX (HQ = 2) were the major contributors to the HI for the future on-site child resident. 4-Amino-2,6-dinitroluene (HQ = 1) was the major contributor to the HI for the future on-site adult resident.

The HIs calculated for on-site residential use of surface water as a domestic water source are subject to the following sources of uncertainty:

- There are no toxicity data for 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene on IRIS or in HEAST; therefore, provisional RfDs from NCEA were used to estimate risks. The use of provisional toxicity values introduces uncertainty into the risk assessment except that HI calculations are biased high.

- The maximum detected concentration in surface water was used as the exposure point concentration for estimating risks to future on-site residents. The maximum detected concentrations of COPCs in surface water all occurred in the sample collected from location 03SWSD17, which is immediately downgradient of Spring A. If HIs were calculated for the other individual sample locations, HIs for locations 03SWSD16, 03SWSD15, 03SWSD18, and 03SWSD19 would be less than 1.

For the 1-acre EU, the HI for a future on-site child resident (HI - 24) and future on-site adult resident (HQ = 3) exposed to surface soil exceeded unity. 2,4,6-Trinitrotoluene (HQ = 19) and RDX (HQ = 3) were the major contributors to the HI for the future on-site child resident. 2,4,6-Trinitrotoluene (HQ = 2) was the major contributor to the HI for the future on-site adult resident. As discussed in Section 5.1, Surface Soil, the highest detected concentrations of 2,4,6-trinitrotoluene and RDX occurred in samples 03SS22 and 03SS24. HIs for exposure to surface soil samples collected outside of the area bounded by these two samples would be 0.2 for the adult resident and 2 for the child resident, although the target organ specific HIs would be less than or equal to 1, indicating that adverse noncarcinogenic effects would not be anticipated for these receptors. This indicates that the unacceptable HIs for child and adult residents are a result of being driven by the elevated concentrations of 2,4,6-trinitrotoluene and RDX at sampling locations 03SS22 and 03SS24.

For the 6-acre EU, the HI for a future on-site child resident (HI = 2) exposed to surface soil exceeded unity. Ingestion of iron (HQ = 1) was the major contributor to the HI for the future on-site child resident. The RfD for iron is based on the Recommended Daily Allowance (RDA) for adult human nutrition. Children and adolescents require more iron in their diets than adults do; consequently, use of an RfD based on the adult RDA for iron to evaluate exposures to children results in an overestimation of the risks for children. When the HI for exposures to iron by children exceed unity, U.S. EPA Region 3 recommends recalculating the HI using an RfD of 1.1 mg/kg/day. This value is based on the RDA of 0.36 to 1.11 mg/kg/day for children ages 6 months to 10 years. Recalculating the HI for a child resident exposed to soil using a RfD of 1.1 mg/kg/day results in a HQ of 0.3 for iron and a total HI of 0.7.

#### 7.5.2.2 Carcinogenic Risks - RME

Cumulative ILCRs for the adolescent trespasser, off-site child and adult residents, construction worker, maintenance worker, and child and adult recreational users were less than or within U.S. EPA's target risk range of $10^{-4}$ to $10^{-6}$. The cumulative ILCR of 1 x $10^{-4}$ for the occupational worker is equal to the upper bound of the target risk range. Chemical specific ILCRs exceeded 1 x $10^{-6}$ for off-site child residents (ILCR = 9 x $10^{-6}$), off-site adult resident (ICLR = 1 x $10^{-5}$), and off-site lifelong residents (ILCR = 2 x $10^{-5}$) exposed to RDX in surface water. Chemical specific ILCRs were greater than 1 x $10^{-6}$ for occupational workers exposed to 1,1,2,2-tetrachloroethene (ILCR = 3 x $10^{-5}$), trichloroethene (ILCR = 7 x $10^{-5}$), RDX (ILCR = 1 x $10^{-5}$), and vinyl chloride (ILCR = 1 x $10^{-6}$) in ground water. Chemical specific ILCRs were greater than or equal to 1 x $10^{-6}$ for child recreational users exposed to 1,1,2,2 tetrachloroethene (ILCR = 7 x $10^{-6}$), trichloroethene (ILCR = 2 x $10^{-5}$), and RDX (ILCR = 2 x $10^{-6}$) in ground water and RDX (ILCR = 1 x $10^{-6}$) in surface water. Chemical specific ILCRs for adult recreational users exposed to 1,1,2,2-tetrachloroethene (ILCR = 6 x $10^{-6}$), trichloroethene (ILCR = 2 x $10^{-5}$), and RDX (ILCR = 2 x $10^{-6}$) in ground water were greater than 1 x $10^{-6}$). Chemical specific ICLRs were greater than or equal to 1 x $10^{-6}$ for lifelong recreational users exposed to 1,1,2,2-tetrachloroethene (ICLR = 1 x $10^{-5}$), trichloroethene (ICLR = 3 x $10^{-5}$), and RDX (ICLR = 5 x $10^{-6}$) in ground water and RDX (ICLR = 1 x $10^{-6}$) in surface water.

For the 1-acre EU, the ILCRs for exposure to surface soil by the future on-site lifelong resident (ILCR = 2 x $10^{-4}$) exceeded the U.S. EPA's target risk range. 2,4,6-trinitrotoluene (ILCR = 4 x $10^{-5}$) and RDX (ILCR = 1 x $10^{-4}$) were the major contributors to the cancer risk. Chemical specific ILCRs were greater than or equal to 1 x $10^{-6}$ for exposures to 2,4,6-trinitrotoluene (ILCR = 2 x $10^{-5}$), RDX (ILCR = 8 x $10^{-5}$), and 2,3,7,8-TCDD equivalents (ILCR = 1 x $10^{-6}$) by future on-site child residents; 2,4,6-trinitrotoluene (ILCR = 1 x $10^{-5}$) and RDX (ILCR = 4 x $10^{-5}$) by future on-site adult residents; and 2,3,7,8-TCDD equivalents (ILCR = 2 x $10^{-6}$) by future lifelong residents. As previously discussed, the highest detected concentrations of 2,4,6-trinitrotoluene and RDX occurred in samples 03SS22 and 03SS24. The ILCR for exposures to surface soil samples collected outside of the area bounded by these two samples would be 6 x $10^{-6}$ for the future on-site lifetime resident, which is within the U.S. EPA target risk range. This indicates that the unacceptable ICLRs for child and adult residents are the result of the elevated concentrations of 2,4,6-trinitrotoluene and RDX at sampling locations 03SS22 and 03SS24.

For the 6 acre EU, ILCRs for exposure to surface soil by future on-site, child, adult, and lifetime residents were less than or within U.S. EPA's target risk range. Chemical specific ILCRs were greater than or equal to 1 x 10 6 for exposures to 2,3,7,8-TCDD equivalents by future on-site child residents (ICLR = 1 x $10^{-6}$) and future on-site lifelong residents (ILCR = 2 x $10^{-6}$).

The ILCRs for domestic use of ground water by future on-site child resident (ILCR = 3 x $10^{-4}$), on-site adult resident (ILCR = 4 x $10^{-4}$), and on-site lifelong resident (7 x $10^{-4}$) exceeded the U.S. EPA's target risk range. Trichloroethene (ILCR = 2 x $10^{-4}$) and 1,1,2,2-tetrachloroethene (ILCR = 9 x $10^{-5}$) were the major contributors to the ILCR for the future on-site child resident. Trichloroethene (ILCR = 3 x $10^{-4}$) and 1,1,2,2-tetrachloroethene (ILCR = 1 x $10^{-4}$) were the major contributors to the ILCR for the future on-site adult resident. Trichloroethene (ILCR = 5 x $10^{-4}$) and 1,1,2,2-tetrachloroethene (ILCR = 2 x $10^{-4}$) were the major contributors to the ILCR for the future on-site lifelong resident. Chemical specific ILCRs were greater than or equal to 1 x $10^{-6}$ for exposures by future on-site child residents to 1,1-dichloroethene (ILCR = 1 x $10^{-6}$), RDX (ILCR = 2 x $10^{-5}$), and vinyl chloride (ILCR = 2 x $10^{-6}$). Chemical specific ILCRs were greater than or equal to 1 x $10^{-6}$ for exposures by future on-site adult residents to 1,1-dichloroethene (ILCR = 1 x $10^{-6}$), RDX (ILCR = 3 x $10^{-5}$), and vinyl chloride (ILCR = 3 x $10^{-6}$). Chemical specific ILCRs were greater than 1 x $10^{-6}$ for exposures by future on-site lifelong residents to 1,1-dichloroethene (ILCR = 3 x $10^{-6}$), RDX (ILCR = 5 x $10^{-5}$), 1,1,2-trichloroethane (ILCR = 1 x $10^{-6}$), and vinyl chloride (ILCR = 5 x $10^{-6}$)

The ILCR of 1 x $10^{-4}$ for domestic use of surface water by future on-site lifelong residents is equal to the upper bound of U.S. EPA's target risk range. RDX (ILCR = 1 x $10^{-4}$) was the major contributor to the risk for domestic use of surface water by the future on-site life long resident. Chemical specific ILCRs for exposure to RDX in surface water were greater than 1 x $10^{-6}$ for future on-site child residents (ILCR = 6 x $10^{-5}$) and future on-site adult residents (ILCR = 7 x $10^{-5}$).

#### 7.5.2.3 Noncarcinogenic Risks – CTE

Cumulative HIs for all receptors were less than or equal to unity for all receptors, with the exception of the occupational worker and future on-site residents. For the 1-acre EU, the HI for exposures to surface soil under the CTE scenario for future on-site child was 7. 2,4,6-Trinitrotoluene was the major contributor to the HI for exposures to surface soil for a 1-acre EU. As previously discussed, the highest detected concentrations of 2,4,6-trinitrotoluene occurred in samples 03SS22 and 03SS24. If these two samples are removed from the dataset, then the HI for future child residents would be within acceptable levels. HIs for exposures to ground water under the CTE scenario for occupational workers and future on-site child and adult residents are 2, 7, and 3, respectively. Ingestion of trichloroethene and 2-amino-4,6-dinitrotoluene was the major contributor to the HI for exposures to ground water. HIs for exposures to surface water under the CTE scenario for future on-site child and adult residents were 3 and 1, respectively. 4-Amino-2,6-dinitroluene was the main contributor to the HI for surface under the CTE scenario.

#### 7.5.2.4 Carcinogenic Risks - CTE

Cumulative ILCRs for all receptors under the CTE scenario did not exceed U.S. EPA's target risk range of $10^{-4}$ to $10^{-6}$.

#### 7.5.2.5 Risks from Lead

Lead was identified as a COPC in soil, surface water, and sediment at the OJT/LSC. The maximum detected concentration of lead in surface soil (10,200 mg/kg), subsurface soil (3,590 mg/kg), shallow sediment (653 mg/kg), and deep sediment (445 mg/kg) exceeded the OSWER soil screening level of 400 mg/kg for residential land use. The maximum detected concentration of lead in surface water under low-flow conditions (20 µg/L) and high-flow conditions (285 µg/L) exceeded the 15 µg/L federal action level promulgated under the Safe Drinking Water Act.

Hypothetical future residential exposures to lead in surface soil and surface water were evaluated using U.S. EPA's IEUBK lead model (U.S. EPA, 2002a). Exposures to lead in surface soil by occupational workers and exposures to lead in surface/subsurface soil by construction workers were evaluated using a slope-factor approach developed by the U.S. EPA Technical Review Workgroup for Lead (EPA, 1996d). The IEUBK model was also used to evaluate residential exposures to lead in sediment by future child residents, although it should be noted that the IEUBK model is designed to evaluate residential exposures to soil and therefore the results of the evaluation are conservative since the exposure frequency used in the IEUBK model for exposure to soil is greater than the exposure frequency for exposure to sediment. The IEUBK model and adult lead model cannot be used to evaluate exposures to surface water by trespassers and recreational users; therefore, risks from exposures to lead in surface water to these receptors were evaluated qualitatively.

Hypothetical future residential exposures to lead in surface soil were evaluated using the IEUBK lead model (U.S. EPA, 2002a). As recommended by the IEUBK model, the average concentration of lead in surface soil of 1,224 mg/kg was used as the exposure point concentration for soil for the 1-acre EU. The average concentration of lead in ground water of 0.34 µg/L was used as the exposure point concentration for drinking water. Default parameters were used for the rest of the model input parameters. IEUBK model outputs are included in Appendix G. The lead concentration of 1,224 mg/kg in surface soil results in 60 percent of future on-site child residents having a blood-lead level greater than 10 µg/dL and a geometric mean blood-lead level of 11 µg/dL. This exceeds the U.S. EPA goal, as described in the 1994 OSWER directive, of no more than 5 percent of children with blood-lead levels greater than 10 µg/dL.

Lead was detected in only one surface soil sample (10,200 mg/kg – 03SS240002) at a concentration that exceeded the screening level of 400 mg/kg. The second highest detected concentration of lead in surface and subsurface soil across the entire site was 244 mg/kg. The average concentration of lead in surface soil excluding sample 03SS24 is 57 mg/kg. Using this value in the IEUBK model results in 0.02 percent of future on-site child residents having a blood-lead level greater than 10 µg/dL and a geometric mean blood-lead level of 1.6 µg/dL. These results are within the goals described in the 1994 OSWER directive, of no more than 5 percent of children with blood-lead levels exceeding 10 µg/dL. These results indicate that the unacceptable risks from exposure to lead in surface soil by child residents are being driven by the elevated lead concentrations in sample 03SS24002.

For the 6-acre EU, the average concentration of lead in surface soil of 358 mg/kg was used as the exposure point concentration for soil. The average concentration of lead in ground water of 0.34 µg/L was used as the exposure point concentration for drinking water. Default parameters were used for the rest of the model input parameters. IEUBK model outputs are included in Appendix G. The lead concentration of 358 mg/kg in surface soil results in 4.5 percent of future on-site child residents having a blood-lead level greater than 10 µg/dL and a geometric mean blood-lead level of 4.5 µg/dL. This is within the blood-lead goal, as described in the 1994 OSWER directive, of no more than 5 percent of children exceeding a 10 µg/dL blood-lead level.

The IEUBK model was also used to evaluate residential exposures to lead in sediment by future child residents, although it should be noted that the IEUBK model is designed to evaluate residential exposures to soil; therefore, the results of the evaluation are conservative since the exposure frequency used in the IEUBK model for exposure to soil is greater than the exposure frequency assured for exposure to sediment. As recommended by the model, the average concentration of lead in sediment of 120 mg/kg was used as the exposure point concentration. Default exposure parameters were used for the rest of the model input parameters. IEUBK model outputs are included in Appendix G. The lead concentration of 120 mg/kg in sediment results in 0.1 percent of future on-site child residents having a blood-lead level greater than 10 µg/dL and a geometric mean blood-lead level of 2.4 µg/dL. This is within the blood-lead goal as described in the 1994 OSWER directive, of no more than 5 percent of children exceeding a 10 µg/dL blood-lead level.

As discussed above, U.S. EPA recommends that exposures to lead by nonresidential adults can be evaluated by use of a slope-factor approach developed by the U.S. EPA Technical Review Workgroup for Lead (U.S. EPA, 1996d). The slope factor approach was used to evaluate exposures to lead in soil by construction workers and occupational workers at the OJT. The slope factor approach was not used to evaluate exposures to lead in soil by maintenance workers because the model should not be used when

exposures are less than 1 day a week and the exposure frequency for maintenance workers is 1 day every other week (24 days/year). As recommended by the model, the average lead concentrations of 310 mg/kg in all (surface and subsurface) soil and 358 mg/kg in surface soil were used as the exposure point concentration for construction workers and occupational workers, respectively. The incidental ingestion rates were 100 mg/day for construction workers and 50 mg/day for occupational workers. The exposure frequency was assumed to be 150 days per year for construction workers and 219 days per year for occupational workers. Default parameters were used for all the model input parameters. The results of the model are included in Appendix G. For construction workers, the lead concentration of 310 mg/kg results in 1.8 percent of construction workers having a blood-lead level greater than 10 µg/dL and a geometric mean blood-lead level of 7.4 µg/dL. For occupational workers, the lead concentration of 358 mg/kg results in 1.6 percent of occupational workers having a blood-lead level greater than 10 µg/dL and a geometric mean blood-lead level of 7 µg/dL. This is within the blood-lead goal of no more than 5 percent of children (fetuses of exposed women) exceeding a 10 µg/dL blood-lead level.

Lead was identified as a COPC in surface water, although it should be noted that concentrations of lead exceeded the screening levels only in samples collected upstream of Spring C. As previously discussed, the surface water flow in LSC above Spring C is intermittent and could not be used as a reliable domestic water supply for future on-site residents. There is year-around surface water flow in LSC downstream of Spring C. The maximum detected concentrations of lead in surface water samples collected downstream of Spring C was 1 µg/L, which is less than the screening level of 15 µg/L. Therefore, no adverse health effects from exposures to lead in surface water are anticipated for future on-site residents or current and future off-site residents using surface water downstream of Spring C as a domestic water source.

Current and future trespassers and future recreational users are assumed to be exposed to surface water along the entire length of LSC; consequently, they may be exposed to locations where the samples with elevated lead concentrations were collected. Lead was detected in only one surface water sample collected during low-flow conditions at a concentration (20 µg/L) that exceeded the drinking water screening level of 15 µg/L. The average concentration of lead in surface water samples collected during low-flow conditions was 3.6 µg/L, which is less than the drinking water screening level. Lead was detected in three surface water samples collected during high-flow conditions at concentrations (50.3 µg/L, 111 µg/L, and 285 µg/L) that exceeded the drinking water screening level. Samples collected to characterize the high-flow conditions were collected during a storm. It is unlikely that trespassers and recreational users will be playing in LSC during a storm. Consequently, surface water samples collected during low-flow conditions are more representative of site conditions when trespassers and recreational users are most likely to be exposed to surface water in LSC. Therefore, no adverse health effects are

anticipated for trespassers and recreational users exposed to lead in surface water in LSC under the defined conditions.

### 7.5.3 Qualitative Risk Evaluation of Metals Eliminated as COPCs Based on Background

Aluminum, antimony, arsenic, chromium, 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 (mg/kg) | Maximum Surface Soil Concentration (mg/kg) | Maximum Subsurface Soil Concentration (mg/kg) | Maximum Sediment Concentration (mg/kg) | Region 9 Residential PRG (mg/kg) | Region 9 Industrial PRG (mg/kg) | Literature Background (mg/kg) |
|---|---|---|---|---|---|---|
| Aluminum | 14,900 | 11,500 | NA | 76,000 | 100,000 | 10,000 - 300,000(1) |
| Antimony | 4.4 | 30 | NA | 31 | 410 | 0.6 - 10(1) |
| Arsenic | 28.4 | 12.6 | 22 | 0.39 | 1.6 | 0.1 - 97(2) |
| Chromium | NA | 34.5 | 48.9 | 30(3) | 64(3) | 1 -2,000(2) |
| Iron | NA | NA | 87,700 | 23,000 | 100,000 | 7,000 - 550,000(1) |
| Manganese | NA | NA | 2,780 | 1,800 | 19,000 | 10 - 4,000(3) |

NA – Not Applicable
1 Dragun, 1988. The Soil Chemistry of Hazardous Materials. Hazardous Material Controls Research Institute, Silver Spring, Maryland.
2 U.S. Region 9 Preliminary Remediation Goals Table, October, 2002.
3 Value is for hexavalent chromium.

The PRGs presented for aluminum, antimony, 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 one-fifth the relevant residential PRG, and approximately one-seventh the relevant industrial PRG. However, based on toxicity information provided by the U.S. 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 antimony is approximately the relevant residential PRG, and approximately one-fourteenth the relevant industrial PRG. The maximum detected concentration of manganese is one and a half times the relevant residential PRG, and approximately one-seventh of the relevant industrial PRG. The maximum detected concentration of iron does exceed the residential 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 PRGs presented for arsenic and chromium are

based on the potential for cancer effects and represent the 1 x $10^{-6}$ (one in-one-million) cancer risk level (the values are the COPC screening levels used in this HHRA). PRGs representing the 1 x $10^{-5}$ and 1 x $10^{-4}$ cancer risk levels would be 10 and 100 times the values presented for the 1 x $10^{-6}$ cancer risk level. Consequently, the maximum detected concentration of arsenic exceeds the 1 x $10^{-6}$ and 1 x $10^{-5}$ cancer risk levels, but not the1 x $10^{-4}$ risk levels. The maximum detected concentration of chromium exceeds the 1 x $10^{-6}$ cancer risk level for the relevant residential PRG, but not the 1 x $10^{-5}$ or 1 x $10^{-4}$ risk levels. Additionally, with the exception of antimony, the metals concentrations reported in the soils and sediments are within the background range reported in the literature. Based on this discussion, the results and conclusions of the risk assessment are not affected by the elimination of aluminum, antimony, arsenic, chromium, iron, and manganese from the quantitative risk assessment for soils and/or sediments.

Aluminum, arsenic, iron, and manganese were detected in surface waters, and arsenic in ground water at concentrations exceeding the conservative screening levels established for COPC selection but were not selected as a COPC because the study area concentrations did not exceed the background concentration. The following table provides a qualitative risk evaluation of these metals by comparing the maximum detected concentration to the EPA Region 9 PRG for tap water and the Federal Safe Water Drinking Act (SWDA) MCL:

| Parameter | Ground Water Concentration (µg/L) | Surface Water Concentration (µg/L) | Region 9 PRG (µg/L) | Federal SWDA MCL (µg/L) | Literature Background (Ground Water) (µg/L) |
|---|---|---|---|---|---|
| Aluminum | NA | 2,010 | 36,000 | 50 – 200(1) | NA |
| Arsenic | 0.3 | 2.5 | 0.045 | 10 | <1.0 – 30(2) |
| Iron | NA | 2,550 | 11,000 | 300(1) | NA |
| Manganese | NA | 201 | 880 | 50(1) | NA |

NA - Not Applicable
1 Secondary (aesthetic-based) MCLs are presented for aluminum, iron, and manganese.
2 Dragun, 1988. The Soil Chemistry of Hazardous Materials. Hazardous Material Controls Research Institute, Silver Spring, Maryland.

The PRGs for aluminum, iron, and manganese are based on the potential for non-cancer effects (the values are 10 times the COPC screening levels used in this HHRA). The maximum detected concentration for aluminum is approximately one-eighteenth the PRG. 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. The maximum detected concentrations for iron and manganese are less than one-fourth the relevant PRGs. As noted above, the PRG for iron is a very

conservative risk-based concentration because it is actually 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 x 10 6 (one-in-one-million) cancer risk level (the values are the COPC screening levels used in this HHRA). PRGs representing the 1 x $10^{-5}$ and 1 x $10^{-4}$ cancer risk levels would be 10 and 100 times the values presented for the 1 x $10^{-6}$ cancer risk level. Consequently, the maximum detected concentration of arsenic exceeds the 1 x$10^{-6}$ and 1 x$10^{-5}$ cancer risk levels, but not the1 x$10^{-4}$ risk level. Additionally, the maximum detected concentration for arsenic does not exceed the current SWDA MCL of 10 µg/L and is within the background range for groundwater reported in the literature. 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 ground water and surface water.

## 7.6 UNCERTAINTY ANALYSIS

There is uncertainty associated with all aspects of the baseline human health risk assessment presented in this section. A summary of the uncertainties, including a discussion of how they may affect the final risk estimates, is provided in this section.

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

Whereas there are various sources of random uncertainty and bias, the magnitude of bias and uncertainty and the direction of bias can be influenced by the assumptions made throughout the risk assessment, including selection of COPCs and selection of values for dose-response relationships. Throughout the entire risk assessment, assumptions, which consider safety factors, are made so that the final calculated risks are overestimated.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the usual variance that accompanies scientific measurements. For

example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used.

Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, on the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

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

This interpretation is especially relevant when the risks exceed the point of departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are less than an acceptable risk level (i.e., $10^{-6}$), the interpretation of no significant risk is typically straightforward. However, when risks calculated using a high degree of uncertainty exceed an acceptable risk level (i.e., $10^{-4}$), a conclusion can be difficult unless uncertainty is considered.

**Potential Risks Associated with the Ingestion of Game Species by Hunters**

As discussed in Section 7.3.1.3, Potential Current and Future Receptors of Concern and Exposure Pathways, hunting is allowed at Crane. Potential exposures by hunters to surface soil, surface water, and sediment were quantitatively evaluated in the HHRA. Potential exposures through ingestion of game species was not quantitatively evaluated in the HHRA, although risks resulting from these exposures are expected to be minimal. The general public is restricted from hunting at Crane. Only military employees, civilian employees, their families, and guests are permitted to hunt at Crane (TtNUS, 2003). NSWC Crane encompasses approximately 62,463 acres or approximately 98 square miles. In comparison, the OJT/LSC study area covers less than 10 acres. Consequently, it is unlikely that a hunter would hunt only

at the OJT/LSC. Additionally, deer and small game animals may avoid the area because of the operations occurring at the ABG, which is located adjacent to the OJT.

Reportedly, white tail deer are the only game species hunted at Crane that would provide a route for any potentially significant exposure to contaminants, in part because they are the only large game species (TtNUS, 2003). However, white tail deer have a large home range that encompasses an area much larger than the study area. Consequently, the deer exposures to site-related contaminants are expected to be minimal. Small games species and turkeys are also hunted at Crane. A typical take is one turkey and two to four small game animals a year (TtNUS, 2003), therefore, any small game and turkeys consumed by people hunting at Crane will comprise a very small portion of their overall diet. In addition, the major COPCs identified in site soil, surface water, and sediment (e.g., explosives and inorganics) do not significantly bioaccumulate, bioconcentrate, or biomagnify within the food chain. Thus, potential risks through exposure to contaminants through ingestion of game species is expected to be minimal.

### 7.6.1 Uncertainty in Selection of COPCs

The most significant issues related to uncertainty in COPC selection are the usability of existing databases (i.e., the use of validated and unvalidated sample results, and the completeness, precision, and accuracy of the data set), the inclusion of chemicals potentially attributable to background, the screening levels that are used, the absence of screening levels for a few chemicals detected in the site media, and changes in the screening criteria. A brief discussion of each of these issues is provided in the remainder of this section

**Usability of Existing Databases**

All data used in the risk assessments for the OJT/LSC were obtained from samples collected in the summer of 2001 (and reported in Appendix E of this report). All the data were validated as described in Section 3.0. An overall review of data quality is also provided in that section. The qualification of data during the formal data validation process is not expected to compromise the results of the baseline human health risk assessment. Analytical data qualified as estimated were utilized, even though the reported positive concentrations or sample-specific quantitation limits may be somewhat imprecise. The use of estimated data adds to the uncertainty associated with the risk assessment; however, the associated uncertainty is expected to be negligible compared to the other uncertainties inherent in the risk evaluation process (i.e., uncertainties with land uses, exposure scenarios, toxicological criteria, etc.). Analytical data qualified for blank contamination were used in the baseline risk assessment. When determining exposure concentrations via statistical procedures, chemicals not detected were

conservatively assumed to be present at a concentration equal to one-half the sample-specific quantitation limit. This includes those chemicals for which the detection limits were elevated relative to the target limits. Analytical results for some chemicals were qualified "R," unreliable, and were not used in the risk assessment. The sporadic rejection of a few chemicals (e.g., HMX, 2-amino-4,6-dinitrotoluene) in a few samples is not considered to be problematic because there are enough usable analytical data for these parameters to identify whether these chemicals are actually present at the site and to estimate the necessary data distribution parameters. In addition, based on historical knowledge of the site, most of the chemicals with rejected results (e.g., acrolein, acrolonitrile, 1,4-phenylenediemine, kepone) are not expected to be present and are not expected to have been related to site activities. Because only results of the most recent sampling events are used and because all data have been validated, the uncertainty in the calculated risks associated with the data is minimal. This is especially true because the COPCs used in the quantitative risk calculations were minimally affected by data quality problems.

As discussed in Section 2, not all of the surface and subsurface soil samples were analyzed for the same parameters. Pesticides and herbicides were analyzed for in surface soil samples but not in subsurface soil samples. Pesticides were not detected in the surface soil samples so they would not be expected to be found in subsurface soil samples. Likewise, herbicides were detected infrequency and at low concentrations in surface soil so they also would not be expected to be found in subsurface soil samples. Metals were only analyzed for in 32 of 48 surface soil samples and 37 of 62 subsurface soil samples. Metals were not expected to be a chemical of concern at the site and the analytical results indicated that metal contamination is not a problem at the site. Consequently, the uncertainty associated with not all samples were not analyzed for the same parameters is expected to be minimal.

Also, as discussed in Section 2, five surface water samples were not able to be collected from the upper portion of LSC during periods of low flow as planned because there was not surface water present in this portion of the stream at the time of sampling. The inability to collect these five surface water samples does not introduce any uncertainty into the risk assessment since the upper portion of LSC is an intermittent stream and is frequently dry. Consequently, there will be no exposures to surface water during these dry periods.

**Chemicals Potentially Attributable to Background**

COPCs for the OJT/LSC were selected using available background concentrations for soil, ground water, surface water, and sediment. Metal concentrations in soil were compared to background concentrations provided in the NSWC Crane Basewide Background Soil Investigation (TtNUS, 2001a) using the Wilcoxon Rank Sum Test at the 95 percent confidence level. The background data sets used for these

comparisons were the representative soil types described in the Basewide Background Soil Investigation, which most closely matched the site soil samples in terms of depositional environment, depth, and grain size. The use of matching soil types reduces the uncertainty in the background comparisons for soils.

Because basewide background data are not available for ground water, concentrations in the upgradient sample were used for the background determination by comparing the maximum site concentration of a constituent with the concentration in the upgradient sample. This method of screening inorganic compounds may result in retaining inorganic compounds as COPCs that would have been deleted as COPCs based on a more rigorous background evaluation. Therefore, site-related risks for inorganics in ground water media may be overestimated.

Basewide background data were also not available for surface water and sediment, although three upgradient surface water samples and four upgradient sediment samples were available. Surface water and sediment results were compared to the upgradient samples were performed using the Wilcoxon Rank-Sum test. In some cases where the Wilcoxon Rank-Sum test showed that site chemical concentrations were not statistically greater than background concentrations, the site concentrations appeared to be incongruous with the background concentrations. In these cases, further statistical evaluations were performed, as discussed in Section 3.4.6. The additional statistic evaluations ensured that only chemicals that truly exceeded background were eliminated from the evaluation and reduced the uncertainty in the background comparisons for surface water and sediment.

**COPC Screening Levels**

The use of risk-based screening values based on conservative land use scenarios (i.e., residential land use for soil and sediment and ingestion of tap water for ground water and surface water), corresponding to an ILCR of $10^{-6}$ and HI of 0.1, should ensure that all the significant contributors to risk from a site are evaluated. The elimination of chemicals that are present at concentrations that correspond to an ILCR less than $10^{-6}$ and an HI less than 0.1 should not affect the final conclusions of the risk assessment because those chemicals are not expected to cause a potential health concern at the detected concentrations.

**Chemicals without Established Screening Levels**

Risk-based screening levels are currently not available for some constituents [e.g., acenaphthylene, benzo(g,h,i)perylene, 2-methylnaphthalene, and phenanthrene]. Therefore, surrogates were selected for these chemicals based on similar chemical structures. In the COPC screening, acenaphthene was used

as a surrogate for acenaphthylene, naphthalene was used as a surrogate for 2-methylnaphthene, and pyrene was selected as a surrogate for benzo(g,h,i)perylene and phenanthrene. Applying toxicity values of one compound to another adds to the uncertainty in the risk assessment both in regard to the selection of COPCs and the subsequently calculated risks.

A large number of constituents do not have U.S. EPA SSLs for the migration from soil to air pathway. The uncertainty caused by this lack of data is expected to be small because potential risks associated with exposures via inhalation are typically orders of magnitude lower than those associated with exposures via incidental ingestion and dermal contact with soil. A comparison of the screening criteria for direct contact exposures with the screening criteria for migration from soil to air shows that the direct contact screening criteria are at least an order of magnitude lower than the migration screening criteria for the same compound. If there are unacceptable risks resulting from inhalation exposures then usually there are unacceptable risks from exposures via incidental ingestion and dermal contact.

**Uncertainty Associated with Changes in Screening Criteria**

U.S. EPA continually reviews the toxicity data for chemicals that typically are detected at hazardous waste sites and as new studies become available U.S. EPA may revise the information presented in the IRIS database. In addition, as new information becomes available U.S. EPA may revise the methodology used to prepare risk assessments. These changes in the toxicity data or risk assessment methodology may result in changes in the screening levels used to select COPCs, which may introduce uncertainty into the selection of COPCs. In addition, these changes may result in an underestimation or overestimation of risk.

Since the HHRA was prepared, U.S. EPA has withdrawn the oral cancer slope factor for 1,1-dichloroethene. The U.S. EPA Region 9 PRG of 0.046 µg/L for 1,1-dichloroethene which was used in the HHRA to select COPCs in ground water was based on carcinogenic effects. The current value of 340 µg/L is based on noncarcinogenic effects. 1,1-Dichloroethene was retained as a COPC in ground water since the maximum detected concentration of 1.1 µg/L exceeded the old PRG. 1,1-Dichloroethene would not be selected as a COPC if the most recent PRG had been used in the HHRA. The evaluation of 1,1-dichloroethene as a carcinogen in the HHRA does not introduce significant uncertainty in the results of the HHRA since the estimated cancer risks for 1,1-dichlroethene are over two orders of magnitude lower than those for the major risk drivers in ground water.

The PRG for trichloroethene has also changed since the HHRA was prepared. As a result of this change, trichloroethene would now be retained as a COPC in low-flow surface water. Trichloroethene was

detected in one of six low-flow surface water samples. The detected concentration of 0.4 µg/L exceeded the updated PRG of 0.028 µg/L, but was less than the U.S. EPA MCL of 5 µg/L. The HHRA evaluated exposures to hypothetical future on-site residents using surface water as a drinking water source. If trichloroethene was carried through the HHRA, then the cancer risks would be 2 x $10^{-6}$ for a child resident, 2 x $10^{-6}$ for an adult resident, and 4 x $10^{-6}$ for a lifelong resident. This does not introduce significant uncertainty in the HHRA since the cancer risks for trichloroethene are less than an order of magnitude lower than the estimated cancer risks for surface water. In addition, trichloroethene is believed to be present in surface water as a result of ground water discharging to surface water and trichloroethene was identified as a major risk driver in ground water.

### 7.6.2 Uncertainty in the Exposure Assessment

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

**Land Use**

The current land use patterns at NSWC Crane are well established, thereby limiting the uncertainty associated with land use assumptions. Land use at the OJT/LSC is currently limited and is expected to be limited in the future, as long as NSWC remains open (off-site residents and potential and infrequent trespassers are the only current and likely future receptors). To be conservative, risks to potential and future construction workers, maintenance workers, occupational workers, recreational users, and on-site residents were estimated for the site.

**Exposure Point Concentrations**

Uncertainty is associated with the use of the 95 percent UCL on the mean concentration as the EPC. As a result of using the 95 percent UCL, the estimations of potential risk for the RME scenario are most likely overstated since this is a representation of the upper limit that potential receptors would be exposed to over the entire exposure period. In some cases (because datasets were fewer than 10 samples or because the UCL was greater than the maximum concentration), the maximum concentration was used as the EPC. Use of the maximum concentration tends to overestimate potential risks because receptors are assumed to be exposed continuously to the maximum concentration for the entire exposure period. Uncertainty is also introduced when the nondetects are assigned a value of one-half the nondetect

quantitation limit in the calculation of the EPC. This may either overstate or understate the risks to the receptors.

There is uncertainty in assuming that current ground water and surface water concentrations will not change in the future, and this would introduce additional uncertainty in the EPC and risks for any ground water or surface water COPC. Concentrations in ground water may diminish over time due to natural attenuation processes involving source depletion and dilution. Because shallow ground water discharges to surface water at the site, any change in the ground water concentrations could affect surface water concentrations.

Exposures to future on-site residents were evaluated using a 1-acre EU located within the 6-acre study area. Exposures were not evaluated for additional 1-acre EUs, which could be located in other regions within the 6-acre study area, although exposures were evaluated using the entire study area as the EU. As previously noted, the location of the 1-acre EU was determined by selecting a region within the 6-acre study area that contained the highest detected concentrations of COPCs near the most active treatment area. As discussed in Section 7.5.2, ILCRs and HIs for 2,4,6-trinitrotoluene and RDX exceeded U.S. EPA acceptable levels for the 1-acre EU. In addition, risks exceeded acceptable levels for exposures to lead in surface soil. As shown on Figure 5-1, concentrations of 2,4,6-trinitrotoluene and RDX only exceeded the screening levels at locations 03SS19, 03SS22, and 03SS24, which are located in the 1-acre EU. As shown on Figure 5-2, concentrations of lead only exceeded the screening level at location 03SS24, which is located in the 1-acre EU. Risks from exposures to these compounds using a 6-acre exposure unit were within acceptable levels, which indicates that concentrations of these compounds are lower outside the 1-acre EU. Therefore, exposures to COPCs in areas outside the 1-acre EU are believed to be within acceptable levels.

The EPCs for ground water were calculated using data from all the ground water monitor wells as opposed to using the monitor wells located in the concentrated areas of the plume. The conclusions of the HHRA would not change if the EPCs had been based on the wells located in the concentrated area of the plume. ICLRs and HIs for exposures from domestic use of ground water exceeded U.S. EPA acceptable levels when the EPCs were based on data from all the ground water monitoring wells. Therefore, ICLRs and HIs would still exceed U.S. EPA acceptable levels if the EPCs had been based on monitoring wells located in the concentrated area of the plume. VOCs and RDX were identified as the major risk drivers in ground water and these chemicals would still be the major contributors to risk if the EPCs were based on the monitoring wells located in the concentrated area of the plume. Therefore, the uncertainty associated with calculating EPCs for ground water using all the ground water monitoring wells is minimal.

**Exposure Routes and Receptor Identification**

The determination of various receptor groups and exposure routes of potential concern was based on current land use observed at the site and the anticipated future land use. Therefore, the uncertainty associated with the selection of exposure routes and potential receptors is minimal because they are considered to be well defined. Although residential use of ground water was evaluated as an exposure scenario, ground water is not currently used at the site nor is it expected to be used in the future. In addition, it is unlikely that on-site surface water will be used as a domestic water source in the future. Therefore, the evaluation of direct exposure to ground water and on-site surface water (domestic use) that was performed in this baseline HHRA was included primarily to aid in risk management decision making.

**Exposure Parameters**

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

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

For many parameters for which limited information exists (i.e., dermal absorption of chemicals from soil), greater uncertainty exists. For example, current U.S. EPA guidance (U.S. EPA, 2001) does not provide dermal absorption factors for exposure to most metals (except arsenic and cadmium) in soil. Therefore, risks for dermal contact from soil are not evaluated for most metals in this risk assessment. Consequently, risks from exposure to soil may be underestimated

Many of the exposure parameters used to calculate exposures and risks in this report are selected from a distribution of possible values, including U.S. EPA guidance (U.S. EPA, 1991, 1993a) and dermal guidance (U.S. EPA 1997b and 2001). For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the majority of actual risks from a postulated exposure. This risk number is used in risk management decisions but does not indicate what a more average or typical exposure might be or what risk range might be expected for individuals in the exposed population.

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

### 7.6.3 Uncertainty in the Toxicological Evaluation

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

**Derivation of Toxicity Criteria**

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

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

and when the chemical of concern is structurally similar to other chemicals for which the toxicity is more completely characterized.

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

For noncancer effects, additional uncertainty factors may be applied in the derivation of the RfD to mitigate poor quality of the key study or gaps in the database. Additional uncertainty for noncancer effects arises from the use of an effect level in the estimation of an RfD, because this estimation is predicated on the assumption of a threshold less than which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimation of an RfD for chronic exposure from subchronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the subchronic study. Uncertainty in the derivation of RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty. This is particularly the case when no gastrointestinal absorption rates are available in the literature or when only qualitative statements regarding absorption are available.

**Uncertainty Associated with Evaluation of the Dermal Exposure Pathway**

According to RAGS Part E (U.S. EPA, 2001), risks for dermal absorption of chemicals in soil are to be quantitatively evaluated for arsenic, cadmium, chlordane, 2,4-dichlorophenoxyacetic acid, DDT, TCDD (and other dioxins), PAHs, PCBs, pentachlorophenol, and semivolatile organic compounds only because of the limited information guidance available to evaluate dermal exposure to other constituents. Therefore, risks from dermal exposure to aluminum, antimony, barium, cobalt, copper, iron, manganese, and nickel (the only COPC metals found in the OJT/LSC solid media aside from cadmium) were not quantified in the risk assessment. Consequently, potential risks may be underestimated by excluding these constituents from the dermal risk assessment calculations.

The model for dermal exposure to soil and sediment assumes that only a very thin, constant thickness layer of soil is available for contaminant transfer to the stratum corneum and that a constant amount of contaminant, proportional to the soil concentration, will be absorbed per unit area of skin and per exposure event. However, adherence to skin varies with such factors as particle size, soil type, and organic carbon content. As estimated by U.S. EPA (U.S. EPA, 2001), the absorbed dermal dose could vary by as much as a factor of 50 from the model estimates, even assuming that activity patterns lead to the exposure duration applied in the experimental trials used to develop absorption factors.

Experimental determination of absorption rates indicates that interspecies differences are considerable, which, along with other variabilities related to condition and age of skin, differences in lag time, and site of application effects, yields appreciable uncertainty in estimated dermal exposures using published chemical-specific permeation functions. In addition, literature data indicate a variation by as much as a factor of 300 in chemical absorption rates for skin in different anatomical areas of the body. It should also be noted that children generally have greater absorption rates than adults.

**Use of Aluminum and Iron Toxicity Criteria**

NCEA provisional RfDs are used to evaluate noncarcinogenic effects from exposure to aluminum and iron. The provisional RfDs for these chemicals are based on allowable intakes rather than adverse effect levels. Therefore, there is some degree of uncertainty associated with the use of the RfDs. Note that

some U.S. EPA regions (e.g., Region 1) consider the use of the oral RfD for aluminum and iron inappropriate and recommend that these metals not be evaluated quantitatively in risk assessments.

### 7.6.4 Uncertainty in the Risk Characterization

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

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

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Because chemical-specific interactions cannot be predicted, the likelihood for risks to be overpredicted or underpredicted cannot be defined, but the methodology that was used is based on current U.S. EPA guidance.

## 7.7 SUMMARY AND CONCLUSIONS

This section summarizes the results of the human health risk assessment performed for the OJT/LSC. A brief summary of the information contained in the human health risk assessment is provided. Table 7-16 contains a summary of conclusions and recommendations.

The baseline human health risk assessment for the OJT/LSC was performed to characterize the potential risks to likely human receptors under current and potential future land use. Potential receptors under current land use are adolescent trespassers and off-site residents. Potential receptors under future land use are construction workers, maintenance workers, occupational workers, recreational users, and hypothetical residents (children and adults). 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.

Potential risks associated with inhalation exposures are considered to be minimal for soil, sediment, and surface water. 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. Inhalation of volatiles from surface water and sediment was considered to yield 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, were evaluated for the OJT/LSC because volatile organics were identified as COPCs in ground water.

The list of COPCs for the OJT/LSC includes the following:

- Surface soil - 2,3,7,8-TCDD equivalents, 2,4-dinitrotoluene, 2,4,6-trinitrotoluene, trichloroethene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinintrotoluene, HMX, RDX, barium, cadmium, chromium, iron, lead, mercury, nickel, and zinc

- Subsurface soil - 2,3,7,8-TCDD equivalents, 1,1,2,2-tetrachloroethane, trichloroethene, acetophenone, benzo(a)pyrene, benzo(b)fluoranthene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 2,4-dinitrotoluene, RDX, barium, cadmium, cobalt, copper, iron, lead, manganese, nickel, and zinc.

- Ground water - 1,1,2,2-Tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, vinyl chloride, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, RDX, barium, cadmium, iron, nickel, and nitrate.

- Sediment - 2-Amino-4,6-dinitrotoluene, aluminum, antimony, barium, cadmium, and lead.

- Surface water - Acetone, methylene chloride, bromomethane, bis(2-ethylhexyl) phthalate, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, RDX, pentachlorophenol, antimony, lead, and nitrate.

Quantitative estimates of noncarcinogenic and carcinogenic risks (HIs and ILCRs, respectively) were developed for potential human receptors. Cumulative HIs for current and future adolescent trespassers, current/future off-sit child and adult residents, future construction workers, future maintenance workers, and future adult recreational users 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 on-site child and adult resident exposed to surface soil in the 1-acre EU exceeded unity. 2,4,6-Trinitrotoluene and RDX were the major contributors to the HI for the future on-site child resident and 2,4,6-trinitrotoluene was the major contributor to the HI for the adult resident. The highest detected concentrations of 2,4,6-trinitrotoluene and RDX occurred in samples 03SS22 and 03SS24. HIs for exposures to surface soil samples collected outside of the area bounded by these two samples would be within acceptable levels indicating that the unacceptable HIs for child and adult residents are the result of elevated concentrations of 2,4,6-trinitotoluen and RDX at sampling locations 03SS22 and 03SS24. Cumulative HIs for the future on-site child and adult resident exposed to surface soil in the 6-acre EU were within acceptable levels.

HIs for future occupational workers, future child recreational users, and future on-site child and adult residents exposed to ground water and future on-site child and adult residents exposed to surface water exceeded unity. Trichloroethene and 2-amino-4,6-dinitrotoluene were the major contributors to the HI for exposures to ground water. 2-Amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and RDX were the major contributors to the HI for exposures to surface water.

Cumulative ILCRs for all receptors were less than or within U.S. EPA's target risk range of $10^{-4}$ to $10^{-6}$ with the exception of the future on-site child, adult, and lifetime residents. The ILCRs for the future on-site lifelong resident exposed to surface soil in the 1-acre EU exceeded the U.S. EPA target risk range of $10^{-4}$ to $10^{-6}$. 2,4,6-Trinitrotoluene and RDX were the major contributors to the ILCR. The highest detected concentrations of 2,4,6-trinitrotoluene and RDX occurred in samples 03SS22 and 03SS24. The ILCR for exposures to surface soil samples collected outside of the area bounded by these two samples would be within the U.S. EPA target risk range. This indicates that the unacceptable ICLRs for the future lifetime residents are the result of elevated concentrations of 2,4,6-trinitotoluen and RDX at sampling locations 03SS22 and 03SS24. ILCRs for the future on-site child, adult, and lifelong resident exposed to surface soil in the 6-acre EU were within U.S. EPA's target risk range.

ILCRs for future on-site child, adult, and lifetime residents exposed to ground water exceeded the U.S. EPA target risk range. 1,1,2,2-Tetrachloroethane and trichloroethene were the major contributors to the ILCR for ground water.

Exposure to lead in surface soil by future on-site child residents were evaluated with the IEUBK Model. The results of the IEUBK model indicated that risks to future on-site child residents from exposures to lead in surface soil exceeded the EPA goal as described in the 1994 OSWER directive, of no more than 5 percent of children exceeding a 10 µg/dL blood-lead level. Lead was detected in only one surface soil

sample (10,200 mg/kg - 03SS24002) at a concentration which exceed the screening level of 400 mg/kg. Exposures to lead in surface soil outside of sample 03SS24002 would be within the goals described in the 1994 OSWER directive of no more than 5 percent of children with blood-lead levels exceeding 10 µg/dL. These results indicate that the unacceptable risks from exposure to lead in surface soil by child resident are being driven by the elevated lead concentrations in sample 03SS24002.

Exposure to lead in sediment by future on-site child residents were also evaluated with the IEUBK Model. Results of the IEUBK model analysis indicate that child blood-lead levels were within the goals of no more than 5 percent of children exceeding a 10 µg/dL blood-lead level.

Exposures to lead in soil by future occupational workers and future construction workers were evaluated with adult lead model. Results of the adult lead model analysis indicate that blood-lead levels for children (fetuses of exposed woman) were within the goal of no more than 5 percent of children exceeding a 10 µg/L blood-lead level.

In summary for the OJT/LSC, no significant potential human health risks are expected for exposures to soil and sediment under current or future land use. Under current land use, no significant potential human health risks are anticipated for exposures to surface water. There are no exposures to ground water under current land use. Under future land use elevated noncarcinogenic and/or carcinogenic risks were elevated for on-site child and adult residents using surface water as a potable water source, mainly as a result of samples collected from location 03SWSD17. 2-Amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and RDX were the major contributors to the elevated risks for surface water. Also under future land use elevated noncarcinogenic and/or carcinogenic risks were calculated for occupational workers, child recreational users, and on-site child and adult residents using ground water as a potable water source. Tetrachloroethane, trichloroethene, and 2-amino-4,6-dinitrotoluene were the major contributors to the elevated risks for ground water. A summary of the major contributors to risks at OJT/LSC is provided in Table 7-16.

TABLE 7-1

SELECTION OF EXPOSURE PATHWAYS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
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 | Surface Soil | Old Jeep Trail | Trespassers | Adolescents | Ingestion | On-Site | Quant | Although access to the base is controlled, once inside the base, access to the OJT/LSC is not limited by any physical restraint Adolescent trespassers may be exposed to surface soil while at the site |
| | | | | | | Dermal | On-Site | Quant | |
| | | | | Residents | Child | Ingestion | Off-Site | None | Off-base residents are not exposed to on-site surface soil |
| | | | | | | Dermal | Off-Site | None | |
| | | | | | Adult | Ingestion | Off-Site | None | Off-base residents are not exposed to on-site surface soil |
| | | | | | | Dermal | Off-Site | None | |
| | | Air | Old Jeep Trail | Trespassers | Adolescents | Inhalation | On-Site | None | Although access to the base is controlled, once inside the base, access to the OJT/LSC is not limited by any physical restraint No COPCs were identified in soil for the inhalation pathway, therefore this pathway is not evaluated |
| | | | | Residents | Child | Inhalation | Off-Site | None | Off-base residents are not exposed to on-site surface soil In addition, no COPCs were identified in soil for the inhalation pathway, therefore this pathway is not evaluated |
| | | | | | Adult | Inhalation | Off-Site | None | Off-base residents are not exposed to on-site surface soil In addition, no COPCs were identified in soil for the inhalation pathway, therefore this pathway is not evaluated |
| | Subsurface Soil | Subsurface Soil | Old Jeep Trail | Trespassers | Adolescents | Ingestion | On-Site | None | Trespassers are not exposed to subsurface soil |
| | | | | | | Dermal | On-Site | None | |
| | | | | Residents | Child | Ingestion | Off-Site | None | Off-base residents are not exposed to on-site subsurface soil |
| | | | | | | Dermal | Off-Site | None | |
| | | | | | Adult | Ingestion | Off-Site | None | Off-base residents are not exposed to on-site subsurface soil |
| | | | | | | Dermal | Off-Site | None | |
| | | Air | Old Jeep Trail | Trespassers | Adolescents | Inhalation | On-Site | None | Trespassers are not exposed to subsurface soil In addition, no COPCs were identified in soil for the inhalation pathway, therefore this pathway is not evaluated |
| | | | | Residents | Child | Inhalation | Off-Site | None | Off-base residents are not exposed to on-site subsurface soil In addition, no COPCs were identified in soil for the inhalation pathway, therefore this pathway is not evaluated |
| | | | | | Adult | Inhalation | Off-Site | None | Off-base residents are not exposed to on-site subsurface soil In addition, no COPCs were identified in soil for the inhalation pathway, therefore this pathway is not evaluated |
| | Ground Water | Ground Water | Shallow Aquifer | Trespassers | Adolescents | Ingestion | On-Site | None | Adolescent trespassers are not expected to be exposed to ground water |
| | | | | | | Dermal | On-Site | None | |
| | | | | Residents | Child | Ingestion | Off-Site | None | Off-base residents are not exposed to ground water from the OJT/LSC |
| | | | | | | Dermal | Off-Site | None | |
| | | | | | Adult | Ingestion | Off-Site | None | Off-base residents are not exposed to ground water from the OJT/LSC |
| | | | | | | Dermal | Off-Site | None | |
| | | Air | Shallow Aquifer | Trespassers | Adolescents | Inhalation | On-Site | None | Adolescent trespassers are not expected to be exposed to ground water |
| | | | | Residents | Child | Inhalation | Off Site | None | Off-base residents are not exposed to ground water from the OJT/LSC |
| | | | | | Adult | Inhalation | Off-Site | None | Off-base residents are not exposed to ground water from the OJT/LSC |
| | Surface Water | Surface Water | Little Sulphur Creek | Trespassers | Adolescents | Ingestion | On-Site | Quant | Although access to the base is controlled, once inside the base, access to the OJT/LSC is not limited by any physical restraint Adolescent trespassers may be exposed to surface water while at the site |
| | | | | | | Dermal | On-Site | Quant | |

TABLE 7-1

SELECTION OF EXPOSURE PATHWAYS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
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 (continued) | Surface Water | Surface Water | Little Sulphur Creek | Residents | Child | Ingestion<br>Dermal | Off-Site<br>Off-Site | Quant<br>Quant | Off-base residents may also use surface water as a drinking water source Although this is a conservative and unlikely scenario |
| | | | | | Adult | Ingestion<br>Dermal | Off-Site<br>Off-Site | Quant<br>Quant | Off-base residents may also use surface water as a drinking water source Although this is a conservative and unlikely scenario |
| | Sediment | Sediment | Little Sulphur Creek | Trespassers | Adolescents | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | Although access to the base is controlled, once inside the base, access to the OJT/LSC is not limited by any physical restraint Adolescent trespassers may be exposed to sediment while at the site |
| | | | | Residents | Child | Ingestion<br>Dermal | Off-Site<br>Off-Site | Qual<br>Qual | Off-base residents may be exposed to sediment Although such exposure are expected to be less than those experienced by future on-site residents |
| | | | | | Adult | Ingestion<br>Dermal | Off-Site<br>Off-Site | Qual<br>Qual | Off-base residents may be exposed to sediment Although such exposure are expected to be less than those experienced by future on-site residents |
| Future | Surface Soil | Surface Soil | Old Jeep Trail | Construction Workers | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | Construction workers may have contact with surface soil during excavation activities |
| | | | | Maintenance Worker | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | Maintenance workers may contact surface soil during normal work activities |
| | | | | Occupational Worker | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | Occupational workers may contact surface soil during normal work activities |
| | | | | Recreational Users | Child | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future |
| | | | | | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>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 | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | | | | | Adult | Ingestion<br>Dermal | On-Site<br>On Site | Quant<br>Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | | Air | Old Jeep Trail | Construction Workers | Adult | Inhalation | On-Site | None | Construction workers may be exposed to fugitive dust and volatile emissions during construction activities No COPCs were identified in soil for the inhalation pathway, therefore, this pathway is not evaluated |
| | | | | Maintenance Worker | Adult | Inhalation | On Site | None | Maintenance workers may be exposed to fugitive dust and volatile emissions during work activities No COPCs were identified in soil for the inhalation pathway, therefore, this pathway is not evaluated |
| | | | | Occupational Worker | Adult | Inhalation | On Site | None | Occupational workers may be exposed to fugitive dust and volatile emissions during work activities No COPCs were identified in soil for the inhalation pathway, therefore, this pathway is not evaluated |
| | | | | Recreational Users | Child | Inhalation | On Site | None | This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future No COPCs were identified in soil for the inhalation pathway, therefore, this pathway is not evaluated |
| | | | | | Adult | Inhalation | On-Site | None | This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future No COPCs were identified in soil for the inhalation pathway, therefore, this pathway is not evaluated |
| | | | | Residents | Child | Inhalation | On-Site | None | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions No COPCs were identified in soil for the inhalation pathway, therefore, this pathway is not evaluated |

TABLE 7-1

SELECTION OF EXPOSURE PATHWAYS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
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 (continued) | Surface Soil | Air | Old Jeep Trail | | Adult | Inhalation | On-Site | None | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions No COPCs were identified in soil for the inhalation pathway, therefore, this pathway is not evaluated |
| | Subsurface Soil | Subsurface Soil | Old Jeep Trail | Construction Workers | Adult | Ingestion | On-Site | Quant | Construction workers may have contact with subsurface soil during excavation activities |
| | | | | | | Dermal | On-Site | Quant | |
| | | | | Maintenance Worker | Adult | Ingestion | On-Site | None | Maintenance workers are not expected to be exposed to subsurface soil |
| | | | | | | Dermal | On-Site | None | |
| | | | | Occupational Worker | Adult | Ingestion | On-Site | None | Occupational workers are not expected to be exposed to subsurface soil |
| | | | | | | Dermal | On-Site | None | |
| | | | | Recreational Users | Child | Ingestion | On-Site | None | Recreational users are not expected to be exposed to subsurface soil |
| | | | | | | Dermal | On-Site | None | |
| | | | | | Adult | Ingestion | On-Site | None | Recreational users are not expected to be exposed to subsurface soil |
| | | | | | | Dermal | On-Site | None | |
| | | | | Residents | Child | Ingestion | On-Site | None | Future residents are not expected to be exposed to subsurface soil |
| | | | | | | Dermal | On-Site | None | |
| | | | | | Adult | Ingestion | On-Site | None | Future residents are not expected to be exposed to subsurface soil |
| | | | | | | Dermal | On-Site | None | |
| | | Air | Old Jeep Trail | Construction Workers | Adult | Inhalation | On-Site | None | Construction workers may be exposed to fugitive dust and volatile emissions during construction activities No COPCs were identified in soil for the inhalation pathway, therefore, this pathway is not evaluated |
| | | | | Maintenance Worker | Adult | Inhalation | On-Site | None | Maintenance workers are not expected to be exposed to subsurface soil In addition, no COPCs were identified in soil for the inhalation pathway |
| | | | | Occupational Worker | Adult | Inhalation | On-Site | None | Occupational workers are not expected to be exposed to subsurface soil In addition, no COPCs were identified in soil for the inhalation pathway |
| | | | | Recreational Users | Child | Inhalation | On-Site | None | Recreational workers are not expected to be exposed to subsurface soil In addition, no COPCs were identified in soil for the inhalation pathway |
| | | | | | Adult | Inhalation | On Site | None | Recreational workers are not expected to be exposed to subsurface soil In addition, no COPCs were identified in soil for the inhalation pathway |
| | | | | Residents | Child | Inhalation | On-Site | None | Future residents are not expected to be exposed to subsurface soil In addition, no COPCs were identified in soil for the inhalation pathway |
| | | | | | Adult | Inhalation | On-Site | None | Future residents are not expected to be exposed to subsurface soil In addition, no COPCs were identified in soil for the inhalation pathway |
| | Ground Water | Ground Water | Shallow Ground Water | Construction Workers | Adult | Ingestion | On-Site | None | Construction workers are not expected to ingest groundwater |
| | | | | | | Dermal | On-Site | Quant | Construction workers may have dermal contact with ground water during excavation activities |
| | | | | Maintenance Workers | Adult | Ingestion | On-Site | None | Maintenance workers are not expected to have contact with ground water |
| | | | | | | Dermal | On-Site | None | |
| | | | | Occupational Worker | Adult | Ingestion | On Site | Quant | Occupational workers may be exposed to ground water if ground water were used as a potable water source |
| | | | | | | Dermal | On-Site | Quant | |
| | | | | Recreational Users | Child | Ingestion | On-Site | Quant | Recreational users may be exposed to ground water if ground water were used as a potable water source |
| | | | | | | Dermal | On-Site | Quant | |
| | | | | | Adult | Ingestion | On-Site | Quant | Recreational users may be exposed to ground water if ground water were used as a potable water source |
| | | | | | | Dermal | On-Site | Quant | |

TABLE 7-1

SELECTION OF EXPOSURE PATHWAYS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
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 (continued) | Ground Water | Ground Water | Shallow Ground Water | Residents | Child | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | | | | | Adult | Ingestion<br>Dermal | On Site<br>On-Site | Quant<br>Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | | Air | Shallow Ground Water | Construction Workers | Adult | Inhalation | On-Site | Quant | Construction workers may be exposed to COPCs that have volatilized from ground water during excavation activities |
| | | | | Maintenance Workers | Adult | Inhalation | On-Site | None | Maintenance workers are not expected to be exposed to COPCs that have volatilized from ground water |
| | | | | Occupational Worker | Adult | Inhalation | On Site | None | Occupational workers are not expected to be exposed to COPCs that have volatilized from ground water |
| | | | | Recreational Users | Child | Inhalation | On-Site | None | Recreational users are not expected to be exposed to COPCs that have volatilized from ground water |
| | | | | | Adult | Inhalation | On-Site | None | Recreational users are not expected to be exposed to COPCs that have volatilized from ground water |
| | | | | Residents | Child | Inhalation | On-Site | Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | | | | | Adult | Inhalation | On-Site | Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | Surface Water | Surface Water | Little Sulphur Creek | Construction Workers | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | None<br>None | Construction workers are not expected to be exposed to surface water |
| | | | | Maintenance Workers | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | None<br>Quant | Maintenance workers are not expected to ingest surface water<br>Maintenance workers may have dermal contact with surface water |
| | | | | Occupational Worker | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | None<br>None | Occupational workers are not expected to be exposed to surface water |
| | | | | Recreational Users | Child | Ingestion<br>Dermal | On-Site<br>On Site | Quant<br>Quant | This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future |
| | | | | | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>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 | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | | | | | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | Sediment | Sediment | Little Sulphur Creek | Construction Workers | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | None<br>None | Construction workers are not expected to be exposed to sediment |
| | | | | Maintenance Workers | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | Maintenance workers may contact sediment |
| | | | | Occupational Worker | Adult | Ingestion<br>Dermal | On Site<br>On-Site | None<br>None | Occupational workers are not expected to be exposed to sediment |
| | | | | Recreational Users | Child | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future |
| | | | | | Adult | Ingestion<br>Dermal | On-Site<br>On-Site | Quant<br>Quant | This scenario is evaluated on the assumption that the Facility would close and be turned into a state park in the future |

TABLE 7-1

SELECTION OF EXPOSURE PATHWAYS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
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 (continued) | Sediment | Sediment | Little Sulphur Creek | Residents | Child | Ingestion | On-Site | Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | | | | | | Dermal | On Site | Quant | |
| | | | | | Adult | Ingestion | On-Site | Quant | Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions |
| | | | | | | Dermal | On-Site | Quant | |

Notes
Quant - Quantitative
Qual - Qualitative

**TABLE 7-2**

**EXPOSURE ROUTES FOR QUANTITATIVE EVALUATION**
**OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE,**
**CRANE INDIANA**

| Receptors | Exposure Routes |
|---|---|
| Construction Workers<br>(future land use) | • Surface/Subsurface Soil Incidental Ingestion<br>• Surface/Subsurface Soil Dermal Contact<br>• Ground Water Dermal Contact (during excavation)<br>• Ground Water Inhalation of Volatile Organics (during excavation) |
| Maintenance Workers<br>(future land use) | • Surface Soil Incidental Ingestion<br>• Surface Soil Dermal Contact<br>• Surface Water/Sediment Dermal Contact<br>• Sediment Incidental Ingestion |
| Occupational Worker<br>(future land use) | • Surface Soil Incidental Ingestion<br>• Surface Soil Dermal Contact<br>• Direct Ingestion of Ground Water<br>• Ground Water Dermal Contact |
| Adolescent Trespassers<br>(6 to 17 Years)<br>(current/future land use) | • Surface Soil Incidental Ingestion<br>• Surface Soil Dermal Contact<br>• Surface Water/Sediment Dermal Contact<br>• Surface Water/Sediment Incidental Ingestion |
| Small Child (0 to 6 years) and<br>Adult Recreational Users<br>(future land use) | • Surface Soil Dermal Contact<br>• Surface Soil Ingestion<br>• Surface Water/Sediment Dermal Contact<br>• Surface Water/Sediment Incidental Ingestion<br>• Direct Ingestion of Ground Water<br>• Ground Water Dermal Contact |
| On-Base Residents (Children/Adults)<br>(future land use) | • Surface Soil Incidental Ingestion<br>• Surface Soil Dermal Contact<br>• Direct Ingestion of Ground Water (Domestic water source)<br>• Ground Water Dermal Contact (Domestic water source)<br>• Inhalation of Volatiles in Ground Water (Domestic water source)<br>• Sediment Dermal Contact<br>• Sediment Incidental Ingestion<br>• Surface Water Ingestion (Domestic water source)<br>• Surface Water Dermal Contact (Domestic water source) |
| Off-Base Residents (Children/Adults)<br>(current/future land use) | • Surface Water Ingestion (Domestic water source)<br>• Surface Water Dermal Contact (Domestic water source) |

Note: No COPCs were identified from the inhalation pathway for soil, therefore inhalation of fugitive dust and volatiles from soil is not quantitatively evaluated in the risk assessment.

TABLE 7-3

EXPOSURE POINT CONCENTRATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical | Surface Soil 1-Acre EU (mg/kg) | Surface Soil 6-Acre EU (mg/kg) | Surface/ Subsurface Soil (mg/kg) | Shallow Ground Water (µg/L) | Sediment (mg/kg) | Surface Water (µg/L) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Trespassers/ Recreational Users[1] | Future On-Site Residents[2] | Current/Future Off-Site Residents[3] |
| **Dioxin/Furans** | | | | | | | | |
| 2,3,7,8-TCDD Equivalents | 0.0000074[4] | 0.0000074[4] | 0 0000074[4] | NA | NA | NA | NA | NA |
| **Volatile Organic Compounds** | | | | | | | | |
| Acetone | NA | NA | NA | NA | NA | 64[4] | NA | NA |
| Bromomethane | NA | NA | NA | NA | NA | 0.529 | 1.6[4] | NA |
| Methylene Chloride | NA | NA | NA | NA | NA | 3.23 | NA | NA |
| 1,1,2,2-Tetrachloroethane | NA | NA | NA | 1 11[5] | NA | NA | NA | NA |
| Trichloroethene | NA | NA | NA | 48.9[5] | NA | NA | NA | NA |
| 1,1,2-Trichloroethane | NA | NA | NA | 48 9[5] | NA | NA | NA | NA |
| 1,1-Dichloroethene | NA | NA | NA | 0.213[5] | NA | NA | NA | NA |
| Cis-1,2-Dichloroethene | NA | NA | NA | 11.3[5] | NA | NA | NA | NA |
| Tetrachloroethene | NA | NA | NA | 0.617[5] | NA | NA | NA | NA |
| Trans-1,2-Dichloroethene | NA | NA | NA | 2 87[5] | NA | NA | NA | NA |
| Vinyl Chloride | NA | NA | NA | 0 4[5] | NA | NA | NA | NA |
| **Semivolatile Organic Compounds** | | | | | | | | |
| Acetophenone | NA | NA | 0.044 | NA | NA | NA | NA | NA |
| Benzo(a)pyrene | NA | NA | 0.002 | NA | NA | NA | NA | NA |
| Bis(2-ethylhexyl)phthalate | NA | NA | NA | NA | NA | 1.36 | NA | NA |
| Pentachlorophenol | NA | NA | NA | NA | NA | 0 059 | NA | NA |
| **Energetics** | | | | | | | | |
| 2,4,6-Trinitrotoluene | 581 | 2 62 | 0 522 | 1 3[5] | NA | NA | NA | NA |
| 2-Amino-4,6-Dinitrotoluene | 2 36 | 0.433 | 0.249 | 0 409[5] | 0 178 | 0.384 | 1.5[4] | NA |
| 4-Amino-2,6-Dinitrotoluene | 1.44 | 0 365 | 0 218 | 1 03[5] | NA | 1.06 | 2.9[4] | 0.54[4] |
| HMX | 291 | 4.77 | 0 890 | NA | NA | NA | NA | NA |
| RDX | 522 | 3.41 | 0.678 | 27 2[5] | NA | 63[4] | 63[4] | 10[4] |

TABLE 7-3

EXPOSURE POINT CONCENTRATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical | Surface Soil 1-Acre EU (mg/kg) | Surface Soil 6-Acre EU (mg/kg) | Surface/ Subsurface Soil (mg/kg) | Shallow Ground Water (µg/L) | Sediment (mg/kg) | Surface Water (µg/L) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Trespassers/ Recreational Users[1] | Future On-Site Residents[2] | Current/Future Off-Site Residents[3] |
| **Inorganics** | | | | | | | | |
| Aluminum | NA | NA | NA | 9 5[5] | 14196 | NA | NA | NA |
| Antimony | NA | NA | NA | NA | 2 88 | 0 784 | NA | NA |
| Barium | 235[6] | 252 | 236 | 87.8[5] | 359 | NA | NA | NA |
| Cadmium | 4 4 | 1.19 | 1 13 | 1.78[5] | 1.78 | NA | NA | NA |
| Chromium | 14.6[6] | 26.4 | 20.9 | 7.02[5] | NA | NA | NA | NA |
| Cobalt | NA | NA | 22 | NA | NA | NA | NA | NA |
| Iron | 21431[6] | 26855 | 28009 | 505[5] | NA | NA | NA | NA |
| Lead | 1324 | 358[5] | 310[5] | NA | 120[5] | 29.1[5] | NA | NA |
| Manganese | NA | NA | 1217 | 58.2[5] | NA | NA | NA | NA |
| Nickel | NA | NA | 125 | 8.86[5] | NA | NA | NA | NA |
| Thallium | NA | NA | NA | 0.173[5] | NA | NA | NA | NA |
| Zinc | NA | NA | NA | NA | NA | NA | NA | NA |
| **Miscellaneous Parameters** | | | | | | | | |
| Nitrate | NA | NA | NA | 296[5] | NA | NA | NA | NA |

Notes:
RAGS Part D Tables for the exposure point concentrations are included in Appendix G.
NA - Not applicable - Chemical is not a COPC for this medium.
Concentrations are the 95 percent UCL on lognormal distribution unless otherwise noted.
1 - Includes all surface water samples.
2 - Includes only surface water samples collected downstream of Spring C (SWSD15 through SWSD19).
3 - Includes only surface water samples collected at location SWSD19
4 - Maximum detected concentration
5 - Arithmetic mean concentration
6 - 95 percent UCL on normal distribution.

TABLE 7-4

SUMMARY OF EXPOSURE INPUT PARAMETERS
SWMU 3 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA
PAGE 1 OF 2

| Exposure Parameter | Off-Site Child Residents | | Off-Site Adult Residents | |
|---|---|---|---|---|
| | RME | CTE | RME | CTE |
| **All Exposures** | | | | |
| $C_{soil}/C_{sed}$ (mg/kg) | NA | NA | NA | NA |
| $C_{gw}$ (ug/L) | NA | NA | NA | NA |
| $C_{sw}$ (ug/L) | Maximum or 95% UCL[1] | Maximum or 95% UCL[1] | Maximum or 95% UCL[1] | Maximum or 95% UCL[1] |
| ED (years) | 6[4] | 2[4] | 24[4] | 7[4] |
| BW (kg) | 15[4] | 15[4] | 70[4] | 70[4] |
| $AT_n$ (days) | 2,190[6] | 730[6] | 8,760[6] | 2,555[6] |
| $AT_c$ (days) | 25,550[6] | 25,550[6] | 25,550[6] | 25,550[6] |
| **Incidental Ingestion/Dermal Contact with Soil** | | | | |
| IR (mg/day) | NA | NA | NA | NA |
| EF-Soil (days/year) | NA | NA | NA | NA |
| FI (unitless) | NA | NA | NA | NA |
| SA ($cm^2$/day) | NA | NA | NA | NA |
| AF (mg/$cm^2$) | NA | NA | NA | NA |
| ABS (unitless) | NA | NA | NA | NA |
| CF (kg/mg) | NA | NA | NA | NA |
| **Ingestion/Dermal Contact with Ground Water** | | | | |
| $IR_{gw}$ (L/day) | NA | NA | NA | NA |
| EF (days/year) | NA | NA | NA | NA |
| ET (hours/day) and $t_{event}$ (hours/event) | NA | NA | NA | NA |
| EV (events/day) | NA | NA | NA | NA |
| A ($cm^2$/day) | NA | NA | NA | NA |
| $K_p$ (cm/hour) | NA | NA | NA | NA |
| t* (hour/event), $\tau$ (hour), and B (unitless) | NA | NA | NA | NA |
| **Inhalation of Volatile Emissions from Ground Water** | | | | |
| $C_{air}$ (mg/$m^3$) | NA | NA | NA | NA |
| InhR ($m^3$/hour) | NA | NA | NA | NA |
| ET (hours/day) | NA | NA | NA | NA |
| **Ingestion/Dermal Contact with Surface Water** | | | | |
| $CR_{sw}$ (ml/hr) or IRgw (L/day) | 1 5[16] | 0 66[16] | 2[4] | 1 4[4] |
| EF (days/year) | 350[4] | 234[4] | 350[4] | 234[4] |
| ET (hours/day) and $t_{event}$ (hours/event) | 0 25[16] | 0 167[16] | 0 25[16] | 0 167[16] |
| EV (events/day) | 1[2] | 1[2] | 1[2] | 1[2] |
| A ($cm^2$/day) | 6,600[12] | 6,600[12] | 18,000[12] | 18,000[12] |
| $K_p$ (cm/hour) | chemical-specific[12] | chemical-specific[12] | chemical-specific[12] | chemical-specific[12] |
| t* (hour/event), $\tau$ (hour), and B (unitless) | chemical-specific[12] | chemical-specific[12] | chemical-specific[12] | chemical-specific[12] |
| CF (L/$cm^3$) | 1E-03 | 1E-03 | 1E-03 | 1E-03 |

TABLE 7-4

SUMMARY OF EXPOSURE INPUT PARAMETERS
SWMU 3 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Exposure Parameter | Off-Site Child Residents | | Off-Site Adult Residents | |
|---|---|---|---|---|
| | RME | CTE | RME | CTE |
| **Incidental Ingestion/Dermal Contact with Sediment** | | | | |
| IR (mg/day) | NA | NA | NA | NA |
| EF-Sediment (days/year) | NA | NA | NA | NA |
| FI (unitless) | NA | NA | NA | NA |
| SA ($cm^2$/day) | NA | NA | NA | NA |
| AF (mg/$cm^2$) | NA | NA | NA | NA |
| ABS (unitless) | NA | NA | NA | NA |
| CF (kg/mg) | NA | NA | NA | NA |

**Notes:**

A Skin surface area available for contact
ABS Absorption factor
AF Soil-to-skin adherence factor
$AT_c$ Averaging time for carcinogenic effects
$AT_n$ Averaging time for noncarcinogenic effects
B Bunge Model partitioning coefficient
BW Body weight
CF Conversion factor
CR Contact rate
$C_{soil/sed}$ Exposure concentration for soil/sediment
$C_{gw/sw}$ Exposure concentration for ground water/surface water
$C_{air}$ Exposure concentration for air
ED Exposure duration
EF Exposure frequency
ET Exposure time
EV Event frequency
FI Fraction ingested from contaminated source
InhR Inhalation rate
IR Ingestion rate (soil or groundwater)
$K_p$ Permeability coefficient from water through skin
SA Skin surface area available for contact
$\tau$ Lag time
$t^*$ Time it takes to reach steady-state conditions
$t_{event}$ Duration of event

1 - U S EPA, 1992 Supplemental Guidance to RAGS Calculating the Concentration Term PB92-963373
2 - Professional judgement
3 - U S EPA, 1991 Human Health Evaluation Manual, Supplemental Guidance Standard Default Exposure Factors OSWER Directive 9285 6-03
4 - U S EPA, 1993 Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure
5 - Adolescents ages 7 to 16 years old
6 - U S EPA, 1989 Risk Assessment Guidance for Superfund Vol 1 Human Health Evaluation Manual, Part A
7 - CTE is assumed to be one half the RME value
8 - Ground is assumed to be frozen or snow covered 22 weeks/year
9 - Assume 2 days a month for RME and one day a month for CTE
10 - Assume 1 day a week in warm weather months for RME and every other week for CTE
11 - Assume 2 days a week in warm weather months for RME and one day a week for CTE
12 - U S EPA, 2001 Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim EPA/540/R/99/005
13 - Assume 25 percent of total body surface area is exposed, U S EPA, 1997 Exposure Factors Handbook EPA/600/8-95/002FA
14 - Assume 50 percent of total body surface area is exposed, U S EPA, 2001
15 - Assume that head, arms, hands, lower legs, and feet are exposed, U S EPA, 1997
16 - U S EPA, 1997 Exposure Factors Handbook EPA/600/8-95/002FA
17 - ASTM, 1997 Standard Guide for Risk-Based Corrective Action, E50 04
18 - Foster, S A and P C Chrostowski, 1987 Inhalation Exposure to Volatile Organic Contaminants in the Shower
19 - U S EPA Region 4, 1995 Supplement Guidance to RAGS Region 4 Bulletins
20 - Maximum detected concentration is surface water samples collected downstream of Spring C (Samples SW15 through SW19)

TABLE 7-5

PARAMETERS FOR EVALUATION OF DERMAL CONTACT
WITH GROUND WATER/SURFACE WATER
SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

| Chemical | Estimated Kp (cm/hr) | FA | τ (hr) | B | t* (hr) |
|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | | |
| 1,1,2,2-Tetrachloroethane | 6 94E-03 | 1 | 9 31E-01 | 3.46E-02 | 2.24E+00 |
| 1,1,2-Trichloroethane | 6.44E-03 | 1 | 5.96E-01 | 2.86E-02 | 1.43E+00 |
| 1,1-Dichloroethene | 1 17E-02 | 1 | 3 72E-01 | 4.41E-02 | 8.93E-01 |
| Acetone | 5.21E-04 | 1 | 2.22E-01 | 1.53E-03 | 5.32E-01 |
| Bromomethane | 2.84E-03 | 1 | 3.63E-01 | 1.06E-02 | 8.71E-01 |
| Cis-1,2-Dichloroethene | 1.29E-02 | 1 | 3.67E-01 | 4.87E-02 | 8.80E-01 |
| Methylene Chloride | 3 54E-03 | 1 | 3.19E-01 | 1.26E-02 | 7.65E-01 |
| Tetrachloroethene | 3 34E-02 | 1 | 9 06E-01 | 1.66E-01 | 2.18E+00 |
| Trans-1,2-Dichloroethene | 7.71E-03 | 1 | 3.72E-01 | 2.92E-02 | 8.93E-01 |
| Trichloroethene | 1 16E-02 | 1 | 5 81E-01 | 5.13E-02 | 1.39E+00 |
| Vinyl Chloride | 5 60E-03 | 1 | 2.39E-01 | 1 70E-02 | 5.73E-01 |
| **Semivolatile Organic Compounds** | | | | | |
| Bis(2-ethylhexyl)phthalate | 2 49E-02 | 0.8 | 1 66E+01 | 1 90E-01 | 3.99E+01 |
| **Herbicides** | | | | | |
| Pentachlorophenol | 3.93E-01 | 0.9 | 3.33E+00 | 2.47E+00 | 1.38E+01 |
| **Energetics** | | | | | |
| 2,4,6-Trinitrotoluene | 9.64E-04 | 1 | 1.96E+00 | 5 59E-03 | 4 71E+00 |
| 2-Amino-4,6-Dinitrotoluene | 6.41E-04 | 1 | 1.34E+00 | 3.46E-03 | 3 21E+00 |
| 4-Amino-2,6-Dinitrotoluene | 6 41E-04 | 1 | 1.34E+00 | 3 46E-03 | 3.21E+00 |
| RDX | 3 45E-04 | 1 | 1.85E+00 | 1.98E-03 | 4 43E+00 |
| **Inorganics** | | | | | |
| Antimony | 1.00E-03 | NA | NA | NA | NA |
| Barium | 1 00E-03 | NA | NA | NA | NA |
| Cadmium | 1 00E-03 | NA | NA | NA | NA |
| Chromium | 2.00E-03 | NA | NA | NA | NA |
| Iron | 1 00E-03 | NA | NA | NA | NA |
| Lead | 1 00E-03 | NA | NA | NA | NA |
| Nickel | 2.00E-04 | NA | NA | NA | NA |
| Manganese | 1 00E-03 | NA | NA | NA | NA |
| Thallium | 1.00E-03 | NA | NA | NA | NA |
| **Miscellaneous Parameters** | | | | | |
| Nitrate | 1 00E-03 | NA | NA | NA | NA |

Notes:

NA - Not applicable for inorganics
τ - Lag time.
t* - Time it takes to reach steady-state conditions.

Source: EPA, 2001: Risk Assessment Guidance for Superfund Volume 1· Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R99/005.

**TABLE 7-6**

**INPUT PARAMETERS FOR**
**VOLATILIZATION FROM GROUND WATER TO OUTDOOR AIR MODEL**
**SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

| Parameter | Value | Definition |
|---|---|---|
| Heff | Chemical specific | Henry's Law Constant, ($cm^3$-$H_2O$)/($cm^3$-air) |
| Uair | 370 (site-specific) | Wind speed above ground in mixing zone (cm/sec) |
| dair | 200 (default) | Ambient air mixing zone height, (cm) |
| W | 4500 (default) | Width of source parallel to groundwater flow direction, (cm) |
| A | 20250000 (default) | Source-zone area ($cm^2$) |
| hcap | 0 1 (assumed) | Thickness of capillary fringe, (cm) |
| hv | 0 (assumed) | Thickness of vadose zone, (cm) |
| Lgw | 0.1 (assumed) | Depth to groundwater (cm) |
| Dws | Chemical specific | Effective diffusion coefficient between groundwater and soil ($cm^2$/sec) |
| Dcap | Chemical specific | Effective diffusion through capillary fringe, ($cm^2$/sec) |
| Dair | Chemical specific | Diffusion coefficient in air, ($cm^2$/sec) |
| Dwater | Chemical specific | Diffusion coefficient in water, ($cm^2$/sec) |
| n | 0.38 (default) | Total soil porosity, ($cm^3$/$cm^3$-soil) |
| θacap | 0.038 (default) | Volumetric air content in capillary fringe soils, ($cm^3$-air/$cm^3$-soil) |
| θwcap | 0.342 (default) | Volumetric water content in capillary fringe soils, ($cm^3$-$H_2O$/$cm^3$-soil) |

Notes.
Chemical specific values are presented in Table 7-7.
Default values are representative of site conditions

TABLE 7-7

CHEMICAL PROPERTIES FOR
VOLATILIZATION FROM GROUND WATER TO OUTDOOR AIR MODEL AND SHOWER MODEL
SWMU 03 - OLD JEEP TRAIL / LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA

| Chemical | Molecular Weight (g/mole) | Air Diffusivity ($cm^2$/sec) | Water Diffusivity ($cm^2$/sec) | Henry's Law Constant | |
|---|---|---|---|---|---|
| | | | | (Dimensionless) | (atm-m3/mol) |
| **Volatile Organic Compounds** | | | | | |
| 1,1,2,2-Tetrachloroethane | 167.9 | 7.10E-02 | 7.90E-06 | 1.41E-02 | 3.44E-04 |
| 1,1,2-Trichloroethane | 133.4 | 7.80E-02 | 8.80E-06 | 3.74E-02 | 9.12E-04 |
| 1,1-Dichloroethene | 96.9 | 9.00E-02 | 1.04E-05 | 1.07E+00 | 2.61E-02 |
| Cis-1,2-Dichloroethene | 96.95 | 7.36E-02 | 1.13E-05 | 1.67E-01 | 4.07E-03 |
| Tetrachloroethene | 165.83 | 7.20E-02 | 8.20E-06 | 7.54E-01 | 1.84E-02 |
| Trans-1,2-Dichloroethene | 97 | 7.07E-02 | 1.19E-05 | 3.85E-01 | 9.39E-03 |
| Trichloroethene | 131.4 | 7.90E-02 | 9.10E-06 | 4.22E-01 | 1.03E-02 |
| Vinyl Chloride | 62.5 | 1.06E-01 | 1.23E-05 | 1.11E+00 | 2.71E-02 |

Source: Soil Screening Guidance: User's Guide, U.S. EPA, July 1996.

TABLE 7-8

NON-CANCER TOXICITY DATA - ORAL/DERMAL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern | Chronic/ Subchronic | Oral RfD Value | Oral RfD Units | Oral to Dermal Adjustment Factor (1) | Adjusted Dermal RfD (2) | Units | Primary Target Organ | Combined Uncertainty/Modifying Factors | Sources of RfD. Target Organ | Dates of RfD: Target Organ (3) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Dioxin/Furans** | | | | | | | | | | |
| 2,3,7,8-TCDD Equivalents | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Volatile Organic Compounds** | | | | | | | | | | |
| Acetone | Chronic | 1 0E-01 | mg/kg/day | 1 | 1 0E-01 | mg/kg/day | Liver, Kidney | 1000/1 | IRIS | 06/27/02 |
| Bromomethane | Chronic | 1 4E-03 | mg/kg/day | 1 | 1 4E-03 | mg/kg/day | GS | 1000/1 | IRIS | 06/27/02 |
| Methylene Chloride | Chronic | 6 0E-02 | mg/kg/day | 1 | 6 0E-02 | mg/kg/day | Liver | 100/1 | IRIS | 06/27/02 |
| 1,1,2,2-Tetrachloroethane | Chronic | 6 0E-02 | mg/kg/day | 1 | 6 0E-02 | mg/kg/day | Liver | NA | NCEA | 4/02/02 |
| Trichloroethene | Chronic | 3 0E-04 | mg/kg/day | 1 | 3 0E-04 | mg/kg/day | Liver | NA | NCEA | 4/02/02 |
| 1,1,2-Trichloroethane | Chronic | 4 0E-03 | mg/kg/day | 1 | 4 0E-03 | mg/kg/day | Blood | 1000/1 | IRIS | 06/27/02 |
| 1,1-Dichloroethene | Chronic | 9 0E-03 | mg/kg/day | 1 | 9 0E-03 | mg/kg/day | Liver | 1000/1 | IRIS | 06/27/02 |
| Cis-1,2-Dichloroethene | Chronic | 1 0E-02 | mg/kg/day | 1 | 1 0E-02 | mg/kg/day | Blood | 3000/1 | HEAST | 7/97 |
| Tetrachloroethene | Chronic | 1 0E-02 | mg/kg/day | 1 | 1 0E-02 | mg/kg/day | Liver | 1000/1 | IRIS | 06/27/02 |
| Trans-1,2-Dichloroethene | Chronic | 2 0E-02 | mg/kg/day | 1 | 2 0E-02 | mg/kg/day | Blood | 1000/1 | IRIS | 06/27/02 |
| Vinyl Chloride | Chronic | 3 0E-03 | mg/kg/day | 1 | 3 0E-03 | mg/kg/day | Liver | 30/1 | IRIS | 06/27/02 |
| **Semivolatile Organic Compounds** | | | | | | | | | | |
| Acetophenone | Chronic | 1 0E-01 | mg/kg/day | 1 | 1 0E-01 | mg/kg/day | None Reported | 3000/1 | IRIS | 06/27/02 |
| Benzo(a)pyrene | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Benzo(b)fluoranthene | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Bis(2-ethylhexyl)phthalate | Chronic | 2 0E-02 | mg/kg/day | 1 | 2 0E-02 | mg/kg/day | Liver | 1000/1 | IRIS | 06/27/02 |
| Pentachlorophenol | Chronic | 3 0E-02 | mg/kg/day | 1 | 3 0E-02 | mg/kg/day | Liver, Kidney | 100/1 | IRIS | 06/27/02 |
| **Energetics** | | | | | | | | | | |
| 2,4-Dinitrotoluene | Chronic | 2 0E-03 | mg/kg/day | 1 | 2 0E-03 | mg/kg/day | Liver, CNS | 100/1 | IRIS | 06/27/02 |
| 2,4,6-Trinitrotoluene | Chronic | 5 0E-04 | mg/kg/day | 1 | 5 0E-04 | mg/kg/day | Liver | 1000/1 | IRIS | 06/27/02 |
| 2-Amino-4,6-Dinitrotoluene | Chronic | 6 0E-05 | mg/kg/day | 1 | 6 0E-05 | mg/kg/day | Liver | NA | NCEA | 4/02/02 |
| 4-Amino-2,6-Dinitrotoluene | Chronic | 6 0E-05 | mg/kg/day | 1 | 6 0E-05 | mg/kg/day | Liver | NA | NCEA | 4/02/02 |
| HMX | Chronic | 5 0E-02 | mg/kg/day | 1 | 5 0E-02 | mg/kg/day | Liver | 1000/1 | IRIS | 06/27/02 |
| RDX | Chronic | 3 0E-03 | mg/kg/day | 1 | 3 0E-03 | mg/kg/day | Prostate | 100/1 | IRIS | 06/27/02 |
| **Inorganics** | | | | | | | | | | |
| Aluminum | Chronic | 1 0E+00 | mg/kg/day | 1 | 1 0E+00 | mg/kg/day | Immune, Nails | NA | NCEA | 4/02/02 |
| Antimony | Chronic | 4 0E-04 | mg/kg/day | 0 15 | 6 0E-05 | mg/kg/day | Blood | 1000/1 | IRIS | 06/27/02 |
| Arsenic | Chronic | 3 0E-04 | mg/kg/day | 1 | 3 0E-04 | mg/kg/day | Skin, CVS | 3/1 | IRIS | 06/27/02 |
| Barium | Chronic | 7 0E-02 | mg/kg/day | 0 07 | 4 9E-03 | mg/kg/day | Kidney | 3/1 | IRIS | 06/27/02 |
| Beryllium | Chronic | 2 0E-03 | mg/kg/day | 0 007 | 1 4E-05 | mg/kg/day | GS | 300/1 | IRIS | 06/27/02 |
| Cadmium | Chronic | 5 0E-04 | mg/kg/day | 0 05 | 2 5E-05 | mg/kg/day | Kidney | 10/1 | IRIS | 06/27/02 |
| Chromium VI | Chronic | 3 0E-03 | mg/kg/day | 0 025 | 7 5E-05 | mg/kg/day | None Reported | 300/3 | IRIS | 06/27/02 |
| Cobalt | Chronic | 2 0E-02 | mg/kg/day | 1 | 2 0E-02 | mg/kg/day | CVS, Immune, CNS | NA | NCEA | 4/02/02 |
| Copper | Chronic | 4 0E-02 | mg/kg/day | 1 | 4 0E-02 | mg/kg/day | GS | NA | HEAST | 07/97 |
| Iron | Chronic | 3 0E-01 | mg/kg/day | 1 | 3 0E-01 | mg/kg/day | Blood, GS | NA | NCEA | 4/02/02 |
| Manganese | Chronic | 7 2E-02 | mg/kg/day | 0 04 | 2 9E-03 | mg/kg/day | CNS | 1/1 | IRIS | 06/27/02 |
| Nickel | Chronic | 2 0E-02 | mg/kg/day | 0 04 | 8 0E-04 | mg/kg/day | Body Weight | 300/1 | IRIS | 06/27/02 |
| Thallium | Chronic | 7 0E-05 | mg/kg/day | 1 | 7 0E-05 | mg/kg/day | Liver | NA | IRIS | 06/27/02 |
| Zinc | Chronic | 3 0E-01 | mg/kg/day | 1 | 3 0E-01 | mg/kg/day | Blood | 3/1 | IRIS | 06/27/02 |
| **Miscellaneous Parameters** | | | | | | | | | | |
| Nitrate | Chronic | 1 6E+00 | mg/kg/day | 1 | 1 6E+00 | mg/kg/day | Blood | 1/1 | IRIS | 06/27/02 |

TABLE 7-8

NON-CANCER TOXICITY DATA - ORAL/DERMAL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern | Chronic/ Subchronic | Oral RfD Value | Oral RfD Units | Oral to Dermal Adjustment Factor (1) | Adjusted Dermal RfD (2) | Units | Primary Target Organ | Combined Uncertainty/Modifying Factors | Sources of RfD: Target Organ | Dates of RfD: Target Organ (3) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|---|---|

Notes
1 - U S EPA, 2001 Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim EPA/540/R/99/005
2 - RfDdermal = RfDoral x Oral to Dermal Adjustment Factor
3 - Dates of IRIS, HEAST, or NCEA

Definitions
CNS = Central nervous system
CVS = Cardiovascular system
Immune = Immunological
GS = Gastrointestinal
NA = Not applicable
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
NCEA = U S EPA National Center for Environmental Assessment
(U S EPA Region 3 RBC Table, April 2, 2002)

TABLE 7-9

NON-CANCER TOXICITY DATA - INHALATION
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern | Chronic/ Subchronic | Value Inhalation RfC | Units | Adjusted Inhalation RfD (1) | Units | Primary Target Organ | Combined Uncertainty/Modifying Factors | Sources of RfC.RfD. Target Organ | Dates (2) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|---|
| **Dioxin/Furans** | | | | | | | | | |
| 2,3,7,8-TCDD Equivalents | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Volatile Organic Compounds** | | | | | | | | | |
| Acetone | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Bromomethane | Chronic | 5 0E-03 | $mg/m^3$ | 1 4E-03 | mg/kg/day | Respiratory tract | 100/1 | IRIS | 06/27/02 |
| Methylene Chloride | Chronic | 3 0E+00 | $mg/m^3$ | 8 6E-01 | mg/kg/day | Liver | 100 | HEAST | 7/97 |
| 1,1,2,2-Tetrachloroethane | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Trichloroethene | Chronic | NA | NA | 1 0E-02 | mg/kg/day | Liver | NA | NCEA | 04/2/2002 |
| 1,1,2-Trichloroethane | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1,1-Dichloroethene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Cis-1,2-Dichloroethene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Tetrachloroethene | Chronic | NA | NA | 1 4E-01 | mg/kg/day | Liver | NA | NCEA | 04/02/02 |
| Trans-1,2-Dichloroethene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Vinyl Chloride | Chronic | 1 0E-01 | $mg/m^3$ | 2 8E-02 | mg/kg/day | Liver | 30/1 | IRIS | 06/27/02 |
| **Semivolatile Organic Compounds** | | | | | | | | | |
| Acetophenone | Chronic | NA | NA | 5 7E-06 | mg/kg/day | None Reported | NA | IRIS | 06/27/02 |
| Benzo(a)pyrene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Benzo(b)fluoranthene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Bis(2-ethylhexyl)phthalate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Pentachlorophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Energetics** | | | | | | | | | |
| 2,4-Dinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,4,6-Trinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Amino-4,6-Dinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Amino-2,6-Dinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| HMX | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| RDX | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Inorganics** | | | | | | | | | |
| Aluminum | Chronic | NA | NA | 1 0E-03 | mg/kg/day | NA | NA | NCEA | 04/02/02 |
| Antimony | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Arsenic | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Barium | Chronic | NA | NA | 1 4E-04 | mg/kg/day | NA | NA | HEAST ALT | 7/97 |
| Beryllium | Chronic | 2 0E-05 | $mg/m^3$ | 5 7E-06 | mg/kg/day | GS | 30/1 | IRIS | 06/27/02 |
| Cadmium | NA | NA | NA | 5 7E-05 | mg/kg/day | NA | NA | NCEA | 04/02/02 |
| Chromium VI | Chronic | 1 0E-04 | $mg/m^3$ | 2 9E-05 | mg/kg/day | Respiratory tract | 90/1 | IRIS | 06/27/02 |
| Cobalt | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Copper | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Iron | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Manganese | Chronic | 5 0E-05 | $mg/m^3$ | 1 4E-05 | mg/kg/day | Neuorological | 1/1 | IRIS | 06/27/02 |
| Nickel | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Thallium | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Zinc | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Miscellaneous Parameters** | | | | | | | | | |
| Nitrate | NA | NA | NA | NA | NA | NA | NA | NA | NA |

TABLE 7-9

NON-CANCER TOXICITY DATA - INHALATION
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern | Chronic/ Subchronic | Value Inhalation RfC | Units | Adjusted Inhalation RfD (1) | Units | Primary Target Organ | Combined Uncertainty/Modifying Factors | Sources of RfC·RfD· Target Organ | Dates (2) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|---|

Notes
1 Provide equation used for derivation in text
2 For IRIS values, provide the date IRIS was searched
For HEAST values, provide the date of HEAST
For NCEA values, provide the date of the article provided by NCEA

Definitions
N/A = Not applicable
CBD = Chronic beryllium disease
CNS = Central nervous system
GS = Gastrointestinal
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables

TABLE 7-10

CANCER TOXICITY DATA - ORAL/DERMAL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern | Oral Cancer Slope Factor | Oral to Dermal Adjustment Factor (1) | Adjusted Dermal Cancer Slope Factor (2) | Units | Weight of Evidence/ Cancer Guideline Description | Source | Date (3) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|
| **Dioxin/Furans** | | | | | | | |
| 2,3,7,8-TCDD Equivalents | 1 5E+05 | 1 | 1 5E+05 | $(mg/kg/day)^{-1}$ | B2 | HEAST | 7/97 |
| **Volatile Organic Compounds** | | | | | | | |
| Acetone | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| Bromomethane | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| Methylene Chloride | 7 5E-03 | 1 | 7 5E-03 | $(mg/kg/day)^{-1}$ | B2 | IRIS | 06/27/02 |
| 1,1,2,2-Tetrachloroethane | 2 0E-01 | 1 | 2 0E-01 | $(mg/kg/day)^{-1}$ | C | IRIS | 06/27/02 |
| Trichloroethene | 4 0E-01 | 1 | 4 0E-01 | $(mg/kg/day)^{-1}$ | NA | NCEA | 04/02/02 |
| 1,1,2-Trichloroethane | 5 7E-02 | 1 | 5 7E-02 | $(mg/kg/day)^{-1}$ | C | IRIS | 06/27/02 |
| 1,1-Dichloroethene | 6 0E-01 | 1 | 6 0E-01 | $(mg/kg/day)^{-1}$ | C | IRIS | 06/27/02 |
| Cis-1,2-Dichloroethene | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| Tetrachloroethene | 5 2E-02 | 1 | 5 2E-02 | $(mg/kg/day)^{-1}$ | NA | NCEA | 04/02/02 |
| Trans-1,2-Dichloroethene | NA | NA | NA | NA | NA | NA | NA |
| Vinyl Chloride | 7 2E-01 | 1 | 7 2E-01 | $(mg/kg/day)^{-1}$ | A | IRIS | 06/27/02 |
| **Semivolatile Organic Compounds** | | | | | | | |
| Acetophenone | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| Benzo(a)pyrene | 7 3E+00 | 1 | 7 3E+00 | $(mg/kg/day)^{-1}$ | B2 | IRIS | 06/27/02 |
| Benzo(b)fluoranthene | 7 3E-01 | 1 | 7 3E-01 | $(mg/kg/day)^{-1}$ | B2 | EPA | 07/93 |
| Bis(2-ethylhexyl)phthalate | 1 4E-02 | 1 | 1 4E-02 | $(mg/kg/day)^{-1}$ | B2 | IRIS | 06/27/02 |
| Pentachlorophenol | 1 2E-01 | 1 | 1 2E-01 | $(mg/kg/day)^{-1}$ | B2 | IRIS | 06/27/02 |
| **Energetics** | | | | | | | |
| 2,4-Dinitrotoluene | NA | NA | NA | NA | NA | NA | NA |
| 2,4,6-Trinitrotoluene | 3 0E-02 | 1 | 3 0E-02 | $(mg/kg/day)^{-1}$ | C | IRIS | 06/27/02 |
| 2-Amino-4,6-Dinitrotoluene | NA | NA | NA | NA | NA | NCEA | 04/02/02 |
| 4-Amino-2,6-Dinitrotoluene | NA | NA | NA | NA | NA | NCEA | 04/02/02 |
| HMX | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| RDX | 1 1E-01 | 1 | 1 1E-01 | $(mg/kg/day)^{-1}$ | C | IRIS | 06/27/02 |

TABLE 7-10

CANCER TOXICITY DATA - ORAL/DERMAL
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern | Oral Cancer Slope Factor | Oral to Dermal Adjustment Factor (1) | Adjusted Dermal Cancer Slope Factor (2) | Units | Weight of Evidence/ Cancer Guideline Description | Source | Date (3) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|
| **Inorganics** | | | | | | | |
| Aluminum | NA | NA | NA | NA | NA | NA | NA |
| Antimony | NA | NA | NA | NA | NA | NA | NA |
| Arsenic | 1 5E+00 | 1 | 1 5E+00 | $(mg/kg\text{-}day)^{-1}$ | A | IRIS | 06/27/02 |
| Barium | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| Beryllium | NA | NA | NA | NA | B1 | IRIS | 06/27/02 |
| Cadmium | NA | NA | NA | NA | B1 | IRIS | 06/27/02 |
| Chromium VI | NA | NA | NA | NA | A | IRIS | 06/27/02 |
| Cobalt | NA | NA | NA | NA | NA | NA | NA |
| Copper | NA | NA | NA | NA | NA | NA | NA |
| Iron | NA | NA | NA | NA | NA | NA | NA |
| Manganese | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| Nickel | NA | NA | NA | NA | NA | NA | NA |
| Thallium | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| Zinc | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| **Miscellaneous Parameters** | | | | | | | |
| Nitrate | NA | NA | NA | NA | NA | NA | NA |

Notes
1 - U S EPA, 2001 Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim EPA/540/R/99/005
2 - CSFdermal = CSForal/Oral to Dermal Adjustment Factor
3 - Dates of IRIS, HEAST, or NCEA

Definitions
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
NA = Not Available
NCEA = U S EPA National Center for Environmental Assessment
(U S EPA Region 3 RBC Table, April 2, 2002)
EPA = U S EPA, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July, 1993, EPA/600/R-93/089

EPA Group
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

TABLE 7-11

CANCER TOXICITY DATA - INHALATION
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern | Unit Risk | Units | Adjustment | Inhalation Cancer Slope Factor | Units | Weight of Evidence/ Cancer Guideline Description | Source | Date (1) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|
| **Dioxin/Furans** | | | | | | | | |
| 2,3,7,8-TCDD Equivalents | NA | NA | NA | 1 5E+05 | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 06/27/02 |
| **Volatile Organic Compounds** | | | | | | | | |
| Acetone | NA | NA | NA | NA | NA | NA | NA | NA |
| Bromomethane | NA | NA | NA | NA | NA | NA | NA | NA |
| Methylene Chloride | NA | NA | NA | 1 65E-03 | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 06/27/02 |
| 1,1,2,2-Tetrachloroethane | NA | NA | NA | 2 0E-01 | $(mg/kg\text{-}day)^{-1}$ | C | IRIS | 06/27/02 |
| Trichloroethene | NA | NA | NA | 4 0E-01 | $(mg/kg\text{-}day)^{-1}$ | NA | NCEA | 4/02/02 |
| 1,1,2-Trichloroethane | NA | NA | NA | 5 6E-02 | $(mg/kg\text{-}day)^{-1}$ | C | IRIS | 06/27/02 |
| 1,1-Dichloroethene | NA | NA | NA | 1 75E-01 | $(mg/kg\text{-}day)^{-1}$ | C | IRIS | 06/27/02 |
| Cis-1,2-Dichloroethene | NA | NA | NA | NA | NA | D | IRIS | 06/27/02 |
| Tetrachloroethene | NA | NA | NA | 1 0E-02 | $(mg/kg\text{-}day)^{-1}$ | NA | NCEA | 04/02/02 |
| Trans-1,2-Dichloroethene | NA | NA | NA | NA | NA | NA | NA | NA |
| Vinyl Chloride | 4 4E-03 | $(mg/m^3)^{1}$ | 3 5 | 1 5E-02 | $(mg/kg\text{-}day)^{-1}$ | A | IRIS | 06/27/02 |
| **Semivolatile Organic Compounds** | | | | | | | | |
| Acetophenone | NA | NA | NA | NA | NA | NA | NA | NA |
| Benzo(a)pyrene | NA | NA | NA | 3 1E+00 | $(mg/kg\text{-}day)^{-1}$ | B2 | NCEA | 04/02/02 |
| Benzo(b)fluoranthene | NA | NA | NA | NA | NA | NA | NA | NA |
| Bis(2-ethylhexyl)phthalate | NA | NA | NA | 1 4E-02 | $(mg/kg\text{-}day)^{-1}$ | NA | NCEA | 04/02/02 |
| Pentachlorophenol | NA | NA | NA | NA | NA | NA | NA | NA |
| **Energetics** | | | | | | | | |
| 2,4-Dinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,4,6-Trinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Amino-4,6-Dinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Amino-2,6-Dinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA |
| HMX | NA | NA | NA | NA | NA | NA | NA | NA |
| RDX | NA | NA | NA | NA | NA | NA | NA | NA |
| **Inorganics** | | | | | | | | |
| Aluminum | NA | NA | NA | NA | NA | NA | NA | NA |
| Antimony | NA | NA | NA | NA | NA | NA | NA | NA |
| Arsenic | 4 3E+00 | $(mg/m^3)^{-1}$ | 3 5 | 1 5E+01 | $(mg/kg\text{-}day)^{-1}$ | A | IRIS | 06/27/02 |
| Barium | NA | NA | NA | NA | NA | NA | NA | NA |
| Beryllium | 2 4E+00 | $(mg/m^3)^{-1}$ | 3 5 | 8 4E+00 | $(mg/kg\text{-}day)^{-1}$ | B1 | IRIS | 06/27/02 |
| Cadmium | 1 8E+00 | $(mg/m^3)^{-1}$ | 3 5 | 6 3E+00 | $(mg/kg\text{-}day)^{-1}$ | B1 | IRIS | 06/27/02 |
| Chromium VI | 1 2E+01 | $(mg/m^3)^{-1}$ | 3 5 | 4 2E+01 | $(mg/kg\text{-}day)^{-1}$ | A | IRIS | 06/27/02 |
| Cobalt | NA | NA | NA | NA | NA | NA | NA | NA |
| Copper | NA | NA | NA | NA | NA | NA | NA | NA |
| Iron | NA | NA | NA | NA | NA | NA | NA | NA |
| Manganese | NA | NA | NA | NA | NA | D | IRIS | 06/27/02 |

TABLE 7-11

CANCER TOXICITY DATA - INHALATION
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern | Unit Risk | Units | Adjustment | Inhalation Cancer Slope Factor | Units | Weight of Evidence/ Cancer Guideline Description | Source | Date (1) (MM/DD/YY) |
|---|---|---|---|---|---|---|---|---|
| Nickel | NA | NA | NA | NA | NA | NA | NA | NA |
| Thallium | NA | NA | NA | NA | NA | NA | NA | NA |
| Zinc | NA | NA | NA | NA | NA | NA | NA | NA |
| **Miscellaneous Parameters** | | | | | | | | |
| Nitrate | NA | NA | NA | NA | NA | NA | NA | NA |

Notes
1 For IRIS values, the date IRIS was searched
For HEAST values, the date of HEAST
Definitions
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
NA = Not Available
NCEA = U S EPA National Center for Environmental Assessment
(U S EPA Region 3 RBC Table, April 2, 2002)

EPA Group
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans ,\
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

TABLE 7-12
CUMULATIVE RISKS SUMMARY - REASONABLE MAXIMUM EXPOSURES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks $> 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| Adolescent Trespasser | Surface Soil | Incidental Ingestion | 4E-08 | - - | - - | - - | 0 02 | - - |
| | | Dermal Contact | 1E-08 | - - | - - | - - | 0 002 | - - |
| | | Total Surface Soil | 5E-08 | - - | - - | - - | 0 02 | - - |
| | Surface Water | Incidental Ingestion | 4E-07 | - - | - - | - - | 0 02 | - - |
| | | Dermal Contact | 5E-08 | - - | - - | - - | 0 001 | - - |
| | | Total Surface Water | 4E-07 | - - | - - | - - | 0 02 | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0 006 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0 0004 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0 006 | - - |
| | Total All Media (Study Area) | | 5E-07 | | | | 0 04 | |
| Off-Site Child Resident | Surface Water | Ingestion | 9E-06 | - - | - - | RDX | 1 | - - |
| | | Dermal Contact | 3E-08 | - - | - - | - - | 0 005 | - - |
| | | Total Surface Water | 9E-06 | - - | - - | RDX | 1 | - - |
| Off-Site Adult Resident | Surface Water | Ingestion | 1E-05 | - - | - - | RDX | 0.3 | - - |
| | | Dermal Contact | 6E-08 | - - | - - | - - | 0 003 | - - |
| | | Total Surface Water | 1E-05 | - - | - - | RDX | 0 3 | - - |
| Off-Site Lifelong (Child and Adult) Resident | Surface Water | Ingestion | 2E-05 | - - | RDX | - - | NE | - - |
| | | Dermal Contact | 9E-08 | - - | - - | - - | NE | - - |
| | | Total Surface Water | 2E-05 | - - | RDX | - - | NE | - - |
| Construction Worker | Surface Soil / Subsurface Soil | Incidental Ingestion | 6E-08 | - - | - - | - - | 0.3 | - - |
| | | Dermal Contact | 7E-09 | - - | - - | - - | 0 01 | - - |
| | | Total All Soil | 7E-08 | - - | - - | - - | 0.3 | - - |
| | Ground Water | Dermal Contact | 3E-07 | - - | - - | - - | 0 1 | - - |
| | | Inhalation(2) | 3E-08 | - - | - - | - - | 0 0005 | - - |
| | | Total Groundwater | 3E-07 | - - | - - | - - | 0 1 | - - |
| | Total All Media (Study Area) | | 4E-07 | | | | 0 5 | |
| Maintenance Worker | Surface Soil | Incidental Ingestion | 5E-08 | - - | - - | - - | 0.01 | - - |
| | | Dermal Contact | 2E-08 | - - | - - | - - | 0.001 | - - |
| | | Total Soil | 7E-08 | - - | - - | - - | 0.01 | - - |
| | Surface Water | Dermal Contact | 4E-08 | - - | - - | - - | 0.0005 | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0.003 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0.0002 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0.003 | - - |

TABLE 7-12
CUMULATIVE RISKS SUMMARY - REASONABLE MAXIMUM EXPOSURES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks > $10^{-4}$ | Chemicals with Cancer Risks > $10^{-5}$ and ≤ $10^{-4}$ | Chemicals with Cancer Risks > $10^{-6}$ and ≤ $10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| | Total All Media (Study Area) | | 1E-07 | | | | 0.02 | |
| Occupational Worker | Surface Soil | Incidental Ingestion | 6E-07 | - - | - - | - - | 0 1 | - - |
| | | Dermal Contact | 2E-07 | - - | - - | - - | 0.01 | - - |
| | | Total Surface Soil | 7E-07 | - - | - - | - - | 0 1 | - - |
| | Ground Water | Ingestion | 1E-04 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene, RDX | Vinly Chloride | 2 0 | Trichloroethene |
| | | Dermal Contact | 4E-06 | - - | - - | Trichloroethene | 0 07 | - - |
| | | Total Ground Water | 1E-04 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene, RDX | Vinly Chloride | 2 | Trichloroethene |
| | Total All Media (Study Area) | | 1E-04 | | | | 2 | |
| Child Recreational User | Surface Soil | Incidental Ingestion | 1E-07 | - - | - - | - - | 0 1 | - - |
| | | Dermal Contact | 4E-08 | - - | - - | - - | 0 01 | - - |
| | | Total Surface Soil | 2E-07 | - - | - - | - - | 0 1 | - - |
| | Groundwater | Ingestion | 3E-05 | - - | Trichloroethene | 1,1,2,2-Tetrachloroethane, RDX | 2 | Trichloroethene |
| | | Dermal Contact | 9E-07 | - - | - - | - - | 0 07 | - - |
| | | Total Groundwater | 3E-05 | - - | Trichloroethene | 1,1,2,2-Tetrachloroethane, RDX | 2 | Trichloroethene |
| | Surface Water | Ingestion | 1E-06 | - - | - - | RDX | 0.09 | - - |
| | | Dermal Contact | 1E-07 | - - | - - | - - | 0 008 | - - |
| | | Total Surface Water | 1E-06 | - - | - - | RDX | 0 1 | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0 03 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0 002 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0 03 | - - |
| | Total All Media (Study Area) | | 3E-05 | | | | 2 | |

TABLE 7-12
CUMULATIVE RISKS SUMMARY - REASONABLE MAXIMUM EXPOSURES
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks > $10^{-4}$ | Chemicals with Cancer Risks > $10^{-5}$ and ≤ $10^{-4}$ | Chemicals with Cancer Risks > $10^{-6}$ and ≤ $10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| Adult Recreational User | Surface Soil | Incidental Ingestion | 6E-08 | - - | - - | - - | 0 01 | - - |
| | | Dermal Contact | 4E-08 | - - | - - | - - | 0 003 | - - |
| | | Total Surface Soil | 9E-08 | - - | - - | - - | 0 01 | - - |
| | Groundwater | Ingestion | 2E-05 | - - | Trichloroethene | 1,1,2,2-Tetrachloroethane, RDX | 0 4 | - - |
| | | Dermal Contact | 2E-06 | - - | - - | Trichloroethene | 0 04 | - - |
| | | Total Groundwater | 2E-05 | - - | Trichloroethene | 1,1,2,2-Tetrachloroethane, RDX | 0 4 | - - |
| | Surface Water | Ingestion | 2E-07 | - - | - - | - - | 0.004 | - - |
| | | Dermal Contact | 3E-07 | - - | - - | - - | 0 005 | - - |
| | | Total Surface Water | 5E-07 | - - | - - | - - | 0 009 | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0 003 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0 0005 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0 004 | - - |
| | Total All Media (Study Area) | | 2E-05 | | | | 0 5 | |
| Lifelong Recreational User (Child and Adult) | Surface Soil | Incidental Ingestion | 2E-07 | - - | - - | - - | NE | - - |
| | | Dermal Contact | 8E-08 | - - | - - | - - | NE | - - |
| | | Total Surface Soil | 3E-07 | - - | - - | - - | NE | - - |
| | Groundwater | Ingestion | 5E-05 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | RDX | NE | - - |
| | | Dermal Contact | 3E-06 | - - | - - | Trichloroethene | NE | - - |
| | | Total Groundwater | 5E-05 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | RDX | NE | - - |
| | Surface Water | Ingestion | 1E-06 | - - | - - | RDX | NE | - - |
| | | Dermal Contact | 5E-07 | - - | - - | - - | NE | - - |
| | | Total Surface Water | 2E-06 | - - | - - | RDX | NE | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | NE | - - |
| | | Dermal Contact | - - | - - | - - | - - | NE | - - |
| | | Total Sediment | - - | - - | - - | - - | NE | - - |
| | Total All Media (Study Area) | | 5E-05 | | | | NE | |

NE = Exposure route not evaluated.
Chemical-specific risks are presented in Appendix G.

TABLE 7-13
CUMULATIVE RISK SUMMARY - CENTRAL TENDANCY EXPOSURE
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks $> 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| Adolescent Trespasser | Surface Soil | Incidental Ingestion | 1E-08 | - - | - - | - - | 0 005 | - - |
| | | Dermal Contact | 1E-09 | - - | - - | - - | 0 | - - |
| | | Total Surface Soil | 1E-08 | - - | - - | - - | 0 005 | - - |
| | Surface Water | Incidental Ingestion | 9E-08 | - - | - - | - - | 0 00 | - - |
| | | Dermal Contact | 2E-08 | - - | - - | - - | 0 0004 | - - |
| | | Total Surface Water | 1E-07 | - - | - - | - - | 0 004 | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0 001 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0 00004 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0 001 | - - |
| | Total All Media (Study Area) | | 1E-07 | | | | 0 01 | |
| Off-Site Child Resident | Surface Water | Ingestion | 9E-07 | - - | - - | - - | 0 3 | - - |
| | | Dermal Contact | 5E-09 | - - | - - | - - | 0 003 | - - |
| | | Total Surface Water | 9E-07 | - - | - - | - - | 0 4 | - - |
| Off-Site Adult Resident | Surface Water | Ingestion | 1E-06 | - - | - - | RDX | 0 2 | - - |
| | | Dermal Contact | 1E-08 | - - | - - | - - | 0 002 | - - |
| | | Total Surface Water | 1E-06 | - - | - - | RDX | 0 2 | - - |
| Off-Site Lifelong (Child and Adult) Resident | Surface Water | Ingestion | 2E-06 | - - | - - | RDX | NE | - - |
| | | Dermal Contact | 1E-08 | - - | - - | - - | NE | - - |
| | | Total Surface Water | 2E-06 | - - | - - | RDX | NE | - - |
| Construction Worker | Surface Soil / Subsurface Soil | Incidental Ingestion | 3E-08 | - - | - - | - - | 0 2 | - - |
| | | Dermal Contact | 2E-09 | - - | - - | - - | 0.004 | - - |
| | | Total All Soil | 3E-08 | - - | - - | - - | 0.2 | - - |
| | Ground Water | Dermal Contact | 2E-07 | - - | - - | - - | 0.2 | - - |
| | | Inhalation[2] | 3E-08 | - - | - - | - - | 0 0004 | - - |
| | | Total Groundwater | 2E-07 | - - | - - | - - | 0.2 | - - |
| | Total All Media (Study Area) | | 3E-07 | | | | 0.4 | |

TABLE 7-13
CUMULATIVE RISK SUMMARY - CENTRAL TENDANCY EXPOSURE
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks > $10^{-4}$ | Chemicals with Cancer Risks > $10^{-5}$ and ≤ $10^{-4}$ | Chemicals with Cancer Risks > $10^{-6}$ and ≤ $10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| Maintenance Worker | Surface Soil | Incidental Ingestion | 5E-09 | - - | - - | - - | 0.003 | - - |
| | | Dermal Contact | 3E-10 | - - | - - | - - | 0.00006 | - - |
| | | Total Soil | 5E-09 | - - | - - | - - | 0 003 | - - |
| | Surface Water | Dermal Contact | 6E-09 | - - | - - | - - | 0 0002 | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0 0008 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0 00001 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0.0008 | - - |
| | Total All Media (Study Area) | | 1E-08 | | | | 0.004 | |
| Occupational Worker | Surface Soil | Incidental Ingestion | 9E-08 | - - | - - | - - | 0.05 | - - |
| | | Dermal Contact | 6E-09 | - - | - - | - - | 0 001 | - - |
| | | Total Surface Soil | 9E-08 | - - | - - | - - | 0.05 | - - |
| | Ground Water | Ingestion | 4E-05 | - - | Trichloroethene | 1,1,2,2-Tetrachloroethane, RDX | 2 | Trichloroethene |
| | | Dermal Contact | 1E-06 | - - | - - | - - | 0.05 | - - |
| | | Total Ground Water | 4E-05 | - - | Trichloroethene | 1,1,2,2-Tetrachloroethane, RDX | 2 | Trichloroethene |
| | Total All Media (Study Area) | | 4E-05 | | | | 2 | |

TABLE 7-13
CUMULATIVE RISK SUMMARY - CENTRAL TENDANCY EXPOSURE
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks > $10^{-4}$ | Chemicals with Cancer Risks > $10^{-5}$ and ≤ $10^{-4}$ | Chemicals with Cancer Risks > $10^{-6}$ and ≤ $10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| Child Recreational User | Surface Soil | Incidental Ingestion | 1E-08 | - - | - - | - - | 0 03 | - - |
| | | Dermal Contact | 1E-09 | - - | - - | - - | 0 001 | - - |
| | | Total Surface Soil | 1E-08 | - - | - - | - - | 0 03 | |
| | Ground Water | Ingestion | 4E-06 | - - | | 1,1,2,2-Tetrachloroethane, Trichloroethene | 1 | - - |
| | | Dermal Contact | 1E-07 | - - | - - | - - | 0 03 | - - |
| | | Total Groundwater | 4E-06 | - - | | 1,1,2,2-Tetrachloroethane, Trichloroethene | 1 | - - |
| | Surface Water | Ingestion | 1E-07 | - - | - - | - - | 0.02 | - - |
| | | Dermal Contact | 2E-08 | - - | - - | - - | 0 003 | - - |
| | | Total Surface Water | 1E-07 | - - | - - | - - | 0 02 | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0.0008 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0 0002 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0.001 | - - |
| | Total All Media (Study Area) | | 5E-06 | | | | 1 | |
| Adult Recreational User | Surface Soil | Incidental Ingestion | 4E-09 | - - | - - | - - | 0.003 | - - |
| | | Dermal Contact | 7E-10 | - - | - - | - - | 0 0002 | - - |
| | | Total Surface Soil | 5E-09 | - - | - - | - - | 0 003 | - - |
| | Ground Water | Ingestion | 3E-06 | - - | - - | Trichloroethene | 0 2 | - - |
| | | Dermal Contact | 3E-07 | - - | - - | - - | 0.02 | - - |
| | | Total Groundwater | 3E-06 | - - | - - | - - | 0.2 | - - |
| | Surface Water | Ingestion | 1E-08 | - - | - - | - - | 0 001 | - - |
| | | Dermal Contact | 3E-08 | - - | - - | - - | 0 002 | - - |
| | | Total Surface Water | 5E-08 | - - | - - | - - | 0 003 | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0 0009 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0 00003 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0 0009 | - - |
| | Total All Media (Study Area) | | 4E-06 | | | | 0 2 | |

TABLE 7-13
CUMULATIVE RISK SUMMARY - CENTRAL TENDANCY EXPOSURE
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks $> 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| Lifelong Recreational User (Child and Adult) | Surface Soil | Incidental Ingestion | 2E-08 | - - | - - | - - | NE | - - |
| | | Dermal Contact | 2E-09 | - - | - - | - - | NE | - - |
| | | Total Surface Soil | 2E-08 | - - | - - | - - | NE | - - |
| | Ground Water | Ingestion | 8E-06 | - - | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | NE | - - |
| | | Dermal Contact | 4E-07 | - - | - - | - - | NE | - - |
| | | Total Groundwater | 8E-06 | - - | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | NE | - - |
| | Surface Water | Ingestion | 1E-07 | - - | - - | - - | NE | - - |
| | | Dermal Contact | 5E-08 | - - | - - | - - | NE | - - |
| | | Total Surface Water | 2E-07 | - - | - - | - - | NE | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | NE | - - |
| | | Dermal Contact | - - | - - | - - | - - | NE | - - |
| | | Total Sediment | - - | - - | - - | - - | NE | - - |
| | Total All Media (Study Area) | | 8E-06 | | | | NE | |

**Notes:**
NE = Exposure route not evaluated
Chemical-specific risks are presented in Appendix G

TABLE 7-14

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURES
FUTURE ON-SITE RESIDENTS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks $> 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| On-Site Child Resident | Surface Soil (1-Acre Exposure Unit) | Incidental Ingestion | 8E-05 | - - | 2,4,6-Trinitrotoluene, RDX | 2,3,7,8-TCDD Equivalents | 19 | 2,4,6-Trinitrotoluene, RDX |
| | | Dermal Contact | 2E-05 | - - | RDX | 2,4,6-Trinotrotoluene | 5 | 2,4,6-Trinitrotoluene |
| | | Total Surface Soil | 1E-04 | | 2,4,6-Trinitrotoluene, RDX | 2,3,7,8-TCDD Equivalents | 24 | 2,4,6-Trinitrotoluene, RDX |
| | Surface Soil (6-Acre Exposure Unit) | Incidental Ingestion | 2E-06 | - - | - - | 2,3,7,8-TCDD Equivalents | 1 | - - |
| | | Dermal Contact | 2E-07 | - - | - - | - - | 0.7 | - - |
| | | Total Surface Soil | 2E-06 | - - | - - | 2,3,7,8-TCDD Equivalents | 2 | - - |
| | Ground Water | Ingestion | 3E-04 | Trichloroethene | 1,1,2,2-Tetrachloroehane, RDX | 1,1-Dichloroethene, Vinyl Chloride | 20 | Trichloroethene |
| | | Dermal Contact | 1E-05 | - - | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | 0.9 | - - |
| | | Inhalation | 7E-05 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | - - | 0.2 | - - |
| | | Total Groundwater | 3E-04 | Trichloroethene | 1,1,2,2-Tetrachloroehane, RDX | 1,1-Dichloroethene, Vinyl Chloride | 21 | Trichloroethene, 4-Amino-2,6-Dinitrotoluene |
| | Surface Water | Ingestion | 6E-05 | - - | RDX | - - | 9 | 2-Amino-4,6-Dinitrotoluene, 4-Amino-2,6-dinitrotoluene, RDX |
| | | Dermal Contact | 2E-07 | - - | - - | - - | 0.04 | - - |
| | | Inhalation | - - | - - | - - | - - | 0 | - - |
| | | Total Surface Water | 6E-05 | - - | RDX | - - | 9 | 2-Amino-4,6-Dinitrotoluene, 4-Amino-2,6-dinitrotoluene, RDX |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0.03 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0.002 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0.03 | - - |
| | **Total All Media (1-Acre EU & Surface Water)(1)** | | **2E-04** | | | | **33** | |
| | **Total All Media (6-Acre EU & Surface Water)(1)** | | **6E-05** | | | | **11** | |
| | **Total All Media (1-Acre EU & Ground Water)(2)** | | **5E-04** | | | | **45** | |
| | **Total All Media (6-Acre EU & Ground Water)(2)** | | **3E-04** | | | | **23** | |

TABLE 7-14

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURES
FUTURE ON-SITE RESIDENTS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks $> 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| On-Site Adult Resident | Surface Soil (1-Acre Exposure Unit) | Incidental Ingestion | 4E-05 | - - | RDX | 2,4,6-Trinitrotoluene | 2 | 2,4,6-Trinitrotoluene |
| | | Dermal Contact | 1E-05 | - - | RDX | 2,4,6-Trinitrotoluene | 0.8 | - - |
| | | Total Surface Soil | 5E-05 | - - | RDX, 2,4,6-Trinitrotoluene | - - | 3 | 2,4,6-Trinitrotoluene |
| | Surface Soil (6-Acre Exposure Unit) | Incidental Ingestion | 7E-07 | - - | - - | - - | 0.2 | - - |
| | | Dermal Contact | 2E-07 | - - | - - | - - | 0.01 | - - |
| | | Total Surface Soil | 9E-07 | - - | - - | - - | 0 2 | - - |
| | Ground Water | Ingestion | 3E-04 | Trichloroethene | 1,1,2,2-Tetrachloroethane, RDX | 1,1-Dichloroethene, Vinyl Chloride | 6 | Trichloroethene |
| | | Dermal Contact | 3E-05 | - - | Trichloroethene | 1,1,2,2-Tetrachloroethane | 0.5 | - - |
| | | Inhalation | 6E-05 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | - - | 0.04 | - - |
| | | Total Groundwater | 4E-04 | Trichloroethene | 1,1,2,2-Tetrachloroethane, RDX | 1,1-Dichloroethene, Vinyl Chloride | 6 | Trichloroethene |
| | Surface Water | Ingestion | 7E-05 | - - | RDX | - - | 3 | 4-Aminno-2,6-Dinitrotoluene |
| | | Dermal Contact | 4E-07 | - - | - - | - - | 0.02 | - - |
| | | Inhalation | - - | - - | - - | - - | 0 | - - |
| | | Total Surface Water | 7E-05 | - - | RDX | - - | 3 | 4-Aminno-2,6-Dinitrotoluene |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0.003 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0.0003 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0.004 | - - |
| | **Total All Media (1-Acre EU & Surface Water)(1)** | | **1E-04** | | | | **5** | |
| | **Total All Media (6-Acre EU & Surface Water)(1)** | | **7E-05** | | | | **3** | |
| | **Total All Media (1-Acre EU & Ground Water)(2)** | | **4E-04** | | | | **9** | |
| | **Total All Media (6-Acre EU & Ground Water)(2)** | | **4E-04** | | | | **7** | |

TABLE 7-14

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURES
FUTURE ON-SITE RESIDENTS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks $> 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| On-Site Lifelong Resident (Child and Adult) | Surface Soil (1-Acre Exposure Unit) | Incidental Ingestion | 1E-04 | - - | 2,4,6-Trinitrotoluene, RDX | - - | NE | - - |
| | | Dermal Contact | 4E-05 | - - | RDX | 2,4,6-Trinitrotoluene | NE | - - |
| | | Total Surface Soil | 2E-04 | RDX | 2,4,6-Trinitrotoluene | 2,3,7,8-TCDD Equivalents | NE | |
| | Surface Soil (6-Acre Exposure Unit) | Incidental Ingestion | 2E-06 | - - | - - | 2,3,7,8-TCDD Equivalents | NE | - - |
| | | Dermal Contact | 4E-07 | - - | - - | - - | NE | - - |
| | | Total Surface Soil | 3E-06 | - - | - - | 2,3,7,8-TCDD Equivalents | NE | |
| | Ground Water | Ingestion | 6E-04 | 1,1,2,2-Tetrachloroethane, Trichloroethene | RDX | 1,1,2-Trichloroethane, 1,1,-Dichloroethene, Vinyl Chloride | NE | - - |
| | | Dermal Contact | 4E-05 | - - | Trichloroethene | 1,1,2,2-Trichloroethane | NE | - - |
| | | Inhalation | 1E-04 | Trichloroethene | 1,1,2,2-Trichloroethane | - - | NE | - - |
| | | Total Groundwater | 7E-04 | 1,1,2,2-Tetrachloroethane, Trichloroethene | RDX | 1,1,2-Trichloroethane, 1,1,-Dichloroethene, Vinyl Chloride | NE | |
| | Surface Water | Ingestion | 1E-04 | RDX | - - | - - | NE | - - |
| | | Dermal Contact | 5E-07 | - - | - - | - - | NE | - - |
| | | Total Surface Water | 1E-04 | RDX | - - | - - | NE | |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | NE | - - |
| | | Dermal Contact | - - | - - | - - | - - | NE | - - |
| | | Total Sediment | - - | - - | - - | - - | NE | |
| | **Total All Media (1-Acre EU & Surface Water)(1)** | | 3E-04 | | | | NE | |
| | **Total All Media (6-Acre EU & Surface Water)(1)** | | 1E-04 | | | | NE | |
| | **Total All Media (1-Acre EU & Ground Water)(2)** | | 9E-04 | | | | NE | |
| | **Total All Media (6-Acre EU & Ground Water)(2)** | | 7E-04 | | | | NE | |

**Notes:**
1 - Assumes that surface water is used as a drinking water source.
2 - Assumes that ground water is used a a drinking water source.
EU = Exposure unit.
NA = Not applicable.
Chemical-specific risks are presented in Appendix G.

TABLE 7-15

CUMULATIVE RISK SUMMARY - CENTRAL TENDANCY EXPOSURES
FUTURE ON-SITE RESIDENTS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks > $10^{-4}$ | Chemicals with Cancer Risks > $10^{-5}$ and ≤ $10^{-4}$ | Chemicals with Cancer Risks > $10^{-6}$ and ≤ $10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| On-Site Child Resident | Surface Soil (1-Acre Exposure Unit) | Incidental Ingestion | 9E-06 | - - | - - | 2,4,6-Trinitrotoluene, RDX | 6 | 2,4,6-Trinitrotoluene |
| | | Dermal Contact | 1E-06 | - - | - - | - - | 0.7 | - - |
| | | Total Surface Soil | 1E-05 | - - | - - | 2,4,6-Trinitrotoluene, RDX | 7 | 2,4,6-Trinitrotoluene |
| | Surface Soil (6-Acre Exposure Unit) | Incidental Ingestion | 2E-07 | - - | - - | - - | 0.5 | - - |
| | | Dermal Contact | 1E-08 | - - | - - | - - | 0.01 | - - |
| | | Total Surface Soil | 2E-07 | - - | - - | - - | 0.5 | - - |
| | Ground Water | Ingestion | 3E-05 | - - | Trichloroethene | 1,1,2,2-Tetrachloroehane, RDX | 6 | Trichloroethene |
| | | Dermal Contact | 2E-06 | - - | - - | Trichloroethene | 0.5 | - - |
| | | Inhalation | 9E-06 | - - | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | 0.06 | - - |
| | | Total Groundwater | 4E-05 | - - | Trichloroethene | 1,1,2,2-Tetrachloroehane, RDX | 7 | Trichloroethene |
| | Surface Water | Ingestion | 6E-06 | - - | - - | RDX | 3 | 4-Amino-2,6-dinitrotoluene |
| | | Dermal Contact | 3E-08 | - - | - - | - - | 0.02 | - - |
| | | Inhalation | - - | - - | - - | - - | 0.02 | - - |
| | | Total Surface Water | 6E-06 | - - | - - | RDX | 3 | 4-Amino-2,6-dinitrotoluene |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0.008 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0.0002 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0.008 | - - |
| | **Total All Media (1-Acre EU & Surface Water)(1)** | | **2E-05** | | | | **10** | |
| | **Total All Media (6-Acre EU & Surface Water)(1)** | | **6E-06** | | | | **3** | |
| | **Total All Media (1-Acre EU & Ground Water)(2)** | | **5E-05** | | | | **13** | |
| | **Total All Media (6-Acre EU & Ground Water)(2)** | | **4E-05** | | | | **7** | |

TABLE 7-15

CUMULATIVE RISK SUMMARY - CENTRAL TENDANCY EXPOSURES
FUTURE ON-SITE RESIDENTS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks $> 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| On-Site Adult Resident | Surface Soil (1-Acre Exposure Unit) | Incidental Ingestion | 4E-06 | - - | - - | RDX | 0.7 | - - |
| | | Dermal Contact | 4E-07 | - - | - - | - - | 0.07 | - - |
| | | Total Surface Soil | 4E-06 | - - | - - | RDX | 0.8 | - - |
| | Surface Soil (6-Acre Exposure Unit) | Incidental Ingestion | 7E-08 | - - | - - | - - | 0.05 | - - |
| | | Dermal Contact | 4E-09 | - - | - - | - - | 0.001 | - - |
| | | Total Surface Soil | 8E-08 | - - | - - | - - | 0.05 | - - |
| | Ground Water | Ingestion | 4E-05 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | RDX | 3 | Trichloroethene |
| | | Dermal Contact | 4E-06 | - - | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | 0.3 | - - |
| | | Inhalation | 7E-06 | - - | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | 0.01 | - - |
| | | Total Groundwater | 5E-05 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | RDX | 3 | Trichloroethene |
| | Surface Water | Ingestion | 9E-06 | - - | - - | RDX | 1 | - - |
| | | Dermal Contact | 6E-08 | - - | - - | - - | 0.01 | - - |
| | | Inhalation(2) | - - | - - | - - | - - | 0.003 | - - |
| | | Total Surface Water | 9E-06 | - - | - - | RDX | 1 | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | 0.0009 | - - |
| | | Dermal Contact | - - | - - | - - | - - | 0.00002 | - - |
| | | Total Sediment | - - | - - | - - | - - | 0.0009 | - - |
| | **Total All Media (1-Acre EU & Surface Water)(1)** | | **1E-05** | | | | **2** | |
| | **Total All Media (6-Acre EU & Surface Water)(1)** | | **9E-06** | | | | **1** | |
| | **Total All Media (1-Acre EU & Ground Water)(2)** | | **6E-05** | | | | **4** | |
| | **Total All Media (6-Acre EU & Ground Water)(2)** | | **5E-05** | | | | **3** | |

TABLE 7-15

CUMULATIVE RISK SUMMARY - CENTRAL TENDANCY EXPOSURES
FUTURE ON-SITE RESIDENTS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE INDIANA


| Receptor | Media | Exposure Route | Cancer Risk | Chemicals with Cancer Risks $> 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$ | Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$ | Hazard Index (HI) | Chemicals with HI > 1 |
|---|---|---|---|---|---|---|---|---|
| On-Site Lifelong Resident (Child and Adult) | Surface Soil (1-Acre Exposure Unit) | Incidental Ingestion | 1E-05 | - - | - - | 2,4,6-Trinitrotoluene, RDX | NE | - - |
| | | Dermal Contact | 1E-06 | - - | - - | RDX | NE | - - |
| | | Total Surface Soil | 1E-05 | - - | RDX | 2,4,6-Trinitrotoluene | NE | - - |
| | Surface Soil (6-Acre Exposure Unit) | Incidental Ingestion | 3E-07 | - - | - - | - - | NE | - - |
| | | Dermal Contact | 2E-08 | - - | - - | - - | NE | - - |
| | | Total Surface Soil | 3E-07 | - - | - - | - - | NE | - - |
| | Ground Water | Ingestion | 7E-05 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | RDX | NE | - - |
| | | Dermal Contact | 7E-06 | - - | - - | 1,1,2,2-Trichloroethane, Trichloroethene | NE | - - |
| | | Inhalation | 2E-05 | - - | Trichloroethene | 1,1,2,2-Trichloroethane | NE | - - |
| | | Total Groundwater | 9E-05 | - - | 1,1,2,2-Tetrachloroethane, Trichloroethene | RDX | NE | - - |
| | Surface Water | Ingestion | 1E-05 | - - | RDX | - - | NE | - - |
| | | Dermal Contact | 9E-08 | - - | - - | - - | NE | - - |
| | | Total Surface Water | 1E-05 | - - | RDX | - - | NE | - - |
| | Sediment | Incidental Ingestion | - - | - - | - - | - - | NE | - - |
| | | Dermal Contact | - - | - - | - - | - - | NE | - - |
| | | Total Sediment | - - | - - | - - | - - | NE | - - |
| | **Total All Media (1-Acre EU & Surface Water)(1)** | | **3E-05** | | | | NE | |
| | **Total All Media (6-Acre EU & Surface Water)(1)** | | **1E-05** | | | | NE | |
| | **Total All Media (1-Acre EU & Ground Water)(2)** | | **1E-04** | | | | NE | |
| | **Total All Media (6-Acre EU & Ground Water)(2)** | | **9E-05** | | | | NE | |

**Notes:**
1 - Assumes that surface water is used as a drinking water source.
2 - Assumes that ground water is used a a drinking water source.
EU = Exposure unit.
NA = Not applicable.
Chemical-specific risks are presented in Appendix G.

TABLE 7-16

SUMMARY OF CONCLUSIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Concern[1] | Impact on Human Receptors | Comments |
|---|---|---|
| **SURFACE SOIL** | | |
| 2,3,7,8-TCDD Equivalents | On-Site Child Resident ILCR = 1E-06 (6-acre EU)<br>Lifelong Resident ILCR = 2E-06 (6-acre EU)<br>On-Site Child Resident ILCR = 1E-06 (1-acre EU)<br>Lifelong Resident ILCR = 2E-06 (1-acre EU) | Total risks for soil are less than 1E-04 for all receptors. |
| 2,4,6-Trinitrotoluene | On-Site Child Resident HI = 19 (1-acre EU)<br>On-Site Child Resident ILCR = 2E-05 (1-acre EU)<br>On-Site Adult Resident HI = 2 (1-acre EU)<br>On-Site Adult Resident ILCR = 1E-05 (1-acre EU)<br>Lifelong Resident ILCR = 4E-05 (1-acre EU) | 2,4,6-Trinitrotoluene only exceeded the screening criteria at locations 03SS22 and 03SS24. |
| RDX | On-Site Child Resident ILCR = 8E-05 (1-acre EU)<br>On-Site Child Resident HI = 3 (1-acre EU)<br>On-Site Adult Resident ILCR = 4E-05 (1-acre EU)<br>Lifelong Resident ILCR = 1E-04 (1-acre EU) | RDX only exceeded the screening criteria at locations 03SS19, 03SS22, and 03SS24. |
| Lead | Future On-site residents -More than 5% of children are predicted to have blood lead levels greater than 10 ug/dL | Concentrations of lead in surface soil only exceeded the OSWER screening level of 400 mg/kg at location 03SS24. |
| **GROUND WATER** | | |
| 1,1,2,2-Tetrachloroethane | Occupational Worker ILCR = 3E-05<br>Child Recreational User ILCR = 7E-06<br>Adult Recreational User ILCR = 6E-06<br>Lifelong Recreational User ILCR = 1E-05<br>On-Site Child Resident ILCR = 9E-05<br>On-Site Adult Resident ILCR = 1E-04<br>On-Site Lifelong Resident ILCR = 2E-04 | All risks for groundwater are based on hypothetical future use as a domestic water supply. Groundwater is not currently used at the site. 1,1-Dichloroethene was only detected in 1 of 15 samples. The detected concentration of 1,1-dichloroethene was less than the U.S. EPA MCL and IDEM default closure level. Vinyl chloride was only detected in 1 of 15 samples. |
| 1,1,2-Trichloroethane | On-Site Lifelong Resident ILCR = 1E-06 | |
| 1,1-Dichloroethene | On-Site Child Resident ILCR = 1E-06<br>On-Site Adult Resident ILCR = 1E-06<br>On-Site Lifelong Resident ILCR = 3E-06 | |

TABLE 7-16

SUMMARY OF CONCLUSIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Concern[1] | Impact on Human Receptors | Comments |
|---|---|---|
| **GROUND WATER (Continued)** | | |
| Trichloroethene | Occupational Worker HQ = 2<br>Occupational Worker ICLR = 7E-05<br>Child Recreational User HQ = 2<br>Child Recreational User ILCR = 2E-05<br>Adult Recreational User ILCR = 2E-05<br>Lifelong Recreational User ILCR = 3E-05<br>On-Site Child Resident HQ = 17<br>On-Site Child Resident ILCR = 2E-04<br>On-Site Adult Resident HQ = 5<br>On-Site Adult Resident ILCR = 3E-04<br>On-Site Lifelong Resident ILCR = 5E-04 | All risks for groundwater are based on hypothetical future use as a domestic water supply Groundwater is not currently used at the site. 1,1-Dichloroethene was only detected in 1 of 15 samples The detected concentration of 1,1-dichloroethene was less than the U S. EPA MCL and IDEM default closure level. Vinyl chloride was only detected in 1 of 15 samples. |
| Vinyl Chloride | Occupational Worker ILCR = 1E-06<br>On-Site Child Resident ILCR = 2E-6<br>On-Site Adult Resident ILCR = 3E-06<br>On-Site Lifelong Resident ILCR = 5E-06 | |
| 4-Amino-2,6-dinitrotoluene | On-Site Child Resident HQ = 2 | |
| RDX | Occupational Worker ILCR = 1E-05<br>Child Recreational User ILCR = 2E-06<br>Adult Recreational User ILCR = 2E-06<br>Lifelong Recreational User ILCR = 5E-06<br>On-Site Child Resident HQ = 0.9<br>On-Site Child Resident ILCR = 2E-05<br>On-Site Adult Resident ILCR = 3E-05<br>On-Site Lifelong Resident ILCR = 5E-05 | All risks for groundwater are based on hypothetical future use as a domestic water supply. Groundwater is not currently used at the site. |

TABLE 7-16

SUMMARY OF CONCLUSIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Concern[1] | Impact on Human Receptors | Comments |
|---|---|---|
| **SURFACE WATER** | | |
| 2-Amino-4,6-dinitrotoluene | On-Site Child Resident HQ = 2<br>On-Site Adult Resident HQ = 0.7 | Risks for on-site residents are based on hypothetical future use of surface water as a domestic water supply. Only surface water samples collected down stream of Spring C were used in the analysis. There is year-around ground water-to-surface water flow at Springs A, B, and C. Elevated HIs for future on-site residents using surface water as a domestic water supply are mainly associated with samples from location SWSD17.<br><br>Risks for future recreational users are assume that recreational users have incidental contact with surface water while visiting the site. All surface water samples were used to estimate risks for recreational users<br><br>Surface water samples collected at the southern boundary of the site (03SWSD19) were used to evaluate domestic water use by current/future |
| 4-Amino-2,6-dinitrotoluene | On-Site Child Resident HQ = 5<br>On-Site Adult Resident HQ = 1 | |
| RDX | Off-Site Child Resident ILCR = 9E-06<br>Off-Site Adult Resident ILCR = 1E-05<br>Off-Site Lifelong Resident ILCR = 2E-05<br>Child Recreational User ILCR = 1E-06<br>Lifelong Recreational User ILCR = 1E-06<br>On-Site Child Resident HQ = 2<br>On-Site Adult Resident HQ = 0.6<br>On-Site Child Resident ILCR = 6E-05<br>On-Site Adult Resident ILCR = 7E-05<br>On-Site Lifelong Resident ILCR = 1E-04 | |

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

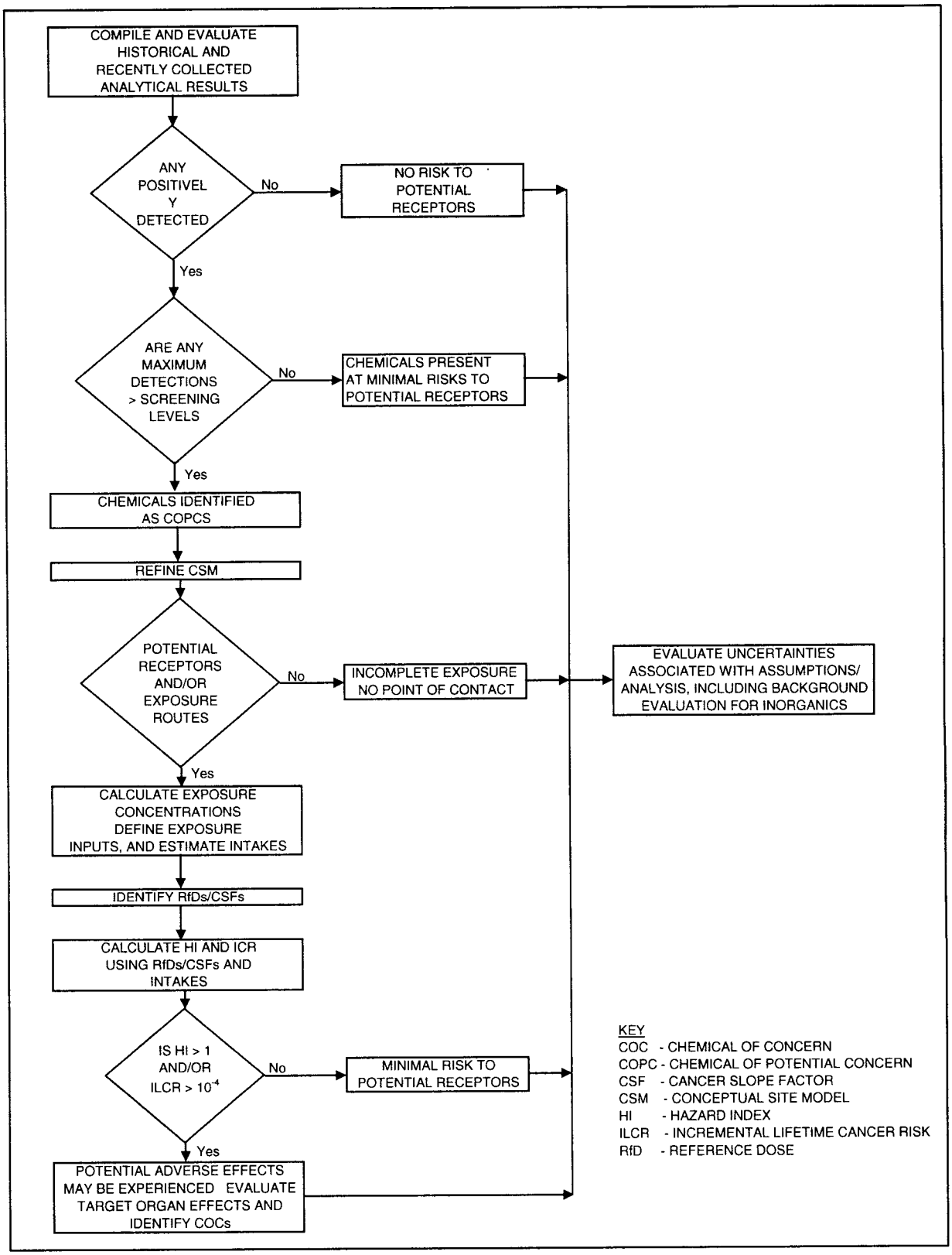
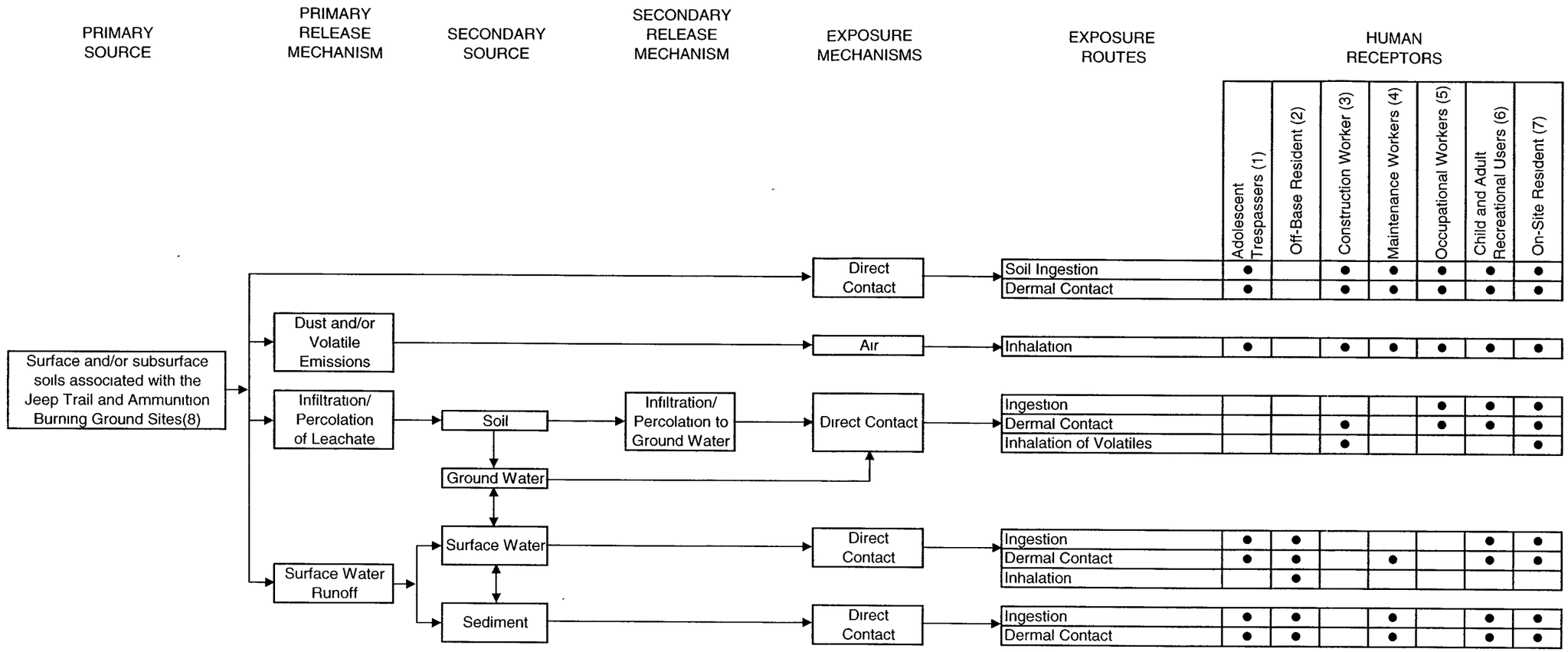



**FIGURE 7-1**

**SUMMARY OF HUMAN HEALTH RISK ASSESSMENT PROCESS**
**SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**




LEGEND

● = Complete exposure pathway.

A blank space indicates that the exposure route is not complete for this receptor.

KEY

(1) Potential receptor under current and future land use Access to the site is not limited once inside the facility.
(2) Off-base residents currently exist downgradient of the Old Jeep Trail and Little Sulphur Creek.
(3) Potential receptor under future land use. A short-term project (e.g , utility installation may occur.
(4) Maintenance workers are not currently assigned to the Old Jeep Trail or Little Sulphur Creek.
(5) Plausible future receptor. However, the Old Jeep Trail is not likely to be developed.
(6) Potential receptor under future land use. Based could close and be turned into a state park
(7) Evaluated for risk management decision making purposes only.
(8) Construction workers are evaluated for exposures to surface/subsurface soil. All other receptors are only evaluated for exposure to surface soil.

**FIGURE 7-2**

**CONCEPTUAL SITE MODEL**
**SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK**
**NSWC CRANE**
**CRANE, INDIANA**

# 8.0 ECOLOGICAL RISK ASSESSMENT

The goal of the SERA is to evaluate the potential for adverse ecological impacts of site-related contamination. This SERA is used to determine the need for further investigation and/or remedial action at SWMU 03, NSWC Crane.

## 8.1 INTRODUCTION

The SERA methodology used at NSWC Crane is in accordance with the following guidance documents:

- Department of Navy Environmental Policy Memorandum 97-04: Use of Ecological Risk Assessments (May 16, 1997).
- Chief of Naval Operations Letter 5090 Ser N453E/9U 59 5335 (April 5, 1999).
- Navy Policy for Conducting Ecological Risk Assessment (DON, 1999).
- Final Guidelines for Ecological Risk Assessment (U.S. EPA, 1998b).
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (U.S. EPA, 1997b).

This ERA consists of Steps 1, 2, and 3a of the eight steps required by U.S. EPA guidance (U.S. EPA, 1997b and 1998a) and the Navy Policy for Conducting Ecological Risk Assessments (DON, 1999). The first two steps are a screening level risk assessment. Step 3a is the first step of the BERA and consists of refining the list of COPCs that were retained following Steps 1 and 2. Steps 3b through 7 are conducted if additional evaluations or investigations are necessary, which was not the case for SWMU 03. Finally, Step 8, Risk Management, is incorporated throughout the ERA process, in cooperation with the Region 5 Biological Technical Assistance Group (BTAG).

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

## 8.2 PROBLEM FORMULATION

Problem formulation is the first step of a SERA. It results in three products (U.S EPA, 1998b):

- Assessment endpoints that adequately reflect management goals and the ecosystems they represent.

- Conceptual models that describe the key relationships between a stressor and assessment endpoint or among several stressors and assessment endpoints.

- An analysis plan.

Problem formulation includes identification of the following:

- Ecosystems potentially at risk
- Source and stressor characteristics
- Exposure characteristics
- Ecological effects

The problem formulation process enables the risk assessor to identify the ecological resources to be protected (known as assessment endpoints); the measurements that will be used to evaluate risks to those resources (known as measures of effects); and the chemicals, geographic areas, and environmental media relevant to the risk assessment.

### 8.2.1 Site Description

The OJT consists of a portion of a narrow, forested stream valley centered on LSC. Most terrestrial areas within the site support deciduous forest vegetation in varying stages of natural succession. Aquatic habitats within the site consist of the surface waters and sediments of LSC. Terrestrial and aquatic habitats in areas surrounding the ABG, including the OJT, were characterized in detail in August and September 1995 as part of an ERA completed in February 1999 (TtNUS, 1999). The following site description is based on information in that ERA.

**Terrestrial Habitats:** The most frequent tree species at SWMU 03 are mockernut hickory (*Carya tomentosa*), shagbark hickory (*Carya ovata*), sugar maple (*Acer saccharum*), tulip poplar (*Liriodendron tulipifera*), sassafras (*Sassafras albidum*), red oak (*Quercus rubra*), white oak (*Quercus alba*), and American beech (*Fagus grandifolia*). Common understory plants include flowering dogwood (*Cornus florida*) and sugar maple. Various tree seedlings, clubmosses, grasses, rushes, and forbs occur as groundcover at the site.

The forested habitats on and surrounding the OJT support numerous bird species. A total of 25 bird species were observed in the area of the ABG during the 1995 biological survey. Commonly observed species included wild turkey (*Meleagris galopava*), whippoorwill (*Caprimulgus vociferus*), common crow

(*Corvus brachyrhynchos*), common flicker (*Colaptes auratus*), American gold finch (*Spinus tristis*), chipping sparrow (*Spizella passerina*), and blue jay (*Cyanocitta crigtata*).

An effort to trap and identify small and intermediate size mammals conducted in the vicinity of the ABG between August 24, 1995 and August 26, 1995 resulted in the capture of only opossums (*Didelphis virginiana*) and raccoons (*Procyon lotor*). Wildlife signs observed during the survey included white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*) or red fox (*Vulpes vulpes*), and squirrel (various species possible). The authors of the survey noted that the noise, smoke, and other human activity at the ABG, as well as predation, may have reduced the diversity of wildlife in the surrounding area. A greater diversity of terrestrial wildlife might occur in portions of the OJT more distant from the ABG.

The terrestrial and aquatic habitats at SWMU 03 provide potential habitat for a number of reptile and amphibian species. However, many reptiles and amphibians are difficult to observe. Direct observations of reptiles and amphibians in the vicinity of the ABG during the 1995 biological survey were limited to the American toad (*Bufo americanus americanus*), striped chorus frog (*Pseudacris triseriata*), bullfrog (*Rana catesbeiana*), Eastern garter snake (*Thamnophis sirtalis sirtalis*), and Eastern box turtle (*Terrapene carolina*).

**Aquatic Habitats:** The channel of LSC has a riffle-and-pool structure, and standing water is limited to pooled areas during low-flow conditions, such as during the 1995 biological survey. The 1995 survey included identification of fish and benthic macroinvertebrates in pools near two springs that flow into the creek. Spring A is located in the southern (most downstream) portion of SWMU 03. The water depth in the pool near Spring A was 6½ feet at the time of the 1995 survey. Spring C is located approximately 2,500 feet upstream of Spring A. The water level in the Spring C pool was 1½ feet during the survey. The LSC channel upstream of Spring C is generally dry except after rain events, resulting in the absence of permanent aquatic communities in most portions of the creek within SWMU 03.

Fish were captured for identification using an electrofishing backpack unit. In the pool near Spring A, the bluntnose minnow (*Pimenthales notatus*) was abundant, the gizzard shad (*Dorosoma cepedianum*) and creek chub (*Semotilis atromaculatus*) were common, and the largemouth bass (*Micropterus salmoides*) was uncommon. In the Spring C pool, the gizzard shad, silverjaw minnow (*Ericymba buccata*), and bluntnose minnow (*Pimenthales notatus*) were common and the ribbon shiner (*Notropus fumeus*) and blacknose dace (*Rhinichthys atratulus*) were uncommon.

Benthic macroinvertebrates were collected using a D-frame kick net and preserved using 70-percent isopropanol. At the Spring A pool, 71 individuals in seven taxa were observed. The EPT Index was calculated to be 0.429, which is indicative of a relatively unpolluted stream. At the Spring C pool, 81 individuals in eight taxa were observed. The EPT Index was 0.375, indicative of a relatively unpolluted stream. For a riffle in LSC adjoining the Spring C pool, 40 individuals in four taxa were observed, and the EPT Index was 0.500, which is also indicative of a relatively unpolluted stream.

The waterbodies at SMWU 03 discharge directly to Little Sulphur Creek. 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).

**Threatened and Endangered Species:** The Endangered Species Management Plan for NSWC Crane lists the federal and state threatened and endangered species and species of special concern potentially present at NSWC Crane. The Indiana bat and bald eagle are the only federally threatened or endangered species at NSWC Crane. Although the Indiana bat may be present at SWMU 03, the bald eagle is not likely present at SWMU 03 due to a lack of vast expanses of open water (i.e., the preferred hunting habitat for the Bald Eagle). In addition, a number of state endangered and federal and state species of concern have been listed. These species and their status have been discussed in Section 1.3.7.

LSC flows southward for about two miles before it enters Sulphur Creek. Sulphur 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 (IDNR, 2000). Also, the East Fork of the White River is the site for an ongoing study of lake sturgeon populations, another state endangered species (IDNR, 2000). Finally, spotted darters, a state endangered species, has been found in the East Fork of the White River (IDNR, 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.

### 8.2.2 Potential Sources of Contamination and Associated Exposure Pathways

Because the OJT/LSC site was identified as an area potentially warranting further investigation (TtNUS, 1999), surface soil samples were collected from terrestrial habitats on the site, and sediment and surface water samples were collected from aquatic habitats within the channel of LSC. The samples were analyzed for VOCs, SVOCs, energetics, pesticides, PCBs, herbicides, and inorganics. Soil samples were also analyzed for dioxins. Analytical results for the samples are presented in Section 4.0, while the nature and extent of contamination is discussed in Section 5.0.

Chemicals released from materials dumped in terrestrial areas of the OJT can initially contaminate surface soils. Natural precipitation can then cause the chemical contaminants to leach downward into the subsurface soils and ground water. Discharge of the ground water to LSC can result in the contamination of surface water and sediment inhabited by aquatic receptors. Precipitation striking the soil surface can also dislodge contaminated surface soil and carry it suspended in the runoff into LSC. Because LSC originates up-gradient of the ABG as well as the OJT, it may also carry contamination that originated at the ABG that is not related to the OJT.

Terrestrial ecological receptors such as plants, soil invertebrates, mammals, birds, reptiles, and amphibians can be exposed to contaminated surface soil through direct contact. Mammals, birds, reptiles, and amphibians can also ingest contaminated surface soil, and can ingest food items in which contaminants have accumulated. Some terrestrial receptors such as burrowing mammals or deep-rooted trees could be exposed to shallow layers of contaminated subsurface soils or to shallow ground water, but most terrestrial receptors are not substantially exposed to subsurface soils or to ground water that has not discharged to surface water. After ground water is discharged via seeps, springs, or stream baseflow, terrestrial receptors can ingest or be directly exposed to the contaminated water.

Aquatic ecological receptors such as fish and benthic macroinvertebrates can be exposed to chemical contamination through direct contact and ingestion of contaminated surface water or sediment. Fish and piscivorous (fish-eating) wildlife can also feed on other aquatic biota that have accumulated chemical contaminants from the surface water and sediment.

### 8.2.3 Physical and Chemical Characteristics

Chemicals detected in surface water, sediment, and surface soil samples include dioxins (in soil samples only), VOCs, SVOCs, energetics, pesticides, PCBs, herbicides, and inorganics. Physical and chemical characteristics of chemical contaminants affect their mobility, transport, and bioavailability in the

environment. These characteristics include the organic carbon-water partition coefficient, octanol-water partition coefficient, and vapor pressure. Section 6.0 discusses these factors as they relate to the fate and transport of chemicals detected at the site. Appendix H.1 presents toxicity data for detected chemical constituents.

### 8.2.4 Potential Exposure Pathways

The potential pathways by which ecological receptors may be exposed to COPCs at SWMU 03 were identified, along with the individual receptor species that could be adversely affected by these chemicals. The potential sources of contamination were caused by various activities that have occurred at the site. Chemical contaminants released to soils at the site may have migrated to other media (i.e., ground water, surface water, and sediment). The following subsections discuss the applicable exposure pathways at SWMU 03.

#### 8.2.4.1 Surface Soil

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

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

Larger predatory species, such as the red fox and red-tailed hawk, can be indirectly exposed to soil contaminants by ingesting small mammals that have accumulated contaminants from soil. These pathways were not quantitatively evaluated in the SERA for reasons discussed in Section 8.2.5.1.

#### 8.2.4.2 Ground Water

Ecological receptors are not directly exposed to contaminants in the ground water at the site. Exposure to ground water after discharging as a seep or directly to a surface water body represents a complete exposure pathway and was evaluated as part of the surface water pathway.

#### 8.2.4.3 Surface Water/Sediment

As mentioned above, contaminants in ground water may discharge as a seep that flows into surface water or may discharge directly into a surface water body. Contaminants in soil may also enter LSC via overland flow.

The only aquatic habitat at the site is LSC, which supports benthic macroinvertebrates and small fish in some areas (primarily downstream of Spring C). These receptors could be exposed to chemical contamination by direct contact with, and ingestion of, contaminated surface water or sediments in the creek's channel. Piscivorous wildlife may consume fish that have accumulated chemicals from the surface water and sediment, and bats may consume insects after they emerge from the water. This pathway is complete for LSC. Since the creek is normally dry upstream of Spring C, consumption of fish and invertebrates by piscivorous wildlife is essentially nonexistent within a large portion of SWMU 03. Nevertheless, this exposure pathway was evaluated to address potential impacts farther downstream should migration of contaminants occur.

#### 8.2.4.4 Air

Although inhalation of particulates by mammals and birds may be a complete pathway, it is expected to be insignificant compared to other pathways such as ingestion of food items that have bioaccumulated contaminants from soil. Also, inhalation pathways typically are not evaluated in SERAs because of the uncertainty inherent in estimating exposure levels and toxicological effects. Therefore, the air inhalation pathway was not evaluated in this SERA.

### 8.2.5 Endpoints

#### 8.2.5.1 Assessment Endpoints

Assessment endpoints are explicit expressions of the environmental value that is to be protected (U.S. EPA, 1997b). The selection of these endpoints is based on the habitats present, the migration pathways of probable contaminants, and the routes that contaminants may take to enter receptors.

The habitat at and adjacent to the site consists of forested areas, open fields with grasses, and aquatic habitats. For this SERA, the assessment endpoints are the protection of the following groups of receptors from adverse effects of contaminants on their growth, survival, and reproduction:

- Soil invertebrates
- Terrestrial vegetation
- Herbivorous birds and mammals
- Insectivorous birds and mammals
- Piscivorous birds and mammals
- Benthic invertebrates
- Fish and other aquatic organisms

The following paragraphs discuss why the assessment endpoints listed above were selected for this SERA.

Soil Invertebrates - Soil invertebrates include earthworms, the juvenile life stages of many insects, and other small organisms that directly inhabit the surface soil. These organisms are expected to be present in the soil in terrestrial habitats at the site. Soil invertebrates promote plant growth by aiding in the formation of soil and through redistribution and decomposition of organic matter. Soil invertebrates also serve as a food source for many mammals and birds. Contaminants can bioaccumulate from the soil into the tissues of soil invertebrates used as a food source by mammals and birds.

Terrestrial Vegetation - Terrestrial vegetation at the site consists of herbs (grasses, rushes, forbs, ferns, and other non-woody plants), shrubs, woody vines, and trees. These plants serve as a food source and provide shade and cover for many organisms, and they help prevent soil erosion and excessive surface runoff. Plants can also bioaccumulate some chemical contaminants from the soil, which can then be transferred to organisms that feed on plant tissue.

Herbivorous Birds and Mammals - Herbivorous birds and mammals (animals that consume only plant tissue) forage at the site. Their role in the community is essential because, without them, higher trophic levels could not exist. They may be exposed to and accumulate contaminants that are present in the plants they consume.

Carnivorous Birds and Mammals - Carnivorous birds and mammals consume invertebrates, fish, mammals, birds, reptiles, and amphibians. The term "carnivorous", in this sense, includes insectivorous, piscivorous, and top-level carnivorous species. Insectivorous birds and mammals are present at the SWMU 03 site. These are considered first-level carnivores, and they serve as a food source for higher trophic level carnivores. Piscivorous birds and mammals feed on fish and other aquatic organisms in LSC. (Note: the term "piscivorous", is used in the remainder of this report in a broad sense to describe birds and mammals that prey upon not only fish, but on a variety of aquatic and benthic organisms). Carnivorous birds and mammals that feed on other birds and mammals are at the top of the food-chain. The top carnivores typically are less densely distributed than the herbivores and first-level carnivores because they require a larger area to hunt for their food. All the carnivores may be exposed to and accumulate contaminants that are present in the food items they consume.

Benthic Invertebrates - Benthic invertebrates are similar to soil invertebrates in that they serve as a food source for higher trophic level organisms (i.e., fish, amphibians, birds, mammals). They can also accumulate some contaminants that can then be transferred to the higher trophic level organisms that consume invertebrates.

Aquatic Organisms - Fish and other aquatic organisms are present in LSC. They are exposed to contaminants and can accumulate contaminants from the food items they consume or from the surface water in which they live.

Not all the initial assessment endpoints are evaluated in the SERA. As indicated in U.S. EPA guidance (U.S. EPA, 1997b), "it is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at a site. Instead, assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants from the site." Therefore, the SERA focuses on the endpoints that will tend to yield the highest risks, which should then account for endpoints that will have lower risks.

Large carnivorous mammals and birds (e g., red fox, red-tailed hawk) were not selected as assessment endpoints because the greatest exposure to site contaminants is expected to occur to small mammals and birds that ingest invertebrates, fish, or plants. Additionally, the contaminated area at SWMU 03 represents only a small percentage of these large carnivores' home ranges. Conservative data indicates a home range size of 150 hectar (ha) (370 acres, southern Michigan fields and wood lots) for the red-tailed hawk and 78 ha (193 acres, Wisconsin marsh, forests, and prairies) for the red fox (U.S. EPA, 1993e). SWMU 03 is an approximately six-acre site, representing only a fraction of where these large carnivores potentially hunt and feed, 1 6 percent for the hawk and 3.1 percent for the fox. Therefore, by

protecting the small mammals and birds, large carnivorous mammals and birds will also be protected. The uncertainties associated with not performing food-chain modeling for large carnivorous mammals at the site are presented in Section 8.7.1.

Omnivores were not selected as assessment endpoints because exposure to contaminants in plants is greatest for herbivores and exposure to contaminants in animals is greatest for insectivores. Therefore, omnivores will be protected by protecting herbivores and insectivores.

#### 8.2.5.2 Measurement Endpoints

Measurement endpoints are estimates of biological impacts (e.g., mortality, growth, reproduction) that are used to evaluate the assessment endpoints. The following measures of effects are used to evaluate the assessment endpoints in this SERA, where applicable.

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

- No-observed-adverse effects levels (NOAELs) for representative wildlife species – Mortality, reproduction, and/or developmental effects to birds and mammals were evaluated by comparing estimated ingested doses of contaminants in surface water, sediment, surface soil, plants, invertebrates, and/or fish to these NOAELs.

- Sediment screening values - Mortality and other adverse effects (e.g., those on growth, feeding rates, behavior) of benthic macroinvertebrates were evaluated by comparing chemical concentrations in sediment to screening values designed to be protective of ecological receptors.

- Surface water screening values - Mortality and other adverse effects (e.g., those on growth, feeding rates, behavior) of aquatic organisms were evaluated by comparing chemical concentrations in surface water to screening values designed to be protective of ecological receptors.

#### 8.2.5.3 Selection of Receptor Species

Many receptors in the soil and aquatic environments are adequately described in general categories such as soil invertebrates, vegetation, and sediment-dwelling (benthic) invertebrates. This is due to the nature of the threshold values, effects values, or water-quality criteria that are typically used to characterize risk

for such organisms. For vertebrate receptors, selection of particular species is required so that intake through eating and drinking can be estimated.

Receptor identification is influenced by the contaminants, their likely mode of transport, ultimate fate, and toxicity. Most metals, for example, (with notable exceptions of cadmium and mercury) typically do not bioaccumulate. For contaminants that do not bioaccumulate, organisms that are in direct contact with soil and sediment (i.e., sediment- and soil-dwelling organisms and plants) and animals that may incidentally ingest soil particles are selected as receptors for metals if exposure pathways are complete. For contaminants that bioaccumulate, such as mercury compounds and chlorinated pesticides, effects on upper trophic level receptors must be assessed. Sensitivity to particular contaminants is also considered. For example, birds and mammals may have different sensitivities to organic compounds, so each group, or the most sensitive group for a particular contaminant, is assessed.

Ingestion is the primary route of exposure for most mammals and birds. The selection of species used to represent the receptor groups identified in Section 8.2.5.1 was based on considerations of their preferred habitat, body size, sensitivity, home range, abundance, commercial or sport utilization, legal status, and functional role (e.g., predators). For conservativeness, representative species preferably have small home ranges. Species known to be sensitive to particular contaminants may be selected or toxicity values for those species may be used. The availability of exposure parameters such as body mass, feeding rate, and drinking rate may also be a factor in selecting representative species. The following representative species were used for the food-chain modeling, which is discussed in Section 8.6.2:

- Herbivorous mammal: meadow vole
- Herbivorous bird: bobwhite quail
- Insectivorous bird: American robin
- Insectivorous mammal: short tail shrew
- Piscivorous mammal: raccoon
- Piscivorous bird: belted kingfisher

Receptor profiles for the above species are presented in Appendix H.2.

The federally endangered Indiana bat (*Myotis sodalis*) is known to occur in the vicinity of NSWC Crane. This species, however, was not used to represent insectivorous mammals in the food-chain modeling because of previous evaluations of this species. Specifically, a study was conducted at the ABG during the summer of 2000 to determine concentrations of contaminants in insects used as food items by the Indiana bat (NSWC, 2001). The study consisted of collecting insects from three locations adjacent to

Little Sulphur Creek immediately downstream of the ABG and analyzing the insect tissues for explosive compounds, total phosphorous, and metals. Chemical concentrations in the insect tissue samples were used to evaluate risks to the Indiana bat (using the little brown bat (*Myotis lucifugus*) as a surrogate species) through consumption of the insects. The conclusion of the risk evaluation was that potential risks to bats, as a result of the consumption of insects along Little Sulphur Creek are low, and a study to obtain base-specific background concentrations of metals in insects does not appear to be necessary (see Appendix J).

In addition to the Indiana bat, and as discussed in Sections 1.3.7 and 8.2.1, the federally threatened bald eagle is known to occur at NSWC Crane. There are no records of any other species at NSWC that are federally listed as endangered or threatened. Ten species listed as endangered by the Indiana Department of Natural Resources have been recorded at NSWC. These are the Indiana bat, bobcat, timber rattlesnake, bald eagle, osprey, loggerhead shrike, yellow crowned night heron, Virginia rail, king rail, and Henslow's sparrow (Comarco Systems Inc., 2000). No state-listed threatened species have been recorded at NSWC Crane. Bald eagles and ospreys are not expected to occur at SWMU 03 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 absent from SWMU 03. 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. Risk to the state-endangered timber rattlesnake is not evaluated in this ERA because exposure factors are not well established for this species, and reptile toxicity data are sparse.

As discussed in Section 8.2.5.1, large carnivorous mammals and birds were not selected as assessment endpoints because the area of SWMU 03 is very small when compared to the home range of these species and because the greatest exposure to site contaminants is expected to occur to small mammals and birds that ingest invertebrates, fish, or plants; therefore, risks to the bobcat, and to large carnivorous birds such as hawks and owls, are not specifically evaluated in this ERA, but are discussed in the uncertainty analysis presented in Section 8.7.1.

### 8.2.6 Conceptual Model

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

(U.S. EPA, 1998b). The following risk questions describe these relationships and are evaluated as part of this SERA:

- Are contaminants in surface soil at SWMU 03 causing increased mortality of plants and soil invertebrates?

- Are contaminants in surface soil at SWMU 03 causing increased mortality, decreased reproduction, and/or developmental effects in birds and mammals?

- Are contaminants in surface water or sediment causing increased mortality of benthic invertebrates and fish or increased mortality, decreased reproduction, and/or developmental effects in piscivorous wildlife?

The primary sources of contamination at the site were identified based on past operational practices. The primary stressors are contaminants in the surface soil, surface water, sediment, and ground water. Because ecological receptors are not directly exposed to contaminants in the ground water, the secondary stressors are contaminants in the surface water and sediment. The primary receptors for contaminants in the surface soil are plants and invertebrates, and the secondary receptors are birds and mammals. The primary receptors for contaminants in surface water and sediment are fish and aquatic/benthic invertebrates, and the secondary receptors are birds and mammals. Figure 8-2 presents the conceptual site model.

## 8.3 EXPOSURE CHARACTERIZATION AND THE SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN

### 8.3.1 Screening Levels

The first step in the analysis phase was to select COPCs. This was done by comparing the maximum detected contaminant concentrations in surface water, sediment, and surface soil samples to U.S. EPA Region 5 EDQLs (U.S. EPA, 1999d). As indicated in U.S. EPA Region 5 (October 1999d), the EDQLs provide an initial screening level for chemicals in environmental media which are protective of plants, invertebrates, and mammals. Although the EDQLs have since been updated by the Ecological Screening levels (ESLs) (U.S. EPA Region 5, 2003), they were not used to select chemicals as COPCs because the RFI report was prepared before the ESLs were published. The ESLs were discussed in the Step 3a evaluation (see Section 8.6). Section 4.0 summarizes the procedures that were used to select COPCs. If a chemical was not detected in any of the samples in a particular medium and the reporting limit

exceeded the EDQL, the chemical was not quantitatively carried through the risk assessment as a COPC. However, the chemical, its reporting limit, and the EDQL were summarized in Table 3-4 and qualitatively discussed in the uncertainty analysis. If a chemical was detected in at least one sample, one-half of the reporting limit was substituted for the non-detects to calculate summary statistics (e.g., mean concentrations).

### 8.3.2 Risk Characterization

The risk characterization compares the exposure to the ecological effects. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a stressor was initially evaluated.

An Ecological Effects Quotient (EEQ) approach was used to characterize the risk to terrestrial receptors. This approach characterizes the potential effects by comparing exposure concentrations with the effects data. The EEQs for terrestrial plants and invertebrates were calculated as follows:

$$EEQ = \frac{C_{ss}}{SSSL}$$

where:

$C_{ss}$ = Contaminant concentration in surface soil (µg/kg or mg/kg)

SSSL = Plant or Invertebrate Screening Level in Surface Soil (µg/kg or mg/kg)

The EEQs for the aquatic receptors were calculated as follows:

$$EEQ = \frac{C_{sw}}{SWSL} \; or \; \frac{C_{sd}}{SSL}$$

where:

$C_{sw}$ = Contaminant concentration in surface water (µg/L)

$C_{sd}$ = Contaminant concentration in sediment (µg/kg or mg/kg)

SWSL = Surface Water Screening Level (µg/L)

SSL = Sediment Screening Level (µg/kg or mg/kg)

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

## 8.4 ECOLOGICAL SCREENING

The selection of ecological COPCs was presented in Section 4.3. The COPCs were included on the tag maps, and the nature and extent of COPCs were discussed in Section 5.0. Therefore, only a summary of the chemicals that were retained as COPCs is included in this section.

Surface soil, sediment, and surface water samples were collected at the site. Surface soil was collected from the 0 to 2 feet bgs depth interval. Surface water samples were collected under low-flow and high-flow conditions. Due to occasional high-flow conditions of LSC, perturbation of the sediments and consequent mixing between shallow and deep sediments occurs. For this reason, shallow (0-6 inches) and deep sediment (6-12 inches) samples were collected. Statistical comparisons to background concentrations are described in Sections 3.4.2 (surface soil), 3.4.4 (surface water), and 3.4.5 (sediment). Table 4-25 lists those chemicals retained as COPCs following the ecological screening.

### 8.4.1 Surface Soil

Table 4-20 is the screening table for chemicals detected in the surface soil samples. Eight individual dioxins, two SVOCs, one energetic compound, and nine inorganic chemicals were retained as COPCs because they were detected at concentrations statistically exceeding site background (for inorganics) and exceeding corresponding EDQLs. Additionally, six total dioxins along with the bird and mammal TEQs, six energetic compounds, and one inorganic chemical were retained as COPCs because they were detected at concentrations statistically exceeding site background (for the inorganics) and/or corresponding EDQL values were not available.

### 8.4.2 Sediment

Table 4-21 is the screening table for chemicals detected in the shallow sediment layer in LSC. Three SVOCs, one energetic compound, one pesticide, one herbicide, and four inorganic chemicals were retained as COPCs because they were detected at concentrations statistically exceeding upstream background concentrations (for inorganics) and exceeding corresponding EDQLs. Three energetic compounds and five inorganic chemicals were retained as COPCs because they were detected at concentrations statistically exceeding upstream background concentrations (for the inorganics) and/or corresponding EDQL values were not available.

Table 4-22 is the screening table for chemicals detected in the deeper sediment layers in LSC. One SVOC, 1 herbicide, and 4 inorganic chemicals were retained as COPCs because they were detected at concentrations statistically exceeding upstream background concentrations (for inorganics) and

exceeding corresponding EDQLs. Additionally, 5 energetic compounds and 4 inorganic chemicals were retained as COPCs because they were detected at concentrations statistically exceeding upstream background concentrations (for the inorganics) and corresponding EDQL values were not available.

### 8.4.3 Surface Water

Table 4-23 is the surface water screening table for LSC under low-flow conditions. One inorganic chemical in unfiltered samples was retained as a COPC because it was detected at a concentration statistically exceeding the upstream background concentration and exceeding the corresponding EDQL. One VOC, five energetic compounds, and one inorganic chemical in filtered samples were retained as COPCs because they were detected at concentrations statistically exceeding upstream background concentrations (for the inorganics) and/or corresponding EDQL values were not available.

Table 4-24 is the surface water screening table for LSC is under high-flow conditions. One SVOC and four inorganic chemicals in unfiltered samples and two inorganics in filtered samples were retained as COPCs because they were detected at concentrations statistically exceeding upstream background concentrations (for inorganics) and exceeding corresponding EDQLs. Five energetic compounds and one herbicide were retained as COPCs because they were detected and/or corresponding EDQL values were not available.

## 8.5 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 3a.

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 such as:

- Were adequate numbers of samples collected in the appropriate locations?
- Were the samples analyzed for the appropriate parameters with sufficient sensitivity?

This section of the ERA describes whether or not the collected data are adequate for making ecological risk decisions for SWMU 03. Section 5.0 of this report contains discussion of the nature and extent of contamination at SWMU 03, and Figures 1-3 and 1-8 show photographs and topography of the site, respectively.

The ABG is designated as SWMU 03/10. The OJT area is located adjacent to it and is considered an extension of the ABG. The OJT is no longer used as a treatment area; however, it is still used as an active vehicle route. From the ABG area, LSC runs to the southeast through the OJT area, and then southward to the NSWC Crane property boundary. The creek has been impacted by activities at the ABG and OJT. Open burning of explosives and explosive-contaminated materials took place at the ABG and two general areas at the Jeep Trail site. In one portion of the OJT, the Burn Area, empty bomb casings were burned, using black powder, to remove any explosive residues. In the second area, the Burn Pit, explosive-contaminated materials, including small munitions items and components, solvent-contaminated rags, and packaging materials, were burned using wood dunnage in a pit.

The exact size and location of the two OJT treatment areas is unknown. Reportedly open burning also took place along the length of the OJT. The area has not been used for munitions treatment since 1983 and has since been re-vegetated. The ABG treatment area is essentially devoid of vegetation in order to minimize fire hazards during open burning treatments. The areas along LSC, within the ABG, have been seeded with grass to minimize erosion of soil into LSC. The OJT site is located in a gravel-covered area on the western side of the gravel access road (Jeep Trail 25). The OJT and the remainder of the LSC valley are surrounded by wooded areas along the hillsides to the east and west, with miscellaneous natural ground vegetation under the tree canopy and along the creek banks. Ground surface elevations at the OJT range from about 550 to 800 feet amsl. The surface elevation where LSC exits the southern boundary of the installation is approximately 500 feet amsl.

### 8.5.1 Surface Soils

Forty-eight surface soil (0 to 2 feet) samples were collected at SWMU 03. Samples were collected in and around the burn area and the burn pit in order to obtain sufficient spatial coverage for bounding the contaminated area(s) (see Figure 1-7). Therefore, the samples were collected in areas where the chemical contamination is expected to be the greatest.

Surface soil samples were analyzed for dioxins, VOCs, SVOCs, energetics, pesticides, PCBs, herbicides, and inorganics. Figures 5-1 and 5-2 are tag maps that show analytical data on site maps for the organic and inorganic chemicals, respectively. Table 4-1 presents the summary of positive analytical results for the soil samples and Table 4-20 is the ecological risk screening table for surface soils. Twenty-three dioxins/furans (including six dioxin/furan totals), six VOCs, 20 SVOCs, eight energetics, three herbicides, and 23 metals were detected in surface soil samples collected at the OJT. Of these, all individual dioxin/furans, two SVOCs, one energetic, and nine metals were retained as COPCs because their maximum detected concentrations exceeded the Region V EDQLs and background levels (for metals only). Additionally, all total dioxin/furans (including TEQ bird and TEQ human/mammal), six energetics, and one metal were retained as COPCs because an EDQL was not available for comparison. All detected bioaccumulative chemicals (U.S. EPA, 2000a) that exceeded the EDQL were retained as COPCs for food-chain modeling.

Dioxin/furans were detected in four to 11 out of 11 surface soil samples, depending upon the dioxin compound. Although dioxin/furans were detected in the one sample collected within the ABG and two samples south of the ABG, the greatest detections of dioxin/furans in surface soil samples were found in samples surrounding the Burn Pit. EEQs for dioxins/furans ranged from 1.6 (1,2,3,4,6,7,8,9-OCDF) to 17,286 (1,2,3,4,6,7,8,9-OCDD). Concentrations of dioxins/furans decrease south of the Burn Pit, indicating the presence of these chemicals are likely attributable to former combustion activities at the OJT. SVOCs were detected in 1 to 13 of 45 samples seemingly co-occurring with dioxins/furans detections (i.e., surrounding the Burn Area and Burn Pit). Naphthalene had an EEQ of 1.3 while di-n-butyl phthalate had an EEQ of 30. The detections of PAHs were expected in these areas because PAHs are products of combustion. Detected phthalates (particularly di-n-butyl phthalate) could be indicative of disposal and burning of plastics. Energetics were detected in 1 of 48 to 9 of 47 samples in surface soils at the OJT with the detections mostly in the surface soil samples surrounding the Burn Area and Burn Pit (03SS01, 03SS03, 03SS13, 03SS16, 03SS18, 03SS19, 03SS21, 03SS22, 03SS24, and 03SS26). 1,3,5-Trinitrobenzene had an EEQ of 29, while EEQs for other detected energetics could not be calculated because EDQLs were not developed for these chemicals. Detections of energetics in close proximity to the Burn Pit and Burn Area and the lack of these chemicals detected in samples further south of the Burn Pit and Burn Area indicate that these chemicals are likely attributable to the former burning activities at OJT.

Ten of 23 metals detected in surface soils at SWMU 03 were statistically determined to be greater than background concentrations and also exceeded the EDQL (or an EDQL was not available). As indicated in Section 3.4, chemicals detected at concentrations greater than the background concentrations indicate the possibility of a release in potentially isolated locations Metals selected as COPCs are potentially

associated with burned waste at the Burn Pit. Detections of metals are highest in these areas and exceed the background surface soil concentrations to the greatest extent of samples collected at OJT. EEQs ranged from 1.3 for barium to 189,838 for lead. Metals concentrations in other areas across the OJT do not indicate a clear pattern of contamination. Because the surface soil samples appear to be well distributed in the area of the suspected disposal activities, and because potential ecological risks exist, the surface soils at SWMU 03 are further evaluated in Step 3a of the ERA.

### 8.5.2 Sediment/Surface Water

To assess the potential risks associated with migration of chemicals from ground water and soil to sediment and surface water, sediment and surface water samples were collected from locations along LSC.

**Sediment**

A total of fifteen shallow (0 to 6 inches) and 15 deep (6 to 12 inches) sediment samples were collected in LSC. Shallow sediment samples were analyzed for VOCs, SVOCs, energetics, pesticides, herbicides, and inorganics. Deep sediment samples were analyzed for VOCs, SVOCs, energetics, herbicides, and inorganics. Figures 5-7 and 5-8 are tag maps that show organic and inorganic analytical data on site maps. Tables 4-4 and 4-5 present the summary of positive organic and inorganic analytical results for the shallow and deep sediment samples, respectively. Tables 4-21 and 4-22 are the ecological risk screening tables for shallow and deep sediment samples, respectively.

Five VOCs, six SVOCs, four energetics, one pesticide, five herbicides, and 24 metals were detected in shallow sediment samples. Of these, three SVOCs, one energetic, one pesticide, and four metals were retained as COPCs because their maximum detected concentrations exceeded EDQLs and the upgradient concentrations (for metals only). Additionally, three energetics and four metals were retained as COPCs because EDQLs were not available for these chemicals and their maximum detected concentrations exceeded the background concentrations (for metals only). Six VOCs, seven SVOCs, five energetics, six herbicides, and 24 metals were detected in deep sediment samples. Of these, one SVOC, one herbicide, and four metals were retained as COPCs because their maximum detected concentrations exceeded EDQLs and the background concentrations (for metals only). Additionally, all five detected energetics and four metals were retained as COPCs because EDQLs were not available for these chemicals and their maximum detected concentrations exceeded the upgradient concentrations (for metals only). All detected bioaccumulative chemicals (U.S. EPA, 2000a) that exceeded EDQLs were retained as COPCs for food chain modeling.

SVOCs were detected relatively infrequently in sediment samples (with a maximum frequency of detection of 3 out of 15 samples collected). Detections of SVOCs were found in samples downstream of the ABG and sporadically in other LSC samples, indicating no clear pattern of contamination. SVOC detections could be attributable to activities associated with the ABG or indicate deposition over time from past activities at the OJT. EEQs for the COPCs ranged from 3.7 for acenaphthene to 12 for diphenylamine. Methoxychlor was detected only once in shallow sediment sample 03SD18 with an EEQ of 4.7. This sample location is the second to farthest downstream sample collected. Methoxychlor was not detected in any other samples. Additionally, no other pesticides were detected in shallow sediment samples. Therefore, the presence of this pesticide is likely attributable to run-off of spot soil applications and not associated with former OJT activities. 2,4-D was retained as a COPC in both shallow and deep sediment samples with detection frequencies of 7 of 10 samples (shallow) and 5 of 12 samples (deep). The maximum EEQ for 2,4-D in shallow sediment samples was 3.5 with a similar EEQ in deep sediment samples of 4.8. 2,4-D was detected sporadically in LSC sediment samples indicating no clear pattern of contamination. Additionally, 2,4-D was detected in the upgradient sediment location, 03SD04. 2,4-D was detected in surface soil samples (although it was not retained as a COPC), indicating that there is a possibility that 2,4-D was deposited from surface water runoff washing soils into LSC. Due to the nature of herbicide usage and sparse spatial distributions, the herbicide detections possibly reflect topical applications rather than former ABG and/or OJT activities. Energetics were retained as COPCs in both shallow and deep sediments with maximum detection frequencies of 4 of 15 samples (shallow) and 5 of 15 samples (deep). 2,4-Dinitrotoluene had an EEQ of 15 in shallow sediment samples; EEQs could not be calculated for other detected energetics because EDQLs were not available. Concentrations of the energetics were detected primarily in samples collected adjacent to and downstream of the Burn Pit (03SD10, 03SD11, 03SD12, and 03SD13); although the maximum detection of 2,4-dinitrotoluene was found in 03SD06, collected within the ABG. The presence of energetics in the environment is an indication of contamination and the presence of these chemicals is likely attributable to deposition from the ABG and/or the OJT.

Samples 03SD11 (deep) and 03SD15 (shallow) had the greatest detected concentrations of metals overall, although concentrations in other samples across the OJT also exceed the corresponding EDQLs. EEQs in shallow sediment samples ranged from 3.2 for zinc to 21 for lead. EEQs in deep sediment samples ranged from 6.7 for barium to 17 for copper. The maximum detected concentrations of metals in shallow sediment samples were found in several samples including those collected within the ABG and immediately downstream of the ABG (i.e., 03SD05 and 03SD06) and the Burn Pit (03SD11). The maximum concentrations of six COPCs in deep sediment samples (including aluminum, antimony, barium, copper, lead, and zinc) were found at location 03SD11; this location is located downstream of the

Burn Area and Burn Pit. The presence of metals in these samples is most likely attributable to former ABG and/or OJT activities. However, the presence of metals in other OJT samples (including 03SD15 and 03SD16) could be attributable to OJT activities such as vehicular traffic, disposal and burning of wastes, etc. Because the sediment samples appear to be well distributed within LSC, and because potential ecological risks exist, shallow and deep sediment at SWMU 03 are further evaluated in Step 3a of the ERA.

**Surface Water**

A total of six low-flow and 11 high-flow surface water samples were collected in LSC. Twelve low flow surface water samples were originally proposed for collection; however, six sample locations were dry during the field event. Low-flow surface water samples were analyzed for VOCs, energetics, herbicides, total and dissolved metals, total suspended solids (TSS), and dissolved oxygen (DO). High-flow surface water samples were analyzed for VOCs, SVOCs, energetics, herbicides, total and dissolved metals, TSS, and DO. Figures 5-9 and 5-10 are tag maps that show organic and inorganic analytical data on site maps. Tables 4-6 and 4-7 present the summary of positive analytical results for the low-flow and high flow surface water samples, respectively. Tables 4-23 and 4-24 are the ecological risk screening tables for low-flow and high-flow surface water samples, respectively.

Three VOCs, five energetics, one herbicide, and 17 metals were detected in low-flow surface water samples. Of these, lead was retained as a COPC (total metals) because the maximum concentration exceeded the EDQL and the upgradient concentration. Additionally, one VOC, all five detected energetics, and iron (dissolved metals) were retained as COPCs because EDQLs were not available for these chemicals and the maximum concentration exceeded the upgradient concentration (iron only). Two VOCs, two SVOCs, five energetics, three herbicides, and 21 inorganics were detected in high-flow surface water samples. Of these, one SVOC and four metals (total metals) were retained as COPCs because their maximum concentrations exceeded EDQLs and the maximum upgradient concentration (metals only). Additionally, all five detected energetics and 2,4-D were retained as COPCs because EDQLs were not available for these chemicals. All detected bioaccumulative chemicals (U.S. EPA, 2000a) that exceeded EDQLs were retained as COPCs for food chain modeling.

Bromomethane was detected in half of the low-flow surface water samples but was not detected in the high flow samples. Bromomethane was retained as a COPC because an EDQL is not available for comparison. Bromomethane was detected in groundwater samples and may be the source of bromomethane in the low-flow surface water samples. Energetics were detected frequently in both low-flow and high-flow surface water samples, particularly HMX and RDX. EEQs for the energetics could not

be calculated as EDQLs for these chemicals are not available. Energetics were also detected in groundwater samples indicating their presence in surface water could be a result of contaminated groundwater from the ABG or activities associated with the OJT. 2,4-D was detected only in two high-flow surface water samples but was not detected in the low-flow surface water samples. The two detections (in sample locations 03SW09 and 03SW13) were relatively low (0.28 and 0.36 µg/L) and validated as "J" values or "estimated". These samples are located in the middle of the LSC sampled area; 2,4-D was not detected in downstream samples. An EEQ for 2,4-D could not be calculated as an EDQL for this chemical is not available.

Lead was retained as a COPC in low-flow total surface water samples with an EEQ of 15, but lead was not detected in the dissolved metals fraction. Lead was also detected in high-flow total surface water samples with an EEQ of 219, although it was detected at levels less than the concentrations in upgradient high flow dissolved surface water samples. The maximum concentrations of lead did not co-occur at the same sample location in the two sampling events indicating no clear pattern of contamination. Similarly to lead, cadmium, copper, and zinc were all selected as COPCs in high-flow total surface water samples but were either less than the upgradient concentration or less than the EDQL in the dissolved metals fraction. EEQs for these chemicals were 2, 3.7, and 2, respectively. Iron was retained as a COPC in low-flow dissolved surface water samples because the maximum detected concentration exceeded the upgradient maximum detection. Additionally, all iron detections in low-flow dissolved surface water samples exceeded the maximum upgradient detection. An EEQ could not be calculated for iron because an EDQL is not available. Surface water samples were co-located with sediment samples that appear to be well distributed within LSC. Because potential ecological risks exist, low-flow and high-flow surface water at SWMU 03 are further evaluated in Step 3a of the ERA.

### 8.5.3 Summary

In summary, a SERA was performed for SWMU 03. 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. Adequate numbers of samples were collected in areas where the contamination, if present, should be detected. The samples were analyzed for the appropriate parameters based on site history. Finally, based on the data quality review in Section 3.0, the data is of sufficient quality to proceed with the risk assessment. Therefore, the SERA is advancing to the Step 3a of the ERA – the refinement of the site-related COPCs.

## 8.6 STEP 3a – COPC REFINEMENT

Step 3a consists of refining the conservative exposure assumptions/concentrations when evaluating potential risks to ecological receptors (i.e., plants, invertebrates, and wildlife receptors) and re-evaluating the analytical data using benchmarks that may be more appropriate for the assessment endpoints. The objective of the Step 3a evaluation is to further reduce the number of chemicals retained as chemicals of potential concern (COPCs), if possible, to focus any additional efforts on those chemicals causing ecological concern. The Step 3a evaluation is designed to eliminate chemicals from further evaluation for certain groups of receptors. For example, a chemical may not be retained as a COPC in soil based on risks to soil invertebrates but may be retained for evaluating risks to plants or wildlife. Therefore, chemicals are evaluated during Step 3a in order of plants/invertebrates, aquatic receptors, and wildlife.

**Surface Soil**

Chemicals that were initially selected as COPCs in surface soil were carried through three independent flow paths: 1) to further evaluate risks to plants, 2) to further evaluate risks to invertebrates, and 3) to further evaluate risks to wildlife (i.e., mammals and birds). This further evaluation was conducted to determine if there are potential risks to all three receptor groups (i.e., plants, invertebrates, and wildlife), or to only one or two of the receptor groups. This is important because if the site proceeds further in a BERA, the studies in the BERA should only focus on the receptors that are at potential risk. Because most of the Region 5 soil screening levels are based on risks to mammals or birds, potential risks to plants and invertebrates are not known. Therefore, the first step in the Step 3a evaluation was to compare the maximum chemical concentration in the soil to "no-effects benchmarks" for plants and invertebrates such as the U.S. EPA Ecological Soil Screening Levels (Eco-SSLs). Note that although the Eco-SSLs are based on effects concentrations such as $EC_{20}$s, samples with chemical concentrations less than the "no-effects benchmarks" are not expected to have significant effects. The following bullets outline decisions that were made based on this comparison:

- If the concentration was less than the no-effects benchmark, it was concluded that the chemical is not causing an unacceptable risk to that receptor group and the chemical was not evaluated further in Step 3a.

- If the chemical concentration was greater than the no-effects benchmark (or the chemical does not have a no-effects benchmark), the chemical was further evaluated in Step 3a to determine if the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels, proceed to a corrective measures study (CMS), etc.).

Concurrent with the evaluation of risks to plants and invertebrates, bioaccumulative chemicals that were retained as COPCs were further evaluated to determine if there are unacceptable risks to wildlife. Even though the conservative COPC screening level may have been based on risks to wildlife, risks to wildlife were further evaluated in Step 3a to calculate risks under a less conservative exposure scenario. The first step in the process was to determine if the COPC is bioaccumulative. A chemical was considered to be bioaccumulative if it is included in the list of important bioaccumulative chemicals in U.S.EPA (2000a). Also, some chemicals, such as energetics, that are not typically considered to be very bioaccumulative were included in the food chain models to be conservative. If the chemical is not bioaccumulative, it was not carried through the food chain model and it was concluded that the chemical is not causing an unacceptable risk to wildlife. If the chemical is bioaccumulative, it was carried through the food chain model. The following bullets outline decisions that were made based on the results of the food chain model:

- If the EEQ is less than 1.0 using average contaminant concentrations and exposure factors and the No Observable Adverse Effects Level (NOAEL) as the TRV, it was concluded that the chemical is not causing an unacceptable risk to wildlife and the chemical was not evaluated further in Step 3a.

- If the EEQ is greater than 1.0 using average contaminant concentrations and exposure factors and the NOAEL as the TRV, the chemical was further evaluated in Step 3a to determine if the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels, proceed to a CMS, etc.).

For chemicals evaluated further in Step 3a, the other Step 3a factors described below were used to determine if the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels, proceed to a CMS, etc.).

**Sediment**

Chemicals initially selected as COPCs in sediment were carried through two independent flow paths: 1) to further evaluate risks to invertebrates, and 2) to further evaluate risks to wildlife (i.e., mammals and birds). This further evaluation was conducted to determine if there are potential risks from that chemical to both receptor groups (i.e., invertebrates and wildlife), to only one of the receptor groups, or to neither of the receptor groups. This is important because if the site proceeds further in a BERA, the studies in the BERA should only focus on the receptors that are at potential risk. Because many of the Region 5 sediment screening levels are based on equilibrium partitioning, the maximum contaminant concentration

was compared to an alternate lower effects level following the order of preference listed below (as applicable):

- Consensus-Based Threshold Effect Concentrations (TECs) (MacDonald et al., 2000)
- Canadian Sediment Guidelines (OMOE, 1993) Lowest Effects Levels
- Canadian Environmental Quality Guidelines (EC, 1999)
- Long and Morgan (1991) Effects-Range Low
- Long et al., (1995) Effects-Range Low
- Ecotox Thresholds (USEPA, 1996a) Sediment Quality Benchmarks
- Other values, as necessary and available

The following bullets outline decisions that were made based on this comparison:

- If the concentration was less than the lower-effects benchmark, it was concluded that the chemical is not causing an unacceptable risk to invertebrates and the chemical was not evaluated further in Step 3a.

- If the concentration was greater than the lower-effects benchmark, the chemical was further evaluated in Step 3a to determine if the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels, proceed to a CMS, etc.).

For chemicals evaluated further in Step 3a, the other Step 3a factors described below were used to determine if the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels, proceed to a CMS, etc.).

**Surface Water**

Chemicals initially selected as COPCs in surface water were carried through two independent flow paths: 1) to further evaluate risks to aquatic organisms, and 2) to further evaluate risks to wildlife (i.e., mammals and birds). This further evaluation was conducted to determine if there are potential risks from that chemical to both receptor groups (i.e., invertebrates and wildlife), or to only one of the receptor groups. This is important because if the site proceeds further in a BERA, the studies in the BERA should only focus on the receptors that are at potential risk. Organic chemicals that are retained as COPCs were evaluated directly in Step 3a. However, for metals, the following decisions were made:

- If the metal was either not detected in the filtered samples, or was detected at a concentration less than the screening level in the filtered samples, it was concluded that the chemical is not causing an unacceptable risk to aquatic organisms and the chemical was not evaluated further in Step 3a.

- If the metal was detected in the filtered samples at a concentration greater than the screening level, it was concluded that the chemical may be causing an unacceptable risk to aquatic organisms and the chemical was evaluated further in Step 3a.

For chemicals evaluated further in Step 3a, the other Step 3a factors described below were used to determine if the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels, proceed to a CMS, etc.).

**Other Step 3a Factors**

For chemicals that are evaluated further in Step 3a, the following factors were evaluated, as appropriate, to determine if the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels, proceed to a CMS).

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

- Frequency of chemical detection and spatial distribution: A chemical detected at a low frequency typically is of less concern than a chemical detected at higher frequency if toxicity and concentrations and spatial areas represented by the data are similar. All else being equal, chemicals detected frequently were given greater consideration than those detected relatively infrequently.

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

- Habitat: Although exceedances of criteria may occur, potential risks to ecological receptors may be minimal if there is little habitat for those receptors. Therefore, the extent of habitat was used

qualitatively when considering additional evaluation. Areas with little habitat were less of a concern than areas with suitable habitat to support the receptors of interest.

- Alternate benchmarks: These benchmarks are used to further evaluate risks to specific groups of ecological receptors (e.g., plants, invertebrates) because while EDQLs are useful for initial screening they are the most conservative values available for soil and sediment evaluation. Some of the alternate benchmarks are overly protective for some receptors and may not be applicable in some cases. For example, the EDQLs for soil may be based on risks to small mammals. Therefore, an exceedance of that EDQL does not necessarily indicate that potential risks to plants or invertebrates exist, so other more appropriate benchmarks were used to evaluate potential risks to those receptors. Use of these alternate benchmarks was case-specific.

In addition to the general Step 3a factors above, other factors were evaluated in Step 3a for each receptor group. The following sections discuss the other factors than may be used, including the specific alternate benchmarks that may be used in Step 3a.

**Terrestrial Plants and Invertebrates:** The alternate benchmarks that were used to further evaluate risks to plants and invertebrates are listed below. The ecological endpoint for each benchmark that was used in this step was provided in the ERA. For example, if a benchmark is based on a 25% reduction in growth to a lettuce plant, that information was presented.

- Canadian Soil Quality Guidelines (CCME, 1997).

- ORNL Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision (Efroymson, et al., 1997a).

- Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision (Efroymson, et al., 1997b).

Additional sources of toxicity data from the literature not included in the above documents were also used to evaluate potential risks to terrestrial vegetation and invertebrates from contaminants in the surface soil.

**Sediment:** In addition to the Step 3a factors presented above, additional evaluations for sediment included comparing the chemical concentrations in the sediment to higher effects levels to show the

probability of a range of possible effects. The higher effects levels that were used to further evaluate risks to benthic invertebrates were from the same sources listed in order of preference in the sediment subsection. The higher effects levels that are used in this step are defined in the chemical specific sections of this report.

**Surface Water:** In addition to the Step 3a factors presented above, additional evaluations for surface water may include comparing the chemical concentrations in the surface water to acute water quality standards/criteria to show a range of possible effects. More emphasis was placed on the dissolved metals concentrations (compared to total metals concentrations) because dissolved metals are a better indicator of potential bioavailability than are total recoverable metals.

### 8.6.1 Terrestrial Plants, Terrestrial and Aquatic Invertebrates, and Fish

Potential risks to terrestrial plants, terrestrial and aquatic invertebrates, and fish from exposure to COPCs were evaluated by comparing contaminant concentrations in surface soil, sediment, and surface water to alternate benchmarks that have been developed by various organizations. The following subsections discuss whether COPCs are retained for further evaluation for soil invertebrates and terrestrial vegetation (Section 8.6.1.1), benthic invertebrates (Section 8.6.1.2), and aquatic organisms (Section 8.6.1.3). COPCs based on risk to upper level receptors via the food-chain are discussed in Section 8.6.2.

#### 8.6.1.1 Soil

Table 8-1 presents a summary of some of the common alternate benchmarks that were used in refining the list of COPCs in surface soil, along with a summary of the Step 3a evaluation. The toxicological basis of the alternate benchmarks is presented below. As presented in Table 4-20, 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, antimony, arsenic, cobalt, manganese, selenium, thallium, 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.

Dioxins

Several dioxins were initially selected as COPCs because concentrations exceeded EDQLs or EDQLs were not available. 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). Maximum TEQ values at SWMU 03 were 7.5 ng/kg (birds) and 7.4 ng/kg (mammals) (Table 4-20). All concentrations of individual and total dioxins were much less than the no observed effects concentration (NOEC) of 5 mg/kg reported in 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 (1993f), 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 aryl hydrocarbon (Ah) receptor, or a comparably sensitive receptor for dioxins USEPA (1993f). The Ah receptor is important because the dioxins need to bind to the receptor in order to cause toxicity. Also, 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. Because the Ah receptor has not been detected in plants, it is not likely plants at SMWU 03 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 8.6.2 of this ERA.

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 [considered the lowest observed effects concentration (LOEC)] but not in soil with 10 mg/kg TNT (considered the 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)

The maximum concentration of TNT (1,700 mg/kg) is one order of magnitude greater than the earthworm LOEC and two orders of magnitude greater than the plant value presented above. The maximum concentration was detected in sample 03SS240002, which was collected from the southern burn pit/area. TNT was detected in four of 48 samples at SMWU 03 and the second greatest concentration of TNT (510 mg/kg in sample 03SS220002) was the only other detection that was greater than the plant and invertebrate NOECs listed above. Both of these sample locations are in the southern burn pit/area along the fringe of the road (see Figure 5-1) where the habitat for plants and invertebrates is poor (see Figures 1-3 and 1-5 for site photographs). Based on the field sheets and boring logs, the surface soil sample (0 to 2 feet) from 03SS24 consisted of a clayey silt, sand, gravel (top 1.5 feet) and silty clay (bottom 0.5 foot), and trace ash, while the surface soil sample (0-2 feet) from 03SS22 consisted of sand and gravel (top 0.4 foot) and clay with trace silt and sand (bottom 1.6 feet) (see Appendix B). Ash and burnt materials/cinders were found in the subsurface soil immediately below the surface soil samples. Therefore, it is not likely that significant numbers of earthworms would inhabit this area because of the large amount of sand and gravel in the soil. Herbaceous plants are present along the road (see photographs g and h in Figure 1-3). Although the two greatest concentrations of TNT detected at SMWU 03 exceed the plant and invertebrate NOECs listed above, significant impacts to plants and invertebrates are not expected because the poor habitat would limit the numbers of receptors that would inhabit this area, especially earthworms. Therefore, although risks to plants and invertebrates from TNT in the soil are possible, the potential risks from TNT are not great enough to warrant retaining it as a COPC. For that reason, TNT is eliminated as a COPC for risks to plants and invertebrates. Although, TNT is not considered a bioaccumulative chemical, risks to wildlife are evaluated in Section 8.6.2.2 of this ERA to be conservative.

1,3,5-Trinitrobenzene

1,3,5-Trinitirobenzene was initially selected as a COPC because the maximum soil concentration (11 mg/kg) was greater than the EDQL of 0.38 mg/kg. Although the maximum soil concentration is two orders of magnitude greater than the EDQL, the EDQL is based on exposure to wildlife (meadow vole) and not risks to invertebrates and plants. No other alternate toxicity data for 1,3,5-trinitrobenzene were located. However, 1,3,5-trinitrobenzene was detected in only 3 of 48 samples (locations 03SS19, 03SS22, and 03SS24). As mentioned previously, two of these locations (03SS22 and 03SS24) offer no habitat for ecological receptors because the area is gravel-covered. Location 03SS19 is also located in the Jeep Trail and is also gravel-covered, providing poor habitat for ecological receptors. Although there

are uncertainties regarding what concentration would be toxic to invertebrates and plants, the low frequency of detection does not warrant retaining 1,3,5-trinitrobenzene as a COPC. Although, 1,3,5-trinitrobenzene is not considered a bioaccumulative chemical, risks to wildlife are evaluated in Section 8.6.2.2 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 to earthworms 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 seven of 48 samples collected at SMWU 03. The maximum concentration was detected in sample 03SS240002 (30 mg/kg), which is located in the southern burn pit/area. The maximum concentration of 2-ADNT is less than the benchmarks presented above so 2-ADNT is unlikely to impact plants or invertebrates at SMWU 03. Therefore, risks to plants and earthworms are acceptable and 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 wildlife are evaluated in Section 8.6.2.2 of this ERA to be conservative.

2-Nitrotoluene

2-Nitrotoluene was initially selected as a COPC because a Region 5 screening level is not available. All maximum concentrations of energetics were detected in the same sample (03SS24), excluding 2-nitrotoluene, which was detected only in sample 03SS330002 (48 samples were collected at SWMU 03) at a concentration of 0.28 mg/kg. As noted in the field data sheet for 03SS330002 (Appendix B-1), the sample is located in the road bed on the edge of the Jeep Trail and is covered with gravel, providing very little habitat for plants and soil invertebrates. Although uncertainties exist in evaluating risks to

invertebrates and plants because an alternate benchmark for these receptors could not be located, the poor habitat for plants and soil invertebrates at the location of the single 2-nitrotoluene detection does not warrant retaining 2-nitrotoluene as a COPC. Although, 2-nitrotoluene is not considered a bioaccumulative chemical, risks to wildlife are evaluated in Section 8.6.2.2 of this ERA to be conservative.

4-Amino-2,6-dinitrotoluene

4-Amino-2,6-dinitrotoluene (4-ADNT) was initially selected as a COPC because a Region 5 screening level is not available. 4-ADNT was detected in 7 of 48 samples collected with a maximum concentration of 15 mg/kg in sample 03SS240002. Although alternate benchmarks for 4-ADNT are not available, the frequency of detections and concentrations are similar to those of 2-ADNT. Concentrations of 4-ADNT in surface soils at SWMU 03 are not expected to cause risks to plants and invertebrates when using 2-ADNT alternate benchmarks as surrogates for 4-ADNT. Therefore, risks to plants and earthworms are acceptable and 4-ADNT is not retained as a COPC for risks to plants and invertebrates. Although, 4-ADNT is not considered a bioaccumulative chemical, risks to wildlife are evaluated in Section 8.6.2.2 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 alternate 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 9 of 47 samples collected at SMWU 03 with the maximum HMX concentration of 1,600 mg/kg detected in sample 03SS240002. 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 1,600 mg/kg could impacts invertebrates. However, this is not likely because as mentioned previously this location is poor habitat for earthworms due to the soil geology and ash/cinders in the subsurface and earthworms are not likely present at this location.

No toxicological data for plants could be located; however, the area of the maximum detection is not conducive to plants as discussed above for TNT. As indicated in the field sheets (Appendix B-1), soil at

this sample location is sandy with gravel and ash. The areas surrounding the burn pit/area are forested and well vegetated; therefore, it does not appear that plants are being adversely affected by concentrations of HMX at the site. Therefore, although risks to plants and invertebrates from HMX in the soil are possible, the potential risks from HMX are not great enough to warrant retaining it as a COPC. Although, HMX is not considered a bioaccumulative chemical, risks to piscivorous wildlife are evaluated in Section 8.6.2.2 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 alternate toxicity information for RDX was located:

- Plants – 100 mg/kg (Talmage et al., 1999)
- LOEC and NOEC for reproduction of earthworms exposed to RDX were 95 mg/kg and less than 95 mg/kg, respectively (Sunahara et al., 2001, based on a study from 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 six of 48 samples collected at SMWU 03. The maximum RDX concentration of 2,400 mg/kg was detected in sample 03SS240002. The LOEC for earthworm reproduction is based on the productivity of juveniles (total number of juveniles, biomass, and number of juveniles per hatched cocoon) being significantly reduced by RDX at 95 mg/kg in soil; the NOEC was listed as less than 95 mg/kg in the study (Robidoux et al., 2000).

As previously discussed, 03SS24 is the location of maximum concentrations of most energetics detected at SWMU 03. The next greatest detection (140 mg/kg) was at location 03SS22, which is approximately 35 feet west of location 03SS24. As indicated in the field sheets for location 03SS22, the soil profile is similar to that of 03SS24 which was located within the Burn pit/area. As previously discussed, these locations are poor habitat for earthworms and plants due to the soil geology and ash/cinders in the subsurface. The four other detected concentrations at SWMU 03 are less than the alternate benchmarks for plants and invertebrates. Therefore, although risks to plants and invertebrates are possible in the vicinity of the Burn pit/area, the potential risks from RDX are not great enough to warrant retaining it as a COPC. Risks to RDX are unlikely in other areas of SMWU 03. Although, RDX is not considered a bioaccumulative chemical, risks to piscivorous wildlife are evaluated in Section 8.6.2.2 of this ERA to be conservative.

Di-N-Butyl Phthalate

Di-n-butyl phthalate was initially selected as a COPC because the maximum soil concentration (4,500 µg/kg) exceeded the EDQL of 150 µg/kg. However, the EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates. Therefore, concentrations were compared to other available benchmarks to evaluate risks to plants and soil invertebrates:

- Oak Ridge National Laboratory (ORNL) Plant – 200,000 µg/kg (Efroymson et al., 1997a)

The ORNL plant value of 200,000 µg/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 200,000 µg/kg. The maximum di-n-butyl phthalate concentration (4,500 µg/kg) 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 200,000 µg/kg (Efroymson et al., 1997b) 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 1,064,000 µg/kg was the lowest toxic concentration of the three concentrations that reportedly caused toxicity. The ORNL earthworm value of 200,000 µg/kg for dimethylphthalate was obtained by dividing the LC50 (1,064,000 µg/kg) by a safety factor of 5 (Efroymson et al., 1997b). Although there are uncertainties in comparing the maximum di-n-butyl phthalate concentration to toxicity information available for dimethylphthalate, the maximum di-n-butyl phthalate concentration is two orders of magnitude less than the ORNL earthworm benchmark for dimethylphthalate and impacts to invertebrates are not likely. Overall, risk to plants and soil invertebrates from di-n-butyl phthalate in soil is acceptable and this compound is not retained as a COPC.

Naphthalene

Naphthalene was initially selected as a COPC because the maximum soil concentration (130 µg/kg) exceeded the EDQL of 99 µg/kg. The EDQL is based on risks to wildlife (i.e., the masked shrew) and not risks to plants and invertebrates; therefore, the concentrations were compared to the following alternate benchmark to evaluate risks to plants and invertebrates.

- Canadian Soil Quality Guideline (SQG) – 600 µg/kg (CCME, 1997)

The Canadian SQG for naphthalene of 600 µg/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.

Barium

Barium was initially selected as a COPC because the maximum soil concentration (2,040 mg/kg) exceeded the EDQL 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, concentrations were 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, Nov 2003)
- ORNL Plant – 500 mg/kg (Efroymson at al., 1997a)

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, 2003).

An Eco-SSL for plants was not generated because only one study was found that met the necessary evaluation criteria (U.S. EPA, 2003). The study was the same study referenced in Efroymson et al., (1997a), 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., 1997a). In another study cited in Efroymson et al., (1997a), 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.

Four of the 32 samples collected exceed the Eco-SSL for soil invertebrates (locations 03SS23, 03SS26, 03SS41, and 03SS48). These four samples were collected in the heavily vegetated forests surrounding the Jeep Trail (see Figure 1-3) and so it does not appear that vegetation at SMWU 03 is being adversely impacted from barium concentrations in the surface soil. The maximum barium concentration at location 03SS48 is greater than the soil invertebrate and plant benchmarks. This sample is nearest to samples 03SS47 and 03SS46, where barium concentrations were 112 mg/kg and 72.2 mg/kg, respectively. Therefore, elevated barium concentrations in the surface soil are isolated and not indicative of a site-wide problem. The average concentration of barium is 220 mg/kg which is less than the alternate benchmarks above. Therefore, although risks to plants and invertebrates from barium in the soil are possible in the vicinity of the former burn pit, impacts to populations of plants and invertebrates at SWMU 03 are acceptable. The potential risks from barium are not great enough to warrant retaining it as a COPC and barium is eliminated as a COPC for risks to plants and invertebrates.

Beryllium

Beryllium was initially selected as a COPC because the maximum soil concentration (1.4 mg/kg) exceeded the EDQL of 1.06 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, concentrations were compared to the following alternate benchmarks to further evaluate risks to plants and invertebrates:

- ORNL Plant – 10 mg/kg (Efroymson et al., 1997a)
- U.S. EPA Ecological Soil Screening Level (Eco-SSL) for soil invertebrates – 40 mg/kg (U.S. EPA, 2003)

The Eco-SSL for beryllium is the geometric mean of EC20 values based on reproduction as the ecological relevant endpoint reported for three test species. The ORNL Plant benchmark is the lowest of three values from a report of unspecified toxic effects on plants grown in soil with the addition of 10 mg/kg (Efroymson et al., 1997a).

The maximum concentration of 1.4 mg/kg is less than the ORNL Plant value and Eco-SSL for soil invertebrate benchmarks. Therefore risks to plants and invertebrates from beryllium are acceptable and beryllium is not retained as a COPC.

Cadmium

Cadmium was initially selected as a COPC because the maximum soil concentration (4.4 mg/kg) in sample 03SS24 exceeded the EDQL 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 concentrations were compared to the following alternate benchmarks to evaluate risks to plants and soil invertebrates:

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

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 Maximum Acceptable Toxicant Concentration (MATC) or Effects Concentration for 10 percent of the test population ($EC_{10}$) 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, 2003). 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, 2003).

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 8.6.2 of this ERA.

Chromium

Chromium was initially selected as a COPC because the maximum soil concentration (288 mg/kg at location 03SS27) exceeded the EDQL 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, 1999a)

As presented in the supporting document for the Canadian SQG for chromium (EC, 1999a), 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 6$^{th}$ 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 detailed 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 two greatest chromium detections (i.e., the maximum concentration and the next greatest concentration of 52.4 mg/kg at location 03SS28) are located in a small (approximately 30 feet by 60 feet), isolated depression (Figure 5-2). Concentrations in all other samples were considerably lower, with most concentrations in the range of 10 to 20 mg/kg. Significant migration of surface soils from the depression into other areas is unlikely.

The Canadian SQG is based on *total* chromium (for which soil samples at this site were analyzed). Chromium toxicity is due primarily to hexavalent chromium, and other forms of chromium are much less toxic (Eisler, 2000). It is unlikely that chromium in SWMU 03 soil is completely hexavalent chromium. Trivalent chromium is the predominant form of this metal in most soils and is not bioavailable (Eisler, 2000). With the exception of the maximum concentration, chromium concentrations in all surface soil samples were less than the Canadian benchmark for total chromium. In view of the above discussion, potential risk from chromium appears to be limited to an isolated depression and potential risks throughout the remainder of the site are acceptable. Therefore, chromium is not retained as a COPC for risks to plants and invertebrates. However, because chromium is a bioaccumulative chemical, risks to wildlife from chromium are evaluated in Section 8.6.2 of this ERA.

Copper

Copper was initially selected as a COPC because the maximum soil concentration (63.9 mg/kg) exceeded the EDQL of 2.96 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, concentrations were compared to the following alternate benchmark to evaluate risks to plants and invertebrates.

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

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., (1997b) 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., (1997b) shows that most of the studies cited in that document have NOECs that are greater than 60 mg/kg.

The maximum detected copper concentration is less than the ORNL benchmark for plants and is only slightly greater than the ORNL benchmark for earthworms and the Canadian SQG. Overall, risks to plants and soil invertebrates are acceptable and copper is not retained as a COPC. However, because copper is a bioaccumulative chemical, risks to wildlife from copper are evaluated in Section 8.6.2 of this ERA.

Iron

Iron was detected in all surface soil samples; it was initially selected as a COPC because an EDQL was not available. According to the narrative statement of the Eco-SSL for iron (U.S. EPA, November 2003), 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, November 2003). Soil samples at SMWU 03 were not analyzed for pH; however, a review of 48 samples collected across NSWC Crane indicates pH concentrations in the range of 5 to 8.5. Only one surface soil sample that was analyzed for pH at NSWC Crane had a concentration greater

than 8 S.U. Therefore, it is likely that pH of surface soils at SMWU 03 are within the 5 and 8 S.U. pH range that iron is not expected to cause toxicity.

A benchmark for soil invertebrates is not available for iron. The maximum concentration detected in SWMU 3 surface soils was 51,600 mg/kg (sample 03SS340002) and the average iron concentration in SMWU 03 surface soils was 23,437 mg/kg. The maximum concentration in background surface soils was 40,800 mg/kg with an average of 18,100 mg/kg; therefore, surface soil concentrations at SMWU 03 are relatively similar to background. Additionally, iron is generally considered a non-toxic chemical that is not typically bioavailable in the environment. Although the absence of toxicological benchmarks precludes a complete assessment of risks posed by iron, risks to plants and invertebrates are acceptable, and iron is not retained as a COPC.

Lead

Lead was initially selected as a COPC because the maximum soil concentration (10,200 mg/kg) exceeded the EDQL of 0.05 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 concentrations of lead were compared to the following alternate benchmarks to evaluate risks to these receptors.

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

The Eco-SSL for plants is the geometric mean of the MATC values for four test species under three different test conditions (pH of 4.0 to 6.3). The ecological endpoint for the derivation of the Eco-SSL for plants was growth.

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 concentration detected in sample 03SS240002 is greater than the Eco-SSLs presented above; however, concentrations in most surface soil samples were less than 30 mg/kg. As noted above for TNT, location 03SS24 is located in the southern burn pit/area along the fringe of the road (see Figure 5-1) where the habitat for plants and invertebrates is poor (see Figures 1-3 and 1-5 for site photographs). Based on the field sheets and boring logs, the surface soil sample consists of clayey-silt,

sand, gravel, and trace ash. The ash and burnt materials/cinders found in the subsurface soils of the burn pit/area and the large amount of clayey-silt, sand, and gravel are not likely supporting large earthworm populations. Herbaceous plants are present along the road (see photographs g and h in Figure 1-3). Lead concentrations in nearby surface soil samples were considerably lower at 11.3 mg/kg (03SS20), 16.2 mg/kg (03SS21), 27.6 mg/kg (03SS22), 16 mg/kg (03SS25), and 66 mg/kg (03SS26). (Appendix E, Table 5-1). These sample locations are within less than 60 feet of the elevated concentration location 03SS24. Overall, the data indicate that potential risk is primarily limited to the vicinity of sample 03SS24; however, significant risks to plants and invertebrates are not expected because the poor habitat would limit the numbers of receptors that would inhabit this area, especially earthworms. Therefore, although risks to plants and invertebrates from lead in the soil are possible, the potential risks from lead are not great enough to warrant retaining it as a COPC. For that reason, lead is eliminated as a COPC for risks to plants and invertebrates. Because lead is a bioaccumulative chemical, risks to wildlife from lead are evaluated in Section 8.6.2 of this ERA.

Mercury

Mercury was initially selected as a COPC because the maximum soil concentration (0.26 mg/kg) exceeded the EDQL of 0.073 mg/kg and was greater than background concentrations. The most recent soil EDQL (now referred to as ESLs) of 0.1 mg/kg is based on risks to earthworms. However, even though the derivation of the ESL is based on earthworms, the following alternate benchmark was used to further evaluate risks to plants and soil invertebrates:

- Canadian SQG – 12 mg/kg (CCME, 1997)

As presented in the supporting document for the Canadian SQG for mercury (EC, 1999b), the Canadian guideline of 12 mg/kg for mercury is based on the 25$^{th}$ percentile of effects and no effects data distribution for plants and invertebrates. The 25$^{th}$ percentile is the 6$^{th}$ 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 detected mercury concentration is less than the SQG; therefore risks to plants and soil invertebrates are acceptable. 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 are evaluated in Section 8.6.2 of this ERA.

Nickel

Nickel was initially selected as a COPC because the maximum soil concentration (32.6 mg/kg) exceeded the EDQL of 13.6 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 benchmark was used to evaluate risks to plants and soil invertebrates.

- Canadian SQG – 50 mg/kg (EC, 1999c)

The Canadian SQG for nickel (50 mg/kg) is the 25$^{th}$ percentile of effects and no effects data distribution for plants and invertebrates, which is the 8$^{th}$ of 31 data points and corresponds to an effect on the growth of onion. The maximum nickel concentration is less than the SQG. Therefore, risk to plants and soil invertebrates in surface soil are acceptable and nickel is not retained as a COPC. However, because nickel is a bioaccumulative chemical, risks to wildlife from nickel are evaluated in Section 8.6.2 of this ERA.

Zinc

Zinc was initially selected as a COPC because the maximum soil concentration (739 mg/kg) exceeded the EDQL 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.

The maximum zinc concentration (739 mg/kg) at location 03SS28 is located in the southeastern portion of a small (approximately 30 feet by 60 feet) isolated depression (Figure 5-2). The zinc concentration in

sample 03SS270002, located within the same depression, was 145 mg/kg. In addition to the maximum zinc detection, concentrations in three other samples were greater than the SQG. However, these concentrations only slightly exceeded the SQG (211 mg/kg at 03SS24, 230 mg/kg at 03SS41, and 211 mg/kg at 03SS45) and zinc concentrations in most other surface soil samples were in the range of 30 to 80 mg/kg (Appendix E, Table 5-1). Therefore it is not likely that significant impacts will occur to plants and invertebrates at locations with zinc concentrations slightly greater than the Canadian SQG. Overall, the data indicate that potential risk from exposure to zinc appears to be primarily limited to an isolated depression. Therefore, although risks to plants and invertebrates from zinc in the soil are possible, the potential risks from zinc are not great enough to warrant retaining it as a COPC. However, because zinc is a bioaccumulative chemical, risks to wildlife from zinc are evaluated in Section 8.6.2 of this ERA..

#### 8.6.1.2 Sediment

Indiana has not established SSLs for any contaminants, and the U.S. EPA has established SSLs for only a few contaminants. Therefore, other non-regulatory alternate benchmarks were used to evaluate the sediment data. Table 8-2 presents a summary of the common alternate benchmarks used in refining the list of COPCs, along with a summary of the Step 3a evaluation. The summary of upgradient sediment comparisons is presented in Appendix F. As presented in Table 4-21 and Table 4-22, 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 the upgradient sediment concentrations. For shallow sediment samples these included arsenic, beryllium, chromium, iron, manganese, mercury, nickel, selenium, silver, thallium and vanadium. For deep sediment samples these included arsenic, beryllium, chromium, iron, manganese, nickel, selenium, thallium, and vanadium. Any risks from these inorganic chemicals would be within background risks and not related to site activities. Background comparisons were not used as a COPC selection criterion for organics

As previously discussed, both shallow (0 to 6 inches) and deep (6 to 24 inches) sediment samples were collected. Benthic organisms are present primarily in the top six inches only and therefore, concentrations of chemicals detected in shallow sediment samples are better indicators of potential exposure to these ecological receptors than are concentrations in deep sediment samples. However, as a conservative measure, deep sediment samples are also evaluated because sediment dwelling organisms may be exposed to those concentrations during heavy rain events or in cases where sediment below six inches is disturbed.

Additionally, the presence of sediment dwelling organisms in some portions of LSC is unlikely. The intermittently dry portions are unsuitable habitat for sustaining benthic populations over any extended

period of time. In cases where habitat quality is questionable, the uncertainties are discussed below with consideration of potential risks from the COPCs in sediment. During a site visit in June 2004, the Navy and U.S. EPA inspected LSC. Portions upstream of spring C were noted as generally dry, except just above the bridge where a few small depressions with water a few square feet in size were noted. Various pieces of metal debris were observed in the stream channel, most of which likely originated from the ABG. The metal debris varied of melted pieces, small canisters, container tops, and appeared to consist of aluminum, lead, and/or copper. During the June 2004 site visit, it was observed that the creek becomes perennial downstream of the bridge (see Photo P3 on Figure 2) and especially downstream of Spring C, where the flow of water increases. Halfway downstream to the next bridge, it was noted that the substrate was rocky with gravel but very little sediment. There were a few deeper pools/runs in this portion of the creek that were several feet deep. Various aquatic insects were observed under rocks, and fish, crayfish, and frogs were present in the water; some of the fish were three to five inches long. Also, a few salamanders were observed under the rocks. Therefore, although not much habitat exists for aquatic receptors upstream of Spring C, LSC does support a variety of aquatic species downstream of Spring C.

Previous site visits and observations in which the stream bed of northern portions of LSC (Spring C to past the burn pit) were similar to that which was observed during the U.S. EPA visit in June 2004. As mentioned in section 8.2.1, aquatic habitats in areas surrounding the ABG, including the OJT, were characterized in detail in August and September 1995 as part of an ERA completed in February 1999 (TtNUS, 1999). Benthic macroinvertebrates were collected using a D-frame kick net and preserved using 70-percent isopropanol. At the Spring A pool, 71 individuals in seven taxa were observed. The EPT Index was calculated to be 0.429, which is indicative of a relatively unpolluted stream. At the Spring C pool, 81 individuals in eight taxa were observed. The EPT Index was 0.375, indicative of a relatively unpolluted stream. For a riffle in LSC adjoining the Spring C pool, 40 individuals in four taxa were observed, and the EPT Index was 0.500, which is also indicative of a relatively unpolluted stream. Based on these observations it does not appear that significant impacts to aquatic receptors in LSC have occurred.

Acenaphthene

Acenaphthene was initially selected as a COPC because the maximum detected shallow sediment concentration (25 µg/kg) exceeded the EDQL of 6.7 µg/kg. The EDQL is based on the Canadian interim sediment quality guideline (SQG) for acenaphthene and is the conservative screening value. The probable effects level (PEL) for acenaphthene is 88.9 µg/kg. The PEL represents the lower limit of the range of chemical concentrations that are usually or always associated with adverse biological effects. The maximum detected acenaphthene concentration is greater than the conservative screening value but

is less than the upper effects level. Concentrations that are greater than the SQG but less than the PEL are considered representative of a range where adverse biological effects are occasionally expected to occur. However, adverse effects to ecological receptors at LSC are not expected to occur for the following reasons. Acenaphthene was detected in only one of 15 shallow sediment samples and was not detected in deep sediment samples. The single detected concentration in shallow sediment samples was found at downstream location 03SD18, which is in the perennial portion of LSC. As noted earlier, significant impacts to aquatic receptors have not occurred in the perennial portion of LSC because fish, crayfish, frogs, and other aquatic receptors were observed there during a June 2004 site visit. Few other PAHs were detected in sediments, and concentrations of no other PAHs exceeded screening levels (see Tables 4-21 and 4-22). For these reasons, risks to sediment-dwelling biota from acenaphthene and other PAHs in sediment are acceptable and acenaphthene is not retained as a COPC.

Di-N-Butyl Phthalate

Di-n-butyl phthalate was initially selected as a COPC because the maximum shallow sediment concentration (590 µg/kg) and the maximum deep sediment concentration (880 µg/kg) exceeded the EDQL of 110.5 µg/kg. However, the new EDQL (now referred to as ESLs) is 1,114 µg/kg. The maximum sediment concentrations are less than the new ESL and risks to sediment dwelling invertebrates are acceptable. Therefore, di-n-butyl phthalate was not retained as a COPC in sediment.

Diphenylamine

Diphenylamine was initially selected as a COPC because the maximum detected shallow sediment concentration (420 µg/kg) exceeded the EDQL of 34.6 µg/kg. No alternative benchmarks pertaining to sediment-dwelling biota exposed to diphenylamine are available so other step 3a factors are considered in further evaluating risks to sediment dwelling invertebrates from diphenylamine.

Diphenylamine was detected in three of 15 shallow sediment samples, at 96 µg/kg in a sample within the ABG, at 100 µg/kg in a sample slightly downstream of the ABG, and its maximum concentration was in a sample near Spring C (Figure 5-7). It was not detected in deep sediment samples. The two samples by the ABG are in the portion of LSC that is dry except during rain events, so there is little possibility of significantly impacting the sediment-dwelling community in this area. There are sediment invertebrates at the location of the maximum detected concentration; however, significant impacts to aquatic receptors have not occurred in the perennial portion of LSC because fish, crayfish, frogs, and other aquatic receptors were observed there during a June 2004 site visit. Diphenylamine was also not detected in surface soil, subsurface soil, or groundwater samples at SWMU 03. Because the source of

contamination at SMWU 03 is wastes deposited and burned at the dumpsite and burning grounds (Figure 8-2), diphenylamine should be detected in the source area samples if its presence was related to site activities. For these reasons, site-related risks to sediment dwelling invertebrates are acceptable and diphenylamine is not retained as a COPC.

TNT

TNT was initially selected as a COPC in both shallow and deep sediment because a Region 5 screening level is not available. Based on a conference call between TtNUS, U.S. EPA Region 5, and the US Army Corps of Engineers (USACE) on October 6, 2004, Jeff Steevens from USACE indicated that NOECs and LOECs for nitroaromatic compounds were developed in a paper by Condor, et. al., (2004). The study calculated NOECs and LOECs for nitroaromatic compounds and in order to convert the values from nmol/kg to mg/kg, an average molecular weight of 200 was used. The average molecular weight was based on the approximate average molecular weights of TNT, ANTs, and DNTs of 227, 197, and 167, respectively. Based on this study, the NOEC, LC50, and LOEC for survival of 112, 184 and 304 nmol/g, respectively, converted to 22.4 mg/kg, 36.8 mg/kg, and 60.8 mg/kg, respectively.

The maximum concentration of TNT was 2.2 mg/kg detected in the deep sediment sample 03SD120612. The maximum concentration in shallow sediment samples was 0.69 mg/kg in sample 03SD110006. The maximum TNT concentrations are less than the NOEC, LC50, and LOEC values as developed by Condor et al. (2004). Additionally, the maximum concentrations were detected at locations in the portion of LSC that is dry except during heavy rain events, so there is little possibility of significantly impacting the sediment-dwelling community in this area. Therefore, risks to sediment dwelling invertebrates are acceptable and TNT is not retained as a COPC.

RDX

RDX was initially selected as a COPC in deep sediment because a Region 5 screening level is not available. Therefore, alternate toxicity information was located.

- Survival of *Chironomus tentans* was not statistically different from control samples at RDX concentrations as high as 711 mg/kg (Steevens et al., 2002).

The maximum concentration was detected in sample 03SD110612 at a concentration of 0.45 mg/kg which is three orders of magnitude less than the toxicological data reported in Steevens et al. (2002).

RDX was not detected in shallow sediment samples. Therefore, risks to sediment invertebrates from RDX are acceptable and RDX is not retained as a COPC in sediment.

HMX

HMX was initially selected as a COPC because a screening level is not available; therefore, the following toxicity information was located:

- Survival of *Chironomus tentans* was not statistically different from control samples at HMX concentrations as high as 146 mg/kg (Stéevens et al., 2002).

The maximum concentration of HMX (130 mg/kg) was detected in shallow sediment sample 03SD110006 and is less than the NOEC reported above for this compound The HMX concentration in the deep sediment sample collected from location 03SD11 was 19 mg/kg, which is less than the NOEC value for survival. Therefore, risks to aquatic receptors from HMX in the sediment are acceptable and HMX is not retained as a COPC in sediment.

2,4-Dinitrotoluene, 2-Amino-4,6-dinitrotoluene, and 4-Amino-2,6-dinitrotoluene

2,4 Dinitrotoluene (2,4-DNT) was initially selected as a COPC because the single detected concentration (1.1 mg/kg) in shallow sediment sample 03SD060006) exceeded the Region 5 EDQL (0.08 mg/kg). 2-amino-4,6-dinitrotoluene (2-ADNT) and 4-amino-2,6-dinitrotoluene (4-ADNT) were initially selected as COPCs because no Region 5 EDQLs are available for comparison. Based on a conference call between TtNUS, U.S. EPA Region 5, and the US Army Corps of Engineers (USACE) on October 6, 2004, Jeff Steevens from USACE indicated that NOECs and LOECs for nitroaromatic compounds were developed in a paper by Condor, et. al. (2004). The study calculated NOECs and LOECs for nitroaromatic compounds and in order to convert the values from nmol/kg to mg/kg, an average molecular weight of 200 was used. The average molecular weight was based on the approximate average molecular weights of TNT, ANTs, and DNTs of 227, 197, and 167, respectively. Based on this study, the NOEC, LC50, and LOEC for survival of 112, 184 and 304 nmol/g, respectively, converted to 22.4 mg/kg, 36.8 mg/kg, and 60.8 mg/kg, respectively. The maximum concentrations of 2,4-DNT (1.1 mg/kg in 03SD060006), 2-ADNT (0.73 mg/kg in 03SD110612), and 4-ADNT (0.4 mg/kg in 03SD120612) are less than the NOEC, LC50, and LOECs for TNT and these degradation products.

These degradation energetics of TNT were detected infrequently. 2,4-DNT was detected only once in 15 shallow sediment samples and not at all in deep sediment samples. 2-ADNT was detected in one of 15

shallow sediment samples and in two of 15 deep sediment samples. 4-ADNT was detected only once in 15 deep sediment samples and not at all in shallow sediment samples. With the low frequency of detections and apparent relatively low toxicity, risks to sediment dwelling invertebrates from 2,4-DNT, 2-ADNT, and 4-ADNT are acceptable. Therefore, these energetics are not retained as COPCs in sediment.

Methoxychlor

Methoxychlor was initially selected as a COPC because the maximum shallow sediment concentration (17 µg/kg) exceeded the EDQL of 3.59 µg/kg. Methoxychlor was not detected in deep sediments and was detected in only one of 15 shallow sediment samples. The revised Region 5 sediment EDQL (now referred to as ESL) of 13.6 µg/kg was developed using the same equilibrium partitioning method as the Ecotox Threshold of 19 µg/kg (U.S. EPA. 1996a) but with an improved water quality Tier II value. Based on the U.S. EPA's comment on the draft ERA, the Ecotox Threshold value of 19 µg/kg for methoxychlor was in effect when the work plan for this ERA was approved and the maximum concentration is less than 19 µg/kg. Methoxychlor does not need to be retained as a COPC for risks to sediment dwelling invertebrates. However, because methoxychlor is a bioaccumulative chemical, risks to wildlife from methoxychlor are evaluated in Section 8.6.2 of this ERA.

2,4-D (2,4-Dichlorophenoxyacetic acid)

2,4-D was initially selected as a COPC because the maximum shallow sediment concentration (20 µg/kg) and maximum deep sediment concentration (28 µg/kg) exceeded the EDQL of 5.79 µg/kg. However, the most recent EDQL (now referred to as ESL) is 1,273 µg/kg. The maximum sediment concentrations are less than the ESL and risks to sediment dwelling invertebrates are acceptable. For this reason, 2,4-D is not retained as a COPC. However, because 2,4-D is a bioaccumulative chemical, risks to wildlife from 2,4-D are evaluated in Section 8.6.2 of this ERA.

Aluminum

Aluminum was initially selected as a COPC because an EDQL was 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 concentration in deep sediment (56,900 mg/kg) is greater than the TEL; however, the location of the maximum deep sediment concentration (03SSD11) is typically dry and does not support

benthic organisms. All other concentrations in the deep sediment samples are less than the TEL. Additionally, the maximum aluminum concentration in shallow sediment (23,200 mg/kg) is less than the TEL. Because aluminum was only detected in one sample at a concentration greater than the TEL and because that sample was located in an area where benthic organisms are not expected to be present, risks to sediment-dwelling biota are acceptable and aluminum is not retained as a COPC.

Antimony

Antimony was initially selected as a COPC because an EDQL was not available. The alternate benchmark selected for antimony is the Effects Range Low (ER-L) of 2 mg/kg (Long and Morgan, 1991). The Effects Range Median (ER-M) for antimony is 25 mg/kg. The maximum detected concentration (7.6 mg/kg in shallow samples) exceeds the conservative ER-L but is less than the ER-M. As noted in Long et al. (1995), concentrations greater than the ER-L but less than the ER-M represent the range within which effects "would occasionally occur".

Antimony was detected in 8 of 15 shallow sediment samples. Of these, concentrations in shallow sediment samples exceeded the ER-L at four locations (03SD05, 03SD11, 03SD13, and 03SD15). Sample location 03SD05 is located within the northern boundaries of the ABG where aquatic habitat is minimal. Locations 03SD11 and 03SD13 are located north of Spring C where permanent aquatic habitat is absent. Location 03SD15 was collected south of Spring C, the perennial portion of LSC. Antimony was not detected in deep sediments collected south of Spring C where permanent aquatic habitat exists. Additionally, antimony was eliminated as a COPC in surface soils at SMWU 03 due to background. Therefore, although antimony may be present at a concentration causing potential risks at one location in the perennial portion of LSC, it does not appear that antimony is related to site activities. Therefore, risks to sediment-dwelling biota from antimony in sediment are acceptable and antimony is not retained as a COPC.

Barium

Barium was initially selected as a COPC because an EDQL was not available. 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.

The maximum concentration in shallow sediment (853 mg/kg) was detected at location 03SD05, which is located in LSC slightly within the northern boundary of the ABG (Figure 5-7). Thus, this concentration is not believed to be related to OJT activities rather an indication of ABG contamination. Barium concentrations in shallow and deep sediments were elevated at the first three sampling locations downstream of the ABG (samples 03SD10, 03SD11, and 03SD12), with the maximum deep sediment concentration in sample 03SD11 (981 mg/kg). Barium concentrations were lower in samples farther downstream, but exceeded background sediment concentrations. As noted in Section 8.2.5.1, barium was elevated in surface soil sample 03SS48 and relatively high levels were detected in samples 03SB23 and 03SB26 (see Figure 5-2). Soil sample 03SS48 is approximately 50 feet from the creek but is downgradient from sediment samples 03SD10 and 03SD11. Thus, the elevated sediment concentrations in these two samples are not the result of migration from the vicinity of soil sample 03SS48. In summary, the spatial distribution of barium concentrations in sediments is somewhat perplexing, with low concentrations in background sediments, a high concentration in one ABG sample (03SD05), low to moderately high in other ABG samples, and sporadically high concentrations in LSC downstream of the ABG and OJT.

The paucity of toxicity data inhibits a complete evaluation of risks posed by barium. However, barium is a common element in sediments and it is not generally associated with significant toxicity (ATSDR, 1997). The data appear to indicate that barium concentrations in LSC may be related to former activities along the OJT, as well as a source or sources within the ABG. As previously noted, portions of LSC upgradient of Spring C (03SD15) are typically dry except during heavy rain events and significant impacts to sediment invertebrates are not expected because the poor habitat would limit the number of receptors that would inhabit this area. The portions of LSC downgradient of Spring C are perennial and currently support aquatic invertebrates as was observed during the June 2004 site visit. Therefore, it does not appear that aquatic receptors are being adversely impacted in the perennial portion of LSC. Although risks to sediment invertebrates from barium in the sediment are possible, the potential risks from barium are not great enough to warrant retaining it as a COPC. For that reason, barium is eliminated as a COPC for risks to sediment invertebrates.

Cadmium

Cadmium was initially selected as a COPC because the maximum shallow sediment concentration (3.5 mg/kg) and the maximum deep sediment concentration (4 mg/kg) exceeded the EDQL of 0.596 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 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 consensus-based TEC is the geometric mean of the threshold effect level (TEL; Smith et al., 1996), effect range low value (ERL; 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 1997e) 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 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 cadmium concentrations are greater than the TEC but less than the PEC. Concentrations in most downstream samples (03SD15 - 03SD19) where permanent aquatic habitat exists are less than the TEC or only slightly exceed the TEC (0.37 mg/kg – 2 mg/kg). As noted previously, it does not appear that aquatic receptors are being adversely impacted in the downstream area because an abundance of aquatic life was observed during the June 2004 site visit. Therefore, although risks to sediment invertebrates from cadmium in the sediment are possible, the potential risks from cadmium are not great enough to warrant retaining it as a COPC. For that reason cadmium is eliminated as a COPC for risks to sediment invertebrates. However, because cadmium is a bioaccumulative chemical, risks to wildlife from cadmium are evaluated in Section 8.6.2 of this ERA.

Copper

Copper was initially selected as a COPC because the maximum shallow sediment concentration (198 mg/kg) and the maximum deep sediment concentration (273 mg/kg) exceeded the EDQL of 16 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 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 concentrations are greater than the less conservative PEC value. As mentioned previously, the PEC is the level above which harmful effects on sediment dwelling organisms are expected to frequently occur (MacDonald, et al., 2000). The maximum copper concentration in shallow sediment samples was detected at location 03SD15, which is the nearest sample downstream from Spring C. The copper concentration (43.7 mg/kg) detected at location 03SD16 also exceeds the TEC but is less than the PEC. Copper concentrations in locations further downstream of 03SD16 were less than the TEC. Although copper was detected in sediment samples collected from areas north of Spring C, these portions of LSC are only wet during heavy rain events and significant impacts to plants and invertebrates are not expected because the poor habitat would limit the numbers of receptors that would inhabit this area. It does not appear, however, that copper is causing unacceptable risks in other areas of LSC. As noted previously, it does not appear that aquatic receptors are being adversely impacted in the downstream area because an abundance of aquatic life was observed during the June 2004 site visit. Therefore, although risks to sediment invertebrates from copper in the sediment are possible, the potential risks from copper are not great enough to warrant retaining it as a COPC. For that reason copper is eliminated as a COPC for risks to sediment invertebrates. However, because copper is a bioaccumulative chemical, risks to wildlife from copper are evaluated in Section 8.6.2 of this ERA.

Lead

Lead was initially selected as a COPC because the maximum shallow sediment concentration (653 mg/kg) and deep concentration (445 mg/kg) exceeded the EDQL of 31 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 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 concentration of 653 mg/kg was detected at location 03SD06 and exceeds the TEC and PEC. Location 03SD06 is upgradient of the OJT and within the ABG. Lead concentrations were also elevated at locations 03SD05 (204 mg/kg) and 03SD07 (215 mg/kg), which are also located within the ABG, as well as at locations 03SD10 and 03SD11, slightly downstream of the ABG (Figure 5-8). Sample 03SD110006 is located in the portion of LSC near the burn pit which also had high lead concentrations. Therefore, the source of lead at 03SD11 may be the burn pit or associated activities at the OJT. Lead concentrations in almost all background samples (upgradient of the ABG) were less than the EDQL. The low concentrations in background samples and elevated concentrations in samples within and slightly downstream of the ABG and OJT indicate that potential risks from lead are potentially related to activities

associated with the ABG and OJT. The areas of elevated lead concentrations are located primarily in the intermittent portions of LSC that are typically dry except during heavy rain events and do not sustain benthic populations. Therefore, potential risk posed by lead in sediment exists in some areas of the LSC channel, but appears to be minor in most portions of downstream areas where permanent aquatic habitat exists. Therefore, although risks to sediment invertebrates from lead in the soil are possible, the potential risks from lead are not great enough to warrant retaining it as a COPC. Because lead is a bioaccumulative chemical, risks to wildlife from lead are evaluated in Section 8.6.2 of this ERA.

Tin

Tin was initially selected as a COPC because an EDQL was not available. Alternative benchmarks pertaining to sediment-dwelling biota exposed to tin are also not available. The maximum detected tin concentration was 13.8 mg/kg in sample 03SD120006. Tin was detected in only two of 15 shallow sediment samples and three of 15 deep sediment samples in the intermittent portions of LSC. Tin was not detected in the perennial portion of LSC where permanent aquatic habitat exists. Additionally, tin was not detected in surface soil samples indicating the occurrence of tin in sediment samples is not related to site activities at SWMU 03. The evaluation of tin is limited by the lack of benchmarks. However, its relatively infrequent detections in areas of LSC that do not support permanent aquatic habitat suggest a low exposure and low potential for toxicity to sediment-dwelling biota; therefore tin is not retained as a COPC.

Zinc

Zinc was initially selected as a COPC because the maximum shallow sediment concentration (385 mg/kg) and deep sediment concentration (1,120 mg/kg) exceeded the EDQL of 120 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)

Zinc concentrations exceed the TEC in 10 shallow sediment samples and eight deep sediment samples. Additionally, the maximum concentration in deep samples is greater than the PEC. Concentrations exceeded the TEC in 2 of 5 shallow samples within the ABG (03SD07 at 194 mg/kg and 03SD05 at 206 mg/kg). Concentrations were also elevated relative to the TEC in the first three samples downstream of the ABG (Figure 5-8), including the maximum concentration of 1,120 mg/kg in 03SD11. Location

03SD11 was located in LSC adjacent to the burn pit at OJT, but zinc concentrations in the adjacent surface soil samples were much lower than 1,120 mg/kg (see Figure 5-2). The maximum concentration in the shallow sediment samples of 385 mg/kg was in sample 03SD160006, located in LSC between Spring A and Spring C. Concentrations were less than the TEC in samples 03SD190612 (113 mg/kg), the furthest downstream sample, and in 03SD170612 (50.1 mg/kg), approximately 1,500 feet upstream of sample 03SD190612. Concentrations only slightly exceeded the TEC at location 03SD18, which is midway between these two samples. It is difficult to determine from the distribution of elevated concentrations whether or not zinc in LSC is related to former burning and/or dumping at the OJT site or is due to a source within the ABG. The presence of elevated zinc concentrations in two samples collected within the ABG, in one sample upgradient of the ABG and in one sample adjacent to the OJT suggests, however, that there may be multiple sources of zinc including a source or sources of zinc upstream of the OJT site. However, as previously noted, portions of LSC upgradient of Spring C (03SD15) are typically dry except during heavy rain events and significant impacts to sediment invertebrates are not expected for these segments of LSC because the poor habitat would limit the number of receptors that would inhabit this area. The portions of LSC downgradient of Spring C are perennial and currently support abundant aquatic invertebrates as was observed during the June 2004 site visit. Therefore, it does not appear that aquatic receptors are being adversely impacted in the perennial portion of LSC. Although risks to sediment invertebrates from zinc in the sediment are possible, the potential risks from zinc are not great enough to warrant retaining it as a COPC. For that reason, zinc is eliminated as a COPC for risks to sediment invertebrates. Because zinc is a bioaccumulative chemical, risks to wildlife from zinc are evaluated in Section 8.6.2 of this ERA.

#### 8.6.1.3 Surface Water

Table 8-3 presents a summary of some of the common alternate benchmarks that were used in refining the list of COPCs in low-flow and high-flow surface water samples, along with a Step 3a evaluation. The summary of upgradient surface water comparisons is presented in Appendix F. As presented in Table 4-23 and Table 4-24, 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 the upgradient surface water concentrations. Aluminum, iron, and manganese were eliminated as COPCs in total low-flow and high-flow surface water samples because site concentrations did not exceed background concentrations. Aluminum and manganese were also eliminated as COPCs in dissolved low-flow and high-flow surface water samples because site concentrations did not exceed background concentrations. Risks from these chemicals were not evaluated in the ERA, however, any risks would be within background risks and not related to site activities.

Water-quality standards (WQS) for surface water have been developed for Indiana (IDEM, 1998). In addition, U.S. EPA has established AWQC for several contaminants (U.S. EPA, 2002c). The Indiana WQS are based on the U.S. EPA AWQCs, which were updated after the IDEM values were promulgated. Therefore, the updated AWQCs are more appropriate to use in evaluating the surface water data. Other, non-regulatory surface water screening values were also used to evaluate the data, when necessary. Both the acute and chronic SWSLs were used to evaluate the COPCs to determine potential impacts in a lines-of-evidence approach. The following sections discuss these values, as appropriate.

As mentioned previously, some portions of LSC are dry (in particular, the portion of LSC between the ABG boundaries and Spring C) except during heavy rain events and in fact, water samples were not available for collection during low flow conditions of several locations. Therefore, these portions of LSC do not support populations of any aquatic organisms. The perennial portions of the southern limits of LSC at SWMU 03 begin with the discharge of Spring C. Surface water concentrations at locations beginning at 03SW15 and downstream are better indicators of potential exposure to aquatic receptors than are concentrations in samples collected in northern portions of LSC. Although a formal hydrologic study has not been conducted, LSC, between ABG and Spring C, is estimated to be wet approximately 10 to 15 times a year during significant rain events. LSC typically only remains wet for a few days following the rain event, depending upon the amount of rain that is received.

Bromomethane

Bromomethane was initially selected as a COPC in surface water because a SWSL was not available; however, the most recent ESL for bromomethane is 16 µg/L. Bromomethane was detected in three low-flow samples with a maximum concentration of 1.6 µg/L in sample 03SW1701. Bromomethane was not detected in high-flow samples. The maximum concentration of bromomethane is less than the new ESL and so risks to aquatic invertebrates are acceptable. Therefore, bromomethane is not retained as a COPC for risks to aquatic organisms in LSC.

Bis(2-ethylhexyl) phthalate

Bis(2-ethylhexyl) phthalate was initially selected as a COPC because the maximum concentration (6 µg/l) exceeded the EDQL (2.1 µg/L). Bis (2-ethylhexyl) phthalate was detected in two of 11 high-flow samples; both detections only slightly exceeded the SWSL. These two detections in high flow samples were at locations 03SW09 and 03SW14 which are in the intermittent portions of LSC north of Spring C. In fact, these two locations were dry when low-flow samples were collected in June 2001 (see Appendix

B-5.1) and surface water was not available for sample collection. Bis (2-ethylhexhl) phthalate was not detected in any samples collected during the low flow conditions. Therefore, the lack of permanent aquatic habitat at locations where bis (2-ethylhexyl) phthalate was detected during the high flow conditions indicates that aquatic invertebrates at these locations are likely absent and risks to aquatic receptors in LSC are acceptable. Therefore, bis (2-ethylhexyl) phthalate is not retained as a COPC for risks to aquatic receptors in LSC.

Energetics

Six energetics (2,4,6-TNT, 2-ADNT, 4-ADNT, HMX, RDX, and nitrocellulose) were detected in low-flow and/or high-flow surface water samples and were retained as COPCs because EDQLs are not available. However, their relatively low concentrations (many at less than parts-per-billion concentrations) suggest negligible or minimal risk.

The alternate benchmark selected for TNT is the chronic water quality criterion of 90 µg/L (Talmage et al., 1999). TNT was detected in one of six low-flow samples collected and not in any high-flow samples. The single detected concentration of 0.56 µg/L at location 03SW17 is less than the chronic water quality criterion and so risks to aquatic invertebrates are acceptable.

A chronic AWQC for 2-ADNT is not available; however, the secondary chronic value (SCV) for 2-ADNT is 20 µg/L (Talmage et al., 1999). 2-ADNT was detected in two of six low-flow samples and one of 11 high flow samples. The maximum 2-ADNT surface water concentration was detected in the high flow sample collected at location 03SW17 with a concentration of 1.5 µg/L. All detected concentrations in SWMU 03 surface waters are less than the SCV and so risks to aquatic invertebrates are acceptable.

Water quality criteria for 4-ADNT is not available. However, the maximum concentration of 2.9 µg/L is less than the 2-ADNT SCV of 20 µg/L, using 2-ADNT as a surrogate.

Insufficient data were available for the development of a chronic water quality criterion for HMX; however, an SCV is available. The SCV for HMX is 330 µg/L (Talmage et al, 1999). The maximum HMX concentration (90 µg/L) was detected in high flow samples at location 03SW09, which is less than the SCV. Therefore, risks to aquatic invertebrates are acceptable.

Insufficient data were also available for the development of a chronic water quality criterion for RDX; however, an SCV is also available. The SCV for RDX is 190 µg/L (Talmage et al, 1999). The maximum

RDX concentration (63 µg/L) was detected in high flow samples at location 03SW17 and is less than the SCV. Therefore, risks to aquatic invertebrates are acceptable.

Available toxicological information for nitrocellulose was located in the Pesticide Action Network (PAN) Pesticides Database (www.pesticideinfo.org). The PAN database is a collection of current regulatory and toxicological information for pesticides. The PAN database for nitrocellulose consists of a compilation of toxicology studies on aquatic organisms from a variety of science journals. Mean toxic doses to aquatic organisms ranged from 10,000 µg/L to 1,000,000 µg/L nitrocellulose. The 10,000 µg/L concentration is derived from a study based on blue-green algae where no biochemical response was observed after 96 hours. Other organisms included in the PAN database include crustaceans (sowbug), fish (catfish, bluegill, and minnow), other phytoplankton, and zooplankton (water flea and scud). Nitrocellulose was detected in only one high flow sample and not at all in low flow samples. The single detected concentration (3,200 µg/L) at location 03SW15 is less than the NOEC reported in the PAN database.

Based on a comparison of water concentrations to the available toxicological information in the literature, risks to aquatic invertebrates appear acceptable. No energetics are retained as COPCs in surface water.

2,4-D

2,4-D was the only herbicide COPC in surface water, and a SWSL was not available for this compound. The new EDQL (now called ESLs) for 2,4-D is 220 µg/L. The maximum concentration of 0.36 µg/L in sample 03SW0902 is less than the new ESL. Therefore, risks to aquatic receptors are acceptable and 2,4-D is not retained as a COPC in surface water.

Cadmium and Zinc

Cadmium and zinc were initially selected as COPCs in unfiltered high-flow samples, but not in low-flow samples. Neither of these metals were COPCs in filtered surface water, since their concentrations in filtered samples were below SWSLs and/or below background values. These metals are not expected to pose significant risks to aquatic organisms because only dissolved (i.e., filtered) metal concentrations are considered to be bioavailable (U.S. EPA, 1992c). For these reasons, cadmium and zinc are not retained as COPCs in surface water.

Copper

Copper was initially selected as a COPC in unfiltered, high-flow surface water because the maximum concentration (18.4 µg/L) was greater than the EDQL. The maximum concentration in filtered sample

03SW0902-F (7.6 µg/L) is below the chronic AWQC of 9.0 µg/L for copper (U.S. EPA, 2002c). Therefore, risks to aquatic organisms are acceptable because only the dissolved (i.e., filtered) metal concentrations are considered to be bioavailable (U.S. EPA, 1992c). In addition, sample 03SW0902 is located north of the ABG. in a dry stream bed under low-flow conditions. For these reasons, risks to aquatic life from copper in the surface water are acceptable and copper is not retained as a COPC.

Iron

Iron was initially selected as a COPC in filtered, low-flow surface water. Iron concentrations in unfiltered high-flow and low-flow, and filtered high-flow samples were less than the corresponding background concentrations. Its concentrations in filtered samples exceeded background filtered concentrations, and since an EDQL was not available, iron was initially selected as a COPC in surface water. However, the maximum iron concentration (154 µg/L) in filtered, low-flow surface water samples is less than the 1,000 µg/L AWQC for iron (U.S. EPA, 2002c); therefore, risks to aquatic organisms from iron are acceptable and iron is not retained as a COPC in surface water.

Lead

Lead was initially selected as a COPC in unfiltered, high-flow and low-flow surface water. The maximum lead concentrations were 285 µg/L in unfiltered, high-flow samples and 20 µg/L in unfiltered, low-flow samples. The maximum concentration of lead in the filtered, high-flow samples (22.6 µg/L), considered to be most indicative of bioavailability (U.S. EPA, 1992c), exceeds the chronic AWQC of 2.5 µg/L for lead (U.S. EPA, 2002c). However, sample 03SW1102 was collected under high-flow conditions in an area of LSC that does not support aquatic life under low-flow conditions. In addition, downstream samples (in areas providing sufficient habitat for aquatic receptors) were collected on the same day and have concentrations of 1.1 µg/L and less. Downstream sample concentrations are below the chronic AWQC and for these reasons, risks to aquatic receptors are acceptable. Lead is not retained as a COPC.

### 8.6.2 Terrestrial Food-chain Modeling

The discussion in Section 8.6.1 was not designed to evaluate risks to wildlife through ingestion of food items, drinking water, and incidental ingestion of soil and sediment. Instead, a food-chain model was used to evaluate potential risks posed by COPCs to upper-level terrestrial wildlife receptors. Section 8.6.2.1 describes the food-chain model methodology, while Section 8.6.2 2 presents and discusses the results of the food-chain modeling. Chemicals evaluated in the terrestrial food-chain model were limited to those identified by the U.S. EPA as bioaccumulative (U.S. EPA, 2000a). The primary reason for including only bioaccumulative chemicals in the food chain model is based on the assumption that

although wildlife can be exposed to chemicals that do not accumulate in food items (i.e., plants, invertebrates), via direct ingestion of the media (i.e., soil), the exposure of the animal consuming that chemical will be low if the chemical is not accumulating in the food item.

#### 8.6.2.1 Methodology

Chemicals evaluated in the terrestrial food-chain model were limited to those identified by U.S. EPA as bioaccumulative (U.S. EPA, 2000a). Risks to terrestrial receptors from bioaccumulative COPCs in soil, sediment, and surface water were evaluated by estimating the chronic daily intake (CDI) and comparing the CDI to toxicity reference values (TRVs) representing acceptable daily doses in mg/kg/day. The TRVs were developed from NOAELs and lowest-observed-adverse-effect-levels (LOAELs) obtained from wildlife studies. The majority of the TRVs were obtained from the ORNL Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al., 1996). Appendix H.3 presents the TRVs that are used in this report and the derivation of the TRVs using the body-weight scaling equation presented below. The appendix also presents the ecological endpoints for the TRVs.

For avian species, the NOAEL (or LOAEL) for the test species is used as the NOAEL (or LOAEL) for the representative species in accordance with Sample et al. (1996). For mammalian species, the NOAEL (or LOAEL) from the test species is adjusted to a NOAEL (or LOAEL) for the representative species using the following body-weight scaling equation from Sample et al. (1996).

$$NOAELw = NOAELt*(bwt/bww)$$

Where:

NOAELw = no-observed-adverse-effect-level for the representative wildlife species
NOAELt = no-observed-adverse-effect-level for the test species
bwt = body weight of the test species
bww = body weight of the representative wildlife species

Note that based on more recent publications [Sample, B. and C. Arenal 1999, Allometric Models for Interspecies Extrapolation of Wildlife Toxicity Data (Bull Environ Contam Toxicol 62: 653-663)], U.S. EPA Region 5 indicated that the use of the metabolic scaling factor may not be appropriate for toxicity/body weight extrapolation factors. Therefore, U.S. EPA recommended that the toxicity/body weight equation be performed without the use of the scaling factor of 0.25 The body-weight scaling was performed because studies have shown that, for mammals, numerous physiological functions such as metabolic

rate, as well as responses to toxic chemicals, are a function of body size (Sample et al., 1996). However, Sample et al. (1996) indicated that physiological scaling factors may not be appropriate for birds. Therefore, a scaling factor of 1.0 is used for birds in this SERA. Table H.3-1 in Appendix H.3 presents the body weights that were used for the representative species and test species.

When a sub-chronic study was used to develop the TRV, the final value was multiplied by a factor of 0.1 to account for uncertainty between sub-chronic and chronic effects. When an LOAEL study was used to develop the NOAEL TRV, the LOAEL was multiplied by a factor of 0.1 to estimate the NOAEL.

Total exposure of the terrestrial receptors to COPCs in soil, surface water, and sediment was determined through food-chain modeling by estimating the daily doses in mg/kg/day using exposure equations. The contaminant concentrations in the surface soil, sediment, and surface water are used to calculate the CDI doses. The following equation presents the food chain model that is used for the surrogate species that are selected for modeling:

$$\text{CDI Dose (mg/kg/day)} = \frac{(FI * FC) + (WI * C_{Sw}) + (SI * C_{Ss} \text{ or } C_{Sd})}{BW}$$

Where: CDI = Chronic daily intake (mg/kg/day)
FI = Food ingestion rate (kg/day)
FC = Food concentration (mg/kg)
WI = Surface water ingestion rate (L/day)
$C_{Sw}$ = Contaminant concentration in surface water (mg/L)
BW = Body weight (kg)
SI = Incidental soil or sediment ingestion rate (kg/day)
$C_{Ss}$ = Contaminant concentration in surface soil (mg/kg)
$C_{Sd}$ = Contaminant concentration in sediment (mg/kg)

For inorganic constituents in surface soil and sediment, as well as organic constituents in surface soil, the contaminant concentration of the prey items (i.e., earthworms, fish) is calculated using the following equation:

$$FC = C_{Ss} \text{ or } C_{Sd} * BAF$$

Where: FC = Contaminant concentration in food (mg/kg)
$C_{Ss}$ = Contaminant concentration in soil (mg/kg)

$C_{Sd}$ = Contaminant concentration in sediment (mg/kg)
BAF = Bioaccumulation Factor (chemical-specific)

For organic constituents in the sediment, the contaminant concentration of the prey items is calculated using the following equation:

$$FC = \frac{C_{Sd} * \%L * BSAF}{\%TOC}$$

Where: FC = Contaminant concentration in food (mg/kg)
$C_{Sd}$ = Contaminant concentration in sediment (mg/kg)
%L = Percentage of lipids in fish [3.6% = the average of various species of sunfish. Appendix H.4 presents the calculation used to derive this value (U.S. EPA, 1997e)]
BSAF = Biota-Sediment Accumulation Factor (chemical-specific)
%TOC = Percentage of total organic carbon in sediment (site-specific)

The average TOC in deep and shallow sediment samples at SWMU 03 was 0.9483 percent (0.009483). The lipid content used in the equation was 3.6 percent (0.036), and is the average of lipid contents in six species of fish native to Indiana and expected to occur in LSC (see Appendix H.4).

Contaminant concentrations in food items were calculated using BAFs and BSAFs from published sources. The following sources of BAFs and BSAFs were used in the SERA:

- Plant BAFs (Organics): Toxicity and Chemical-Specific Factors Database (ORNL, 2002).
- Plant BAFs (Inorganics): Empirical Model for the Uptake of Inorganic Chemicals from Soil by Plants (ORNL, 1998a).
- Soil Invertebrate BAFs: Development and Validation of Bioaccumulation Models for Earthworms (Sample et al., 1998).
- BSAFs (Inorganics): Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation (ORNL, 1998b).
- BSAFs (Organics) The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Volume 1: National Sediment Quality Survey (U.S. EPA, 1997e).

Table H.1-1 in Appendix H.1 presents chemical specific BAFs and BSAFs that were used in this SERA. A default value of 1.0 was used for the BAF or BSAF if chemical-specific data were not available in the above sources. Because sediment-to-fish BSAFs were not available for inorganic chemicals, sediment-to-aquatic invertebrate BSAFs from ORNL (1998b) were used to estimate tissue concentrations of inorganic chemicals in food items of the raccoon and belted kingfisher.

Some of the BAFs and BSAFs presented in the above sources estimate the tissue concentrations in dry weight. These values were converted to wet weight for use in exposure estimation in the food-chain models by multiplying the BAF or BSAF by the average proportion of dry matter content of the organism (Sample et al., 1997). The following table presents the proportion of dry matter that was used to adjust the BAFs and BSAFs to wet weight values (Sample et al., 1997). Sediment-to-fish BSAFs taken from U.S. EPA (1997e) were wet weight values and thus, adjustments were not necessary for sediment-to-fish BSAFs.

| Food Type | Percent Dry Weight |
|---|---|
| Terrestrial Invertebrates (earthworms) | 16 |
| Terrestrial Plants (monocots-young grass) | 30 |
| Aquatic/benthic invertebrates | 29 |

Two food-chain model scenarios were used for each species. The first scenario was very conservative, and used the following assumptions:

- 95% UCL soil, surface water, or sediment concentration;
- 90$^{th}$ percentile BAFs and BSAFs;
- Conservative receptor body weight;
- Conservative receptor ingestion rate [The food ingestion rates are presented as gram of food or water per gram of body weight per day (g/g-day) in U.S. EPA, (1993e). The highest ingestion rate was multiplied by the highest body weight to obtain the maximum daily ingestion rate]; and
- Receptors spend 100% of their time at the site.

The second scenario was considered more representative of conditions at SWMU 03 and used the following assumptions:

- Average soil, surface water, or sediment concentration.

- Median BAFs and BSAFs.

- Average receptor body weight.

- Average receptor ingestion rate [The food ingestion rates are presented as g/g-day in U.S. EPA (1993e). The average ingestion rate was multiplied by the average body weight to obtain the average daily ingestion rate].

- Receptors spend 100% of their time at the site. The EEQs reflect this assumption, however, receptors' home ranges were qualitatively taken into account in Section 8.6.2.2.

The exposure assumptions (i.e., ingestion rate, body weight) were obtained primarily from the Wildlife Exposure Factors Handbook (U.S. EPA, 1993e); other sources were used when necessary and are presented in Table 8-4.

Four terrestrial wildlife EEQs were calculated in the SERA to present a range of potential risk:

- $NOAEL_{max}$: EEQ using maximum exposure assumptions and NOAEL
- $LOAEL_{max}$: EEQ using maximum exposure assumptions and LOAEL
- $NOAEL_{avg}$: EEQ using average exposure assumptions and NOAEL
- $LOAEL_{avg}$: EEQ using average exposure assumptions and LOAEL.

The $NOAEL_{max}$ is considered the most conservative because it is based on conservative assumptions and NOAEL toxicity values. The $LOAEL_{avg}$ is considered the least conservative because it is based on less conservative assumptions (i.e., average COPC concentrations) and LOAEL toxicity values. The LOAELavg was used in Step 3a to further refine the list of COPCs identified during the ecological screening.

#### 8.6.2.2 Results and Discussion

Appendix H.4 presents the calculations of the food-chain modeling. Appendix J presents the risk evaluation for the Indiana bat. Separate discussions are provided below for evaluations of potential risk to herbivorous receptors, insectivorous receptors, and piscivorous receptors. Tables 8-5 and 8-6 present

a summary of the food chain model results for the herbivorous/insectivorous receptors under the conservative and average exposure scenarios, respectively. Vegetation samples that were collected in 1995 and analyzed for metals are presented in Table 8-7 with a comparison of predicted vegetation concentrations of metals in the current SERA to the 1995 tissue data. Tables 8-8 and 8-9 present a summary of the food chain model results for the piscivorous receptors under the conservative and average exposure scenarios, respectively. Table 8-10 is a comparison of aquatic organism tissue concentrations analyzed in the 1995 ABG study compared to the predicted concentrations in the piscivorous food chain models. Finally, Table 8-11 presents a summary of the Step 3a evaluation for terrestrial wildlife.

Herbivorous Receptors

Under the conservative (i.e., maximum exposure) food-chain scenario, COPCs with EEQs greater than 1.0 for representative herbivorous receptors consisted of HMX for the vole, and mercury and lead for the quail (Table 8-5). Under the average exposure scenario, no LOAEL-based EEQs exceeded 1.0, but the HMX NOAEL-based EEQ was 2.2 for the vole and the lead NOAEL-based EEQ slightly exceeded 1.0 for the quail (Table 8-6).

The NOAEL-based EEQs for lead and mercury under the conservative scenario were relatively low, with a maximum EEQ of 2.4 (mercury) and 3.0 (lead) for the quail. As shown in Figures 5-1 and 5 -2, most surface soil samples were within 50-100 feet of neighboring samples. It is unlikely that the quail (or any herbivorous bird species) would obtain the majority of its food items from the vicinity of a single sample at SWMU 03 since the home ranges for these receptors are larger than the area represented by a single soil sample. For example, typical home ranges of bobwhite quail vary from 9 to 41 acres (U.S. EPA, 1993e). With this in mind, the EEQs in the average exposure scenario more accurately depict potential risks rather than the maximum exposure scenario EEQs. Under the average exposure scenario, no LOAEL-based EEQs exceeded 1.0 for the vole or quail.

The TRV for HMX is based on 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 noted at a concentration of 75 mg/kg-day. Although the NOAEL-based EEQs are greater than 1.0 for HMX in the vole food chain model, it appears that the two greatest detected concentrations are biasing the exposure to herbivorous receptors. The two greatest concentrations were detected at locations 03SS24 (1,600 mg/kg) and 03SS22 (77 mg/kg); however, these locations are gravel covered which limits the amount of vegetation in these areas. Also, the area represented by these samples is relatively small (400 $ft^2$) so the numbers of voles, if any, obtaining a significant amount of food from this area is expected to be very low. For that

reason, the average HMX concentration was recalculated by removing samples 03SS024006 and 03SS220006 to evaluate the impact on the EEQ if it were based on a more representative average HMX concentration for the SWMU. The average HMX concentration at SWMU 03 calculated without samples 03SS240006 and 03SS220006 is 1.7 mg/kg. When the average concentration without 03SS24 and 03SS22 is used in the vole food chain model, the NOAEL-based EEQ is less than 1.0. Therefore, because the EEQ was only slightly greater than 1.0 based on the concentration using all of the samples, and because the EEQ was less than one after excluding samples that only represent a small portion of the home range for herbivorous wildlife, the potential increase in mortality of herbivorous mammals is not great enough to warrant retaining HMX as a COPC for further evaluation.

The TRV for lead is based on a study using Japanese quail as the test species. Egg hatching success was reduced among birds consuming 100 mg/kg lead, and reproduction was not impaired at 10 mg/kg lead. The 12 week study did not test concentrations between the 10 mg/kg and 100 mg/kg dose and so the actual effects concentration may be greater than the 10 mg/kg that was used as the LOAEL in the food chain model. The NOAEL-based EEQ for lead (average concentrations) for the quail is 1.02, which is rounded down to 1.0. Therefore, risks to herbivorous birds from lead in the soil are not likely so lead is not retained as a COPC for further evaluation.

As mentioned in Section 8.2.1, potential ecological risks within the ABG were previously evaluated (TtNUS, 1999). Vegetation samples were collected in 1995 and analyzed for metals in that study. A comparison of predicted vegetation concentrations of metals in the current SERA to the 1995 tissue data is summarized in Table 8-7. The value of the comparisons is limited by factors such as the time lapse between sampling events (1995 vs. 2001). Nevertheless, the comparisons are useful as a "reality check" of the food-chain model methodology. The predicted vegetation concentrations of cadmium, chromium, lead, and zinc in the conservative scenario are greater than the maximum concentrations from the earlier study (i.e., the actual tissue sampling study), while predicted concentrations of copper and nickel in the conservative scenario are only slightly less than the maximum concentrations from the earlier study. In the average scenario, the predicted concentrations are similar to the previous average measured concentrations for cadmium, chromium, lead, and mercury. Concentrations predicted in the average food-chain scenario are less than the previous average measured concentrations for copper, nickel, and zinc.

Due to the home ranges of herbivorous mammals and birds, and because the EEQs for all COPCs were relatively low, risks to these upper-level receptors are negligible. No surface soil COPCs are retained as final COPCs for herbivorous receptors.

Insectivorous Receptors

Under the conservative (i.e., maximum exposure) food-chain scenario, COPCs with EEQs greater than 1.0 for representative insectivorous receptors (shrew and robin) consisted of dioxin TEQs, HMX, and five metals (cadmium, chromium, lead, mercury, and zinc) (Table 8-5). Under the average exposure scenario, the NOAEL-derived EEQ for dioxin and all shrew EEQs for HMX and metals were less than 1.0 (Table 8-6). NOAEL-based EEQs for the robin were greater than 1.0 for chromium, lead, mercury, and zinc under the average exposure scenario. The LOAEL-based EEQs for chromium, mercury, and zinc were less than 1.0 while the LOAEL-based EEQ for the robin was 2.4.

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 at a single location. However, for SWMU 03, 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., the area is covered by gravel).

The avian TRVs for chromium are based on a study in which black duck duckling survival was reduced at a dose level of 50 mg/kg chromium; however, no significant differences were observed at a dose level of 10 mg/kg chromium. The maximum detected chromium concentration was 288 mg/kg at 03SS027 with the next greatest detected concentration of 52.4 mg/kg at 03SS028. As discussed in Section 8.6.1.1, the two samples with the greatest chromium detections were located in a small depression (30 by 60 feet) so the exposure is small relative to the home range of insectivorous birds. Most of the other detected concentrations were just slightly greater than or less than the maximum background concentration of 30.6 mg/kg. In fact, the NOAEL EEQ calculated using the average background chromium concentration of 16.4 mg/kg is 3.0, compared to the EEQ of 4.6 using the average chromium concentration at SWMU 03 (25 mg/kg). Therefore, any reduction in survival of birds at the SWMU should be similar to a reduction in survival in background areas. For these reasons, site-related risks to insectivorous birds from chromium are not great enough to warrant retaining chromium as a COPC for further evaluation.

Although the shrew typically forages within small areas (less than one acre), it is unlikely that this representative receptor (or any insectivorous mammal species) would obtain the majority of its food items from the vicinity of a single sample at SWMU 03. The same is true for the robin (and other insectivorous bird species). The robin does have a small home range while nesting (typically 0.5 to 2.0 acres), but robins forage over much larger areas during other seasons (U.S. EPA, 1993e). Soil invertebrate tissues were not collected during the 1995 ABG study, so actual tissue data are not available for comparisons with invertebrate concentrations predicted in this SERA.

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). Lead EEQs for the robin were 24.1 (NOAEL-based) and 2.4 (LOAEL-based) under the average exposure scenario. The soil ingestion rates used in the food-chain model are dry weight, while the other exposure factors are wet weight (see Appendix H.2). Thus, the EEQs are greater than if fresh weight ingestion rates had been used. Nevertheless, as discussed in Section 8.6.1.1, lead was particularly elevated in surface soil sample 03SS24. Based on the field sheets and boring logs, the surface soil sample (0 to 2 feet) from 03SS24 consisted of a clayey silt, sand, gravel (top 1.5 feet) and silty clay (bottom 0.5 foot), and trace ash (see Appendix B). Ash and burnt materials/cinders were found in the subsurface soil immediately below the surface soil sample. Therefore, it is not likely that a large earthworm population would inhabit this area because of the large amount of sand and gravel in the soil so the average concentration was recalculated without sample 03SS240002. The average surface soil lead concentration without sample 03SS240002 would be 40 mg/kg. Under the average exposure scenario, lead EEQs for the robin based on 40 mg/kg would be 6.2 (NOAEL-based) and 0.6 (LOAEL-based). These relatively low EEQs indicate that potential lead-related risks via the food-chain are negligible for insectivorous avian receptors, except in the vicinity of location 03SS24. The extent to which avian insectivores are at risk depends on numerous factors; two major factors being the degree to which receptors forage in the vicinity of this sample, and the size of the area in which this sample accurately reflects soil lead concentrations. As discussed in Section 8.6.1, elevated lead concentrations are limited to a small area so risks to insectivorous mammals are expected to be low.

The TRV for mercury was derived from a study using Mallard duck as the test species. Significant effects (fewer eggs and ducklings were produced) were observed at a dose level of 0.5 mg/kg. Because the study considered exposure over three generations, the dose was considered a chronic LOAEL and was multiplied by an uncertainty factor of 0.1 to develop a chronic NOAEL. The maximum detected mercury concentration was 0.26 mg/kg at 03SS28; the sample from 03SS27 had a detected concentration of 0.17 mg/kg As discussed above, these two samples were located in a small depression (30 by 60 feet) so the exposure is small relative to the home range of insectivorous birds. Most of the other detected concentrations were just slightly greater than or less than the maximum background concentration of 0.14 mg/kg. In fact, the NOAEL EEQ calculated using the average background mercury concentration of 0.033 mg/kg is 2.3, compared to the EEQ of 4.7 using the average mercury concentration at SWMU 03 (0.067 mg/kg). Therefore, any reduction in reproduction of birds at SWMU 03 should be similar to the

reduction in reproduction in background areas. For these reasons, site-related risks to insectivorous birds from mercury are not great enough to warrant retaining mercury as a COPC for further evaluation.

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. The maximum detected zinc concentration was 739 mg/kg at 03SS28; the sample from 03SS27 had a detected concentration of 145 mg/kg. As discussed above, these two samples were located in a small depression (30 by 60 feet) so the exposure is small relative to the home range of insectivorous birds. Most of the other detected concentrations were just slightly greater than or less than the maximum background concentration of 60 mg/kg although a few samples had detected zinc concentrations between 100 to 230 mg/kg. The NOAEL EEQ calculated using the average background zinc concentration of 28 mg/kg is 1.4, compared to the EEQ of 5.2 using the average zinc concentration at SWMU 03 (101 mg/kg). Therefore, although there may be a slight increase in reproductive effects to birds at SWMU 03 from zinc compared to the reproductive effects to birds in background areas, the increase is not great enough to warrant retaining zinc as a COPC for further evaluation.

Although risks to insectivorous wildlife from HMX, chromium, lead, mercury, and zinc in the soil are possible, the potential risks are not great enough to warrant retaining these chemicals as COPCs.

Appendix J presents the risk evaluation that was conducted for the Indiana bat. In summary, aluminum and arsenic were the only metals that had EEQs slightly greater than 1.0 in the conservative scenario, based on the NOAEL. Aluminum was the only metal that had an EEQ slightly greater than 1.0 in the average scenario, based on the NOAEL. No metals had EEQs greater than 1.0 based on the LOAEL. The maximum EEQ for aluminum was 3.0 and the maximum EEQ for arsenic was 1.1.

Based on the conservative assumptions as described in the uncertainty analysis section in Appendix J, it is unlikely that aluminum and arsenic will impact individual bats because the EEQs were very low (see above) and were based on no effects levels. Also, neither the aluminum nor arsenic in the insect tissue is likely to be site-related. Aluminum was below background levels in the surface water and surface soil samples, is not considered to be an important bioaccumulative chemical according to USEPA (2000a), and its bioavailability in the LSC sediment samples is expected to be low based on the pH levels in the

sediment. Arsenic was below background levels in the surface soil sediment, and surface water samples. It is also possible that the aluminum and arsenic in the tissue samples may be due to the paint chips in some of the samples or from natural levels of the metals in the insect tissue. Therefore, no surface soil COPCs are retained as final COPCs for bats.

Piscivorous Receptors

Under the conservative food-chain scenario, COPCs with EEQs greater than 1.0 for representative piscivorous receptors (raccoon and kingfisher) consisted of cadmium, copper, lead, selenium, and zinc (Table 8-8). Under the average exposure scenario, NOAEL-based EEQs exceeded 1.0 for cadmium, copper, lead, selenium, and zinc for the raccoon and for lead and zinc using the kingfisher as a representative receptor (Table 8-9). All LOAEL-based EEQs were less than 1.0 in the average exposure scenario for the kingfisher and copper (2.8), selenium (2.0), and zinc (1.6) were greater than 1.0.

Fish, frogs, and crayfish were collected in 1995 and analyzed for metals in the previously mentioned study at ABG (TtNUS, 1999). A comparison of predicted tissue concentrations of metals in the current SERA to the 1995 tissue data is summarized in Table 8-10. The predicted concentrations of cadmium, copper, lead, and zinc in fish and benthic organisms in the conservative and average food-chain scenarios are greater than the maximum concentrations from the earlier study. In both food-chain scenarios, the predicted concentrations of selenium were less than the selenium concentrations measured in 1995.

The raccoon and kingfisher, as well as other piscivorous birds and mammals, forage over large home ranges. Specifically, raccoons typically forage within areas of over 100 acres, and kingfishers forage along more than 1 km of shoreline (U.S. EPA, 1993e). The EEQs calculated for these representative receptors are relatively low, when conservative assumptions inherent in the food-chain model (e.g., home range contained within the site, 100 percent bioavailability) are considered. For this reason, area use factors were used in recalculating the EEQs for both the kingfisher and raccoon models because it is unlikely that piscivorous birds and mammals will obtain 100 percent of their food from LSC. Most of LSC from its headwaters to Spring C is intermittent and is typically dry. The stream becomes perennial downstream of Spring C (with the exception of the deep pools by Springs A and C); however, most of the creek in this area consists of shallow riffles and runs. Therefore, the size and quantity of fish in this portion of LSC is limited by the habitat to mostly small fish, except perhaps in the pools. This is further supported by the biological survey conducted in 1995 as described in Section 8.2.1 of this report. Based on this survey, the most abundant fish were bluntnose minnows, silverjaw minnows, gizzard shad, and creek chubs; which are small fish species. Less then 50 individuals from each species were collected

with the exception of the bluntnose minnows, of which more than 50 individuals were collected. Although the collected fish samples were not weighed, these species are generally small and are anticipated to weigh only a few grams. Some larger fish were collected in the pooled areas but the numbers were low. Therefore, based on the ingestion rates for the raccoon (1.3 kg per day or 2.9 lbs per day) and the kingfisher (0.068 kg per day or 0.15 lbs per day), it is unlikely that piscivorous mammals and piscivorous birds would forage extensively in LSC.

Based on the above discussion, the food-chain models for the kingfisher and raccoon were recalculated using area use factors (AUFs) of 25 percent and 10 percent, respectively. The AUFs are different for the kingfisher and raccoon based on the amount of food consumed by each species. These values were selected using professional judgment and are expected to provide conservative estimates of exposure as discussed below. The AUFs are not meant to indicate exact percentages of food obtained from LSC; instead these AUFs assume that kingfishers and raccoons will obtain no more than 25 and 10 percent of their food from LSC. From the ingestion rates presented above, and using these AUFs, kingfishers and raccoons would need to obtain over 13.5 and 100 pounds of fish from LSC, respectively over the course of a year. Based on the small number of fish present in LSC, and the small size of the fish that were collected during previous investigations, it is likely that even the AUFs of 25 percent for the kingfisher and 10 percent for the raccoon overestimate exposure to those species. The uncertainties in using the AUF are discussed more in Section 8.7.2 of the Uncertainty Analysis.

The EEQs recalculated using the AUF values are presented in Appendix H.4. Only the NOAEL-based EEQs for lead and zinc exceeded 1.0 under the kingfisher conservative scenario. No EEQs exceeded 1.0 under the average exposure scenario. For the raccoon conservative scenario, cadmium, copper, lead, and zinc had NOAEL-based EEQs greater than 1.0 with copper and zinc LOAEL-based EEQs of 2.84 and 1.72, respectively. However, no EEQs exceeded 1.0 under the average exposure scenario. Additionally, when only copper and zinc sample concentrations for sediment samples 03SD14 through 03SD19 (i.e., area representing viable fish habitat and the area most likely for piscivorous mammals to be feeding along LSC) are considered, the NOAEL EEQs decrease to 0.31 and 0.26, respectively (see Appendix H.4). Therefore, no chemicals were retained as COPCs for risks to piscivorous wildlife.

## 8.7 UNCERTAINTY ANALYSIS

Uncertainties are associated with most steps of a SERA, from selecting endpoints, collecting data, and evaluating toxicity to the receptors. The following sections describe some of the sources of uncertainty that may be associated with this SERA. Appendix J presents the uncertainties associated with the risk evaluation for the Indiana bat.

### 8.7.1 Endpoints

Measures of effects were used to evaluate the assessment endpoints that were selected for the SERA. For this SERA, the measures of effects were not the same as the assessment endpoints. Therefore, the measures were used to predict effects to the assessment endpoints by selecting representative species that were evaluated. For example, a decrease in reproduction of a robin is used to assess a decrease in the reproduction of the songbird population. However, predicting a decrease in reproduction to a robin may either under or overprotect the songbird population, resulting from differences in ingestion rates, toxicity, food preferences, etc. among different bird species.

Several endpoints were not quantitatively evaluated in this SERA. Risks to burrowing animals were not quantitatively evaluated because the methods for quantifying risks to these species have not been well developed. Small reptiles and amphibians may be prevalent at the OJT/LSC and would be among the ecological receptors most exposed to surface soil, sediment, and surface waters at this site because of their limited home range. However, in addition, risks to reptiles and amphibians were not evaluated because exposure factors are not established for most species, and toxicity data are limited (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 Section 8.2.5.1. In addition, several of the chemical classes detected at SWMU 03 (primarily metals and energetics) 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." Also, most metals typically do not biomagnify in terrestrial systems (Newman, 1998). Mercury and dioxins, which are typically considered to be persistent, bioaccumulative, and toxic (PBT) chemicals were detected in surface soil samples at SWMU 03. However, the low EEQs in the food-chain models conducted for SWMU 03 indicate that mercury and dioxins are not causing risks to small carnivorous mammals and birds. For example, using average soil concentrations and average exposure assumptions, EEQs for dioxins were less than 1.0 for the robin and short-tailed shrew. For mercury, using average soil concentrations and average exposure assumptions, the NOAEL EEQ was 4.7 for the robin but the LOAEL EEQ for the robin was less than 1.0. Although dioxins and mercury may accumulate in the tissue of small mammals, risks to carnivorous birds and mammals are expected to be much lower than the risks to the small herbivorous or insectivorous mammals and birds at SWMU 03. This is because the accumulation factors from soil to wildlife, soil to plants, and soil to invertebrates are similar

(U.S. EPA, 1999g) but carnivorous birds and mammals are only expected to obtain a small portion of their food from SWMU 03 (less than 5 percent, see Section 8.2.5.1). However, it was assumed that the small herbivorous and insectivorous mammals and birds at SWMU 03 obtained all of their food from the site.

As discussed in Section 8.2.5.3, several endangered and threatened species or species of special concern are present at NSWC Crane, and potentially may inhabit SWMU 03. Risks to these species were not specifically calculated, with the exception of risks to the Indiana bat for the reasons presented in Section 8.2.5.3; therefore, 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, and osprey are expected to be negligible. Loggerhead shrike 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 03 than aboveground insects; therefore, risks to the robin from consuming worms are expected to be greater than risks to the loggerhead shrike 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 also are expected to be even lower than risks to robins.

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 03, this species may potentially inhabit areas of SWMU 03. 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.

### 8.7.2 Exposure Characterization

During the initial screening, maximum detected concentrations are compared to the U.S. EPA Region 5 Ecological Data Quality Levels (EDQLs). Periodically, these screening values are reviewed and updated as new studies and toxicological information become available. For example the U.S. EPA Region 5 EDQLs were updated and republished in August 2003. In addition, as new information becomes available U.S. EPA may revise the methodology used to prepare risk assessments. Changes in the toxicity data or risk assessment methodology may result in changes in the screening levels used to select COPCs, which may introduce uncertainty into the selection of COPCs. The updated U.S. EPA Region 5 EDQLS were not used in the selection of COPCs; however, the updated EDQLS (now referred to as

ESLs) were used in the Step 3a evaluation. These changes may result in an underestimation or overestimation of risk.

The contaminant dose to terrestrial wildlife was calculated using an equation that incorporates ingestion rates, body weights, BAFs, BSAFs, and other exposure factors. These exposure factors were obtained from literature studies or predicted using various equations. Ingestion rates and body weights vary among species, especially among species inhabiting different areas. For example, the food ingestion rate for the robin was 0.89 g/g-day in a California study and 1.52 g/g-day in a Kansas study (U.S. EPA, 1993e). Therefore, there is uncertainty in applying exposure factors from the literature to the species at NSWC Crane.

Bioaccumulation of contaminants into various biological media (i.e., plants and invertebrates) depends on characteristics of the media such as pH, organic carbon, etc. Therefore, actual BAFs and BSAFs at the site may be different than those used in the SERA, which were obtained from the literature.

There is uncertainty in the chemical data collected at the site. Sampling programs are frequently biased toward locations that have a higher expectation of being contaminated. Therefore, the concentrations do not actually represent the site, but they represent the higher concentrations at a site. As such, predicted exposure doses were probably higher than actual exposure doses.

Surface soil was collected from the 0- to 2-foot bgs depth interval. Background surface soil data were collected from 0- to 1-foot bgs depth interval as a compromise depth for all NSWC Crane projects for which a variety of surface soil depths may be used. There is uncertainty in this approach depending on the source of contamination and how it was disposed at the site (i.e., deposited on the surface as a result of burning activities, buried, etc.) because the two different depth intervals represent slightly different soil populations. However, the uncertainty was not viewed to be unacceptably large given all of the other uncertainties associated with environmental investigations.

Under the conservative scenario, terrestrial wildlife are assumed to live and feed only at the site or only in the portion of a water body affected by the site. These assumptions tend to over-predict risk because it is unlikely that most receptors will obtain all their food from within the site boundaries and from the most contaminated areas. Risk also may be over-predicted in the average scenario, where home range is taken into account, because of the biased sampling in the most contaminated areas. Also, for piscivorous birds and mammals, AUFs were used to recalculate risks to the kingfisher and raccoon. The AUFs that were selected (25 percent for the kingfisher and 10 percent for the raccoon) were used to estimate risks to piscivorous birds and mammals. The AUFs are considered conservative values, which likely overestimate

the exposure to these representative receptor species. However, because risks to piscivorous birds and mammals were negligible using the selected AUFs, the AUFs were not further refined.

As discussed in Section 3.3, results for some sediment, surface soil, and surface water samples were rejected. Therefore, there is uncertainty in not having data from these locations, potentially biasing conclusions of the risk assessment toward locations in which data are available.

### 8.7.3 Ecological Effects Data

Table 3-4 presents the reporting limits versus the EDQLs. As seen on the table, several of the metals have maximum reporting limits that are greater than the EDQLs. This is not expected to significantly impact the conclusions of the risk assessment for several reasons. Several of the metals with reporting limits greater than the EDQLs were detected at greater concentrations in other soil or sediment samples and were determined to be below background levels. Also, although the reporting limits are greater than the EDQLs, they are lower than alternate benchmarks that are typically used to determine if a chemical needs to be further evaluated.

There is uncertainty in the ecological benchmark values. The AWQC developed by the U.S. EPA in theory protects 95 percent of the exposed species. Therefore, some sensitive species may be present at the site that are not protected by the use of these criteria. There also may be situations where the SWSLs are overpredictive of risk if the sensitive species used to develop the criteria are not present. Finally, with the exception of hardness for a few metals, the SWSLs do not account for site-specific factors such as TOC or pH that may affect toxicity.

Potential adverse impacts to aquatic receptors from constituents in sediment are evaluated by comparing the COPC concentration in sediment to screening values. The SSLs have more uncertainty associated with them than do the SWSLs for the following reasons: The procedures for developing them are not as well established so screening values have been developed using different methodologies, and there are fewer sediment toxicity data than surface water toxicity data. Sediment characteristics (i.e., pH, acid volatile sulfide, TOC) also will have a large impact on the bioavailability and toxicity of constituents. Finally, screening values based on equilibrium partitioning have uncertainty associated with log $K_{ow}$ values: the assumed relationship between $K_{ow}$ and $K_{oc}$, and the assumption that pore water exposure is the most important route for sediment-dwelling organisms. There is also uncertainty in applying the SSLs to the sediment in the drainage ditches because of their limited potential for significant aquatic populations.

Potentially adverse impacts to terrestrial plants and invertebrates from constituents in surface soil are evaluated by comparing the COPC concentration to surface soil screening levels (SSSLs). The SSSLs are similar to the sediment screening levels in that they are less established than the SWSLs. Fewer studies and less data are available for establishing SSSLs than SSLs, and many of the SSSLs are based on the results of only a few studies. In addition, the SSSLs are based on different end points depending on the preference of the agency that developed them. Therefore, they have more uncertainty than surface water and sediment screening levels.

The NOAELS and LOAELs that were selected for the representative wildlife species were based on species commonly used in laboratory studies (i.e., rats, mice, ducks). There is uncertainty in the application of toxicity data among species because the contaminant may be more or less toxic to the wildlife species in question than it was to the test species.

The toxicity of chemical mixtures is not well understood. The toxicity data used in the SERA to evaluate risk to ecological receptors is for individual chemicals. Chemical mixtures can affect the organisms very differently than the individual chemicals because of synergistic or antagonistic effects.

Finally, toxicological data for a few COPCs are sparse. Therefore, there is uncertainty in any conclusions involving the potential impacts to ecological receptors from these constituents.

### 8.7.4 Risk Characterization

Unacceptable risks are possible if an EEQ is greater than or equal to 1.0. However, the magnitude of effects to ecological receptors cannot always be accurately inferred based on the magnitude of the EEQ. Rather, an EEQ greater than 1.0 simply indicates that the dose used to derive the toxicity reference value was exceeded. Finally, there is uncertainty in how the predicted risks to a species at the site translate into risk to the population in the area as a whole.

## 8.8 ECOLOGICAL RISK SUMMARY AND CONCLUSIONS

A SERA was performed for the OJT. Several chemicals were retained as COPCs as a result of the initial screening of surface water, sediment, and surface soil. These chemicals were further evaluated and data were scrutinized as a part of the Step 3a refinement. Tables 8-1, 8-2, 8-3, and 8-11 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**

Several dioxins, energetics, SVOCs, and inorganics were initially selected as COPCs in SWMU 03 surface soils because they were detected at concentrations that exceeded EDQLs or because EDQLs were not available: The potential risks to terrestrial plants and invertebrates were further evaluated during Step 3a of the risk assessment process 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. Factors considered during the Step 3a evaluation included frequency of detection, comparisons to background values, comparisons to alternative screening levels, and spatial analysis of detections.

Dioxin concentrations in the surface soil at SWMU 03 are unlikely to affects plants or invertebrates at the site. This determination is 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.

Concentrations of energetics were elevated in a few samples, particularly those collected at locations 03SS22 and 03SS24. Concentrations in surrounding samples were not generally elevated. Both sample location 03SS22 and 03SS24 are in the southern burn pit/area along the fringe of the road (see Figure 5-1) where the habitat for plants and invertebrates is poor (see Figures 1-3 and 1-5 for site photographs). Based on the field sheets and boring logs, the surface soil sample (0 to 2 feet) from 03SS24 consisted of a clayey silt, sand, gravel (top 1.5 feet) and silty clay (bottom 0.5 foot), and trace ash, while the surface soil sample (0-2 feet) from 03SS22 consisted of sand and gravel (top 0.4 foot) and clay with trace silt and sand (bottom 1.6 feet) (see Appendix B). Ash and burnt materials/cinders were found in the subsurface soil immediately below the surface soil samples. Therefore, it is not likely that significant numbers of earthworms would inhabit this area because of the large amount of sand and gravel in the soil. Herbaceous plants are present along the road (see photographs g and h in Figure 1-3) and so it does not appear that vegetation is being adversely impacted from energetics in the surface soil at SMWU 03.

Because the EDQLs are based on risks to wildlife, concentrations of SVOCs in the surface soil were compared to alternate benchmarks that were developed based on risks to terrestrial plants and invertebrates. Because the maximum di-n-butyl phthalate and naphthalene concentrations are less than alternate benchmarks based on terrestrial plants and invertebrates, risks to these receptors from SVOCs are acceptable.

Most EDQLs that were used to select inorganic COPCs in the surface soil at SWMU 03 are based on risks to wildlife. Concentrations of most inorganic chemicals initially selected as COPCs were less than alternate benchmarks developed based on risks to plants and invertebrates and therefore, risks to these receptors from inorganics are acceptable. Some inorganics were particularly elevated at one location or several isolated locations only. Concentrations of these inorganic COPCs were elevated relative to alternate benchmarks at heavily forested locations where it does not appear that vegetation is being adversely impacted or at locations of poor ecological habitat (i.e., samples collected under gravel or within the OJT). Although risks from these inorganics are possible, the potential risks in the soil are not great enough to warrant retaining any inorganic chemicals as COPCs for further evaluation.

In summary, no chemicals initially selected as COPCs were retained for further evaluation for risks to terrestrial plants and invertebrates. However, all bioaccumulative chemicals detected in the surface soil at SWMU 03 (including energetics which are not typically considered bioaccumulative) were further evaluated for risks to wildlife in Section 8.6.2.2.

**Sediment Invertebrates**

Several energetics, SVOCs, pesticides/herbicides, and inorganics were initially selected as COPCs in SWMU 03 shallow and deep sediments because they were detected at concentrations that exceeded EDQLs or because EDQLs were not available. The COPCs were evaluated during Step 3a of the risk assessment process 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. Factors considered during the Step 3a evaluation included frequency of detection, comparisons to background values, comparisons to alternative screening levels, habitat considerations, and spatial analysis of detections.

Concentrations of organic chemicals are unlikely to impact sediment invertebrates at the site. Concentrations of energetics and pesticides/herbicides are less than alternate benchmarks found in the literature and so risks to sediment invertebrates from these organics are acceptable. Two of the three SVOC COPCs are detected in shallow sediment samples only. Acenaphthene was detected in a downgradient location of LSC where it does not appear aquatic receptors have been impacted. The maximum concentration of di-n-butyl phthalate is less than alternate benchmarks and diphenylamine was not detected in any other media at SMWU 03. The low frequency of detections, uncertainty regarding the source of contamination of SVOCs, and the results of the 1995 benthic evaluation indicate that risks to sediment invertebrates at LSC are acceptable from SVOCs.

Concentrations of some inorganics at a few sample locations indicate possible adverse impacts to benthic invertebrates. However, the elevated concentrations tended to be in samples located upstream of Spring C, where the LSC channel is typically dry, and thus, permanent aquatic habitat is absent from these locations. Other COPCs were elevated in samples downstream of Spring C, but potential risks were limited primarily to the vicinity of single samples. During a site visit in June 2004 , various insects were observed under rocks, and fish (some were three to five inches in length), crayfish, frogs, and salamanders were present in areas of LSC downstream of Spring C. Aquatic receptors in the perennial portion of LSC do not appear to be adversely impacted by sediment contaminant concentrations. Therefore, although risks to aquatic receptors in the sediment are possible from these COPCs, the potential risks are not great enough to warrant retaining any chemicals as COPCs for further evaluation.

In summary, no chemicals initially selected as COPCs were retained for further evaluation for risks to sediment invertebrates. However, all bioaccumulative chemicals detected in shallow and deep sediment at SWMU 03 (including energetics which are not typically considered bioaccumulative) were further evaluated for risks to wildlife in Section 8.6.2.2.

**Aquatic Organisms**

Several energetics, VOCs, and inorganics and one herbicide were initially selected as COPCs in SWMU 03 low-flow and high-flow surface water samples because they were detected at concentrations that exceeded EDQLs or because EDQLs were not available. The COPCs were evaluated during Step 3a of the risk assessment process 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.

Concentrations of organic chemicals were all less than alternate benchmarks from the literature; therefore, risks to aquatic organisms are acceptable. An alternate benchmark for bis(2-ethylhexyl) phthalate could not be located; however, only two of the 11 samples collected had detections greater than the EDQL. The two bis(2-ethylhexyl) phthalate detections were reported for locations in intermittent portions of LSC which do not support aquatic life. Therefore, risks to aquatic organisms from organics in the surface water at LSC are acceptable.

Cadmium and zinc were not selected as COPCs in filtered samples; therefore, these inorganic chemicals were not retained for further evaluation because the dissolved portion of the water column is typically considered the bioavailable portion. The maximum copper and iron concentrations are less than the AWQCs. Although the maximum lead concentration in filtered samples exceeded the AWQC during high

flow conditions, this location does not typically support aquatic life. As discussed above for sediment, concentrations greater than the screening levels in samples located upstream of Spring C are not of great concern because this portion of the LSC channel is typically dry, and thus, permanent aquatic habitat is absent from these locations. Likewise, concentrations greater than the screening levels south of Spring C are not of great concern because the area is abundant with various insects, fish, crayfish, frogs, and salamanders as observed in a June 2004 site visit. Therefore, although risks to aquatic receptors in the surface water are possible from these COPCs, the potential risks are not great enough to warrant retaining any chemicals as COPCs for further evaluation. Additionally, the apparent lack of pattern in the detections (high vs. low-flow and filtered vs. non-filtered results in metals samples) indicates that the potential risk to aquatic receptors from metals in surface water is acceptable and no COPCs were retained for further evaluation.

**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. 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. No EEQs were greater than 1.0 for dioxins, RDX, and cadmium and so risks to wildlife from these COPCs are acceptable. NOAEL EEQs were greater than 1.0 for chromium, mercury, and zinc (robin model) and HMX (vole model). LOAEL EEQs were greater than 1.0 for lead only. However, risks to wildlife from COPCs with NOAEL EEQs greater than 1.0 and lead were considered acceptable for the following reasons:

- It is unlikely that herbivorous wildlife will obtain majority of food items from vicinity of any single sample since the home ranges are greater than the area represented by single samples.

- The two greatest detections at SMWU 03 are located at 03SS22 and 03SS24; however, these locations are gravel covered and do not support vegetation that the meadow vole would feed on. Similarly, the subsurface soils at these locations consist of soil (clayey silt, sand, ash, and cinders) that does not support earthworms that the robin could feed on.

- EQs would be less if fresh weight ingestion factors were used.
- Calculated doses are closer to NOAEL than LOAEL.
- Bioavailability of the metals used in the toxicity test to develop the NOAELs and LOAELs are greater than the bioavailability of soil at the site.

Appendix J presents the risk evaluation that was conducted for the Indiana bat. In summary, aluminum and arsenic were the only metals that had EEQs slightly greater than 1.0 in the conservative scenario, based on the NOAEL. Aluminum was the only metal that had an EEQ slightly greater than 1.0 in the average scenario, based on the NOAEL. No metals had EEQs greater than 1.0 based on the LOAEL. The maximum EEQ for aluminum was 3.0 and the maximum EEQ for arsenic was 1.1. Overall, risks to the Indiana bat from these chemicals are expected to be low and do not appear to be related to site activities.

**Risks to Piscivorous Receptors**

In the less conservative food chain model, the five inorganics retained as COPCs had NOAEL based EEQs greater than 1.0 in the raccoon model. Additionally, LOAEL based EEQs for copper, selenium, and zinc were greater than 1.0 in the raccoon model. However, risks to piscivorous wildlife are unlikely because the home ranges of piscivorous birds and mammals are typically larger than SWMU 03. Because it is unlikely that piscivorous receptors will obtain 100 percent of their food from SWMU 03, the food chain models were recalculated incorporating AUFs of 25 percent for the kingfisher and 10 percent for the raccoon. Using the ingestion rates for these species, and using these AUFs, kingfishers and raccoons would need to obtain over 13.5 and 100 pounds of fish from LSC, respectively over the course of a year. Based on the small number of fish present in LSC, and the small size of the fish that were collected during previous investigations, it is likely that even the AUFs of 25 percent for the kingfisher and 10 percent for the raccoon overestimate exposure to those species. However, NOAEL EEQs for all COPCs were less than 1.0 using the AUFS and so risks to piscivorous wildlife are acceptable.

TABLE 8-1

STEP 3A EVALUATION FOR RISKS TO PLANTS AND INVERTEBRATES
SURFACE SOIL COPCs
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern (COPC) | Frequency of Detection | Maximum Detected Concentration | Region V EDQLs | Maximum EEQ[1] | Number of Samples > Screening Level[2] | Step 3a Evaluation | | | | | | | | Risk Determination (Acceptable/ Unacceptable) | Retained as a COPC? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Alternate Benchmarks[3] | | | | | | | Other Step 3a Factors Considered in Evaluation[4] | | |
| | | | | | | Eco-SSL | | Talmage et al., 1999 | | Canadian SQG | ORNL Benchmarks | | | | |
| | | | | | | Plant | Earthworm | Plants | Earthworm | | Plant | Earthworm | | | |
| **Dioxins (ng/kg)** | | | | | | | | | | | | | | | |
| 1,2,3,4,6,7,8,9-OCDD | 11/11 | 3,440 | 0 199 | 17286 | 11 | NA | NA | NA | NA | NA | NA | NA | -All concentrations of individual and total dioxins are much less than a NOEC reported in the literature where two species of earthworms showed no adverse effects when exposed for 85 days to soil containing 5 mg/kg 2,3,7,8-TCDD (Eisler, 1986)<br>-Many, if not all, invertebrates lack the aryl hydrocarbon (Ah) receptor, or comparably sensitive receptor for which dioxins need to bind in order to cause toxicity | Acceptable | No |
| 1,2,3,4,6,7,8,9-OCDF | 3/11 | 62 2 | 38.6 | 1.6 | 1 | NA | NA | NA | NA | NA | NA | NA | | | |
| 1,2,3,4,6,7,8-HPCDD | 11/11 | 233 | 0 199 | 1171 | 11 | NA | NA | NA | NA | NA | NA | NA | | | |
| 1,2,3,4,7,8-HXCDD | 4/11 | 2 1 | 0 199 | 11 | 4 | NA | NA | NA | NA | NA | NA | NA | | | |
| 1,2,3,6,7,8-HXCDD | 5/11 | 10 1 | 0 199 | 51 | 5 | NA | NA | NA | NA | NA | NA | NA | | | |
| 1,2,3,7,8,9-HXCDD | 5/11 | 6 5 | 0 199 | 33 | 5 | NA | NA | NA | NA | NA | NA | NA | | | |
| 1,2,3,7,8-PECDD | 5/11 | 1 3 | 0 199 | 6 5 | 5 | NA | NA | NA | NA | NA | NA | NA | | | |
| 2,3,7,8-TCDD | 5/11 | 3 9 | 0 199 | 20 | 4 | NA | NA | NA | NA | NA | NA | NA | | | |
| TEQ BIRD | 11/11 | 7 5 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | | |
| TOTAL HPCDD | 10/11 | 419 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | | |
| TOTAL HPCDF | 5/11 | 19 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | | |
| TOTAL HXCDD | 2/11 | 4 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | | |
| TOTAL HXCDF | 2/11 | 17 8 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | | |
| TOTAL PECDD | 1/11 | 0 45 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | | |
| TOTAL TCDD | 1/11 | 1 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | | |
| **Energetics (mg/kg)** | | | | | | | | | | | | | | | |
| 1,3,5-TRINITROBENZENE | 3/48 | 11 | 0.38 | 29 | 3 | NA | NA | NA | NA | NA | NA | NA | -Low frequency of detection (detected in 3 of 48 samples), locations of detections are gravel covered and poor habitat for plants and invertebrates | Acceptable | No |
| 2,4,6-TRINITROTOLUENE | 4/48 | 1,700 | NA | NA | NA | NA | NA | 30 | 140 | NA | NA | NA | -Concentrations in the vicinity of the former burn pit (03SS24 and 03SS22) are greater than alternate benchmarks.<br>-Detected in only 4 of 48 samples and only the two greatest detections are greater than alternate benchmarks indicating the contamination is localized to the area of the former burn pit.<br>-Soil at locations of maximum concentrations (03SS24 and 03SS22) consists of sand, gravel, and trace silt and clays, therefore, significant numbers of earthworms are not likely to inhabit the area | Acceptable | No |
| 2-AMINO-4,6-DINITROTOLUENE | 7/48 | 30 | NA | NA | NA | NA | NA | 80 | 80[5] | NA | NA | NA | -Maximum concentration is less than alternate benchmarks | Acceptable | No |
| 2-NITROTOLUENE | 1/48 | 0 28 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | -Low frequency of detection (detected in 1 of 48 samples)<br>-Location of single detected concentration is in the road bed on the edge of the Jeep Trail and is covered with gravel, poor habitat for plants and invertebrates | Acceptable | No |
| 4-AMINO-2 6-DINITROTOLUENE | 7/48 | 15 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | -Maximum concentration is less than alternate benchmarks for 2-amino-4,6-dinitrotoluene (used as a surrogate) | Acceptable | No |
| HMX | 9/47 | 1,600 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | -Only maximum concentration exceeds a LOEC reported in the literature (280 mg/kg) A NOEC was not available<br>-Soil at location of maximum concentration (03SS24) consists of sand gravel and trace silt and clays therefore significant numbers of earthworms are not likely to inhabit the area<br>-Toxicological data for plants is not available however surrounding areas are well vegetated | Acceptable | No |
| RDX | 6/48 | 2 400 | NA | NA | NA | NA | NA | 100 | NA | NA | NA | NA | -Maximum concentration exceeded alternate benchmarks reported in the literature<br>-Soil at locations of maximum concentrations (03SS24 and 03SS22) consists of sand, gravel, and trace silt and clays therefore, significant numbers of earthworms are not likely to inhabit the area | Acceptable | No |
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | | | | |
| DI-N-BUTYL PHTHALATE | 9/45 | 4,500 | 150 | 30 | 5 | NA | NA | NA | NA | NA | 200 000 | NA | -Maximum is two orders of magnitude less than ORNL Plant value<br>-Maximum concentration is two orders of magnitude less than ORNL earthworm value for dimethylphthalate (used as a surrogate) | Acceptable | No |
| NAPHTHALENE | 4/45 | 130 | 99 4 | 1 3 | 1 | NA | NA | NA | NA | 600 | NA | NA | -Maximum concentration is less than the Canadian SQG | Acceptable | No |
| **Inorganics (mg/kg)** | | | | | | | | | | | | | | | |
| BARIUM | 32/32 | 2,040 | 1 04 | 1962 | 32 | NA | 330 | NA | NA | NA | 500 | NA | -Concentrations in four of 32 samples exceed the Eco-SSL for earthworms<br>-Heavily vegetated area does not appear that vegetation is being adversely impacted<br>-Area of elevated concentrations appear to be limited to vicinity of maximum concentration nearest to sample locations 03SS47 and 03SS48 where concentrations are less than alternate benchmarks | Acceptable | No |
| BERYLLIUM | 31/32 | 1 4 | 1 06 | 1 3 | 4 | NA | 40 | NA | NA | NA | 10 | NA | -Maximum concentration is less than ORNL Plant value and Eco-SSL | Acceptable | No |

TABLE 8-1

STEP 3A EVALUATION FOR RISKS TO PLANTS AND INVERTEBRATES
SURFACE SOIL COPCs
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern (COPC) | Frequency of Detection | Maximum Detected Concentration | Region V EDQLs | Maximum EEQ[1] | Number of Samples > Screening Level[2] | Step 3a Evaluation | | | | | | | | Risk Determination (Acceptable/ Unacceptable) | Retained as a COPC? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Alternate Benchmarks[3] | | | | | | | Other Step 3a Factors Considered in Evaluation[4] | | |
| | | | | | | Eco-SSL | | Talmage et al., 1999 | | Canadian SQG | ORNL Benchmarks | | | | |
| | | | | | | Plant | Earthworm | Plants | Earthworm | | Plant | Earthworm | | | |
| CADMIUM | 29/32 | 4 4 | 0 002 | 1982 | 29 | 32 | 140 | NA | NA | NA | NA | NA | -Maximum concentration is less than Eco-SSLs | Acceptable | No |
| CHROMIUM | 32/32 | 288 | 0 4 | 720 | 32 | NA | NA | NA | NA | 64 | NA | NA | -Alternate benchmarks appear overly conservative because they are based on total chromium concentrations chromium in soil at SWMU 03 is likely trivalent because hexavalent chromium (the more toxic form of chromium) rapidly degrades in the environment.<br>-The two greatest concentrations are located in a small (30 feet by 60 feet) isolated depression.<br>-Only maximum concentration exceeds SQG, all other detections are less than SQG. | Acceptable | No |
| COPPER | 32/32 | 63.9 | 2 96 | 22 | 32 | NA | NA | NA | NA | 63 | 100 | 60 | -Maximum concentration is less than ORNL Plant value and only slightly greater than ORNL earthworm value and Canadian SQG | Acceptable | No |
| IRON | 32/32 | 51,600 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | -Micronutrient for plant growth; not toxic to plants in well aerated soils with pH levels between 5 to 8 S U ; pH concentrations in soil at NSWC Crane are in the range of 5 to 8 5 S U. Only one sample collected at NSWC Crane had a pH greater than 8 S U pH concentrations at SWMU 03 are likely in the same range as those across NSWC Crane<br>-Maximum and average site concentrations (51,600 mg/kg and 23,437 mg/kg) are similar to maximum and average facility background soil concentrations (40,800 mg/kg and 18,100 mg/kg)<br>-Not typically bioavailable in the environment. | Acceptable | No |
| LEAD | 32/32 | 10,200 | 0 054 | 189838 | 32 | 115 | 1700 | NA | NA | NA | NA | NA | -Maximum concentration is greater than Eco-SSLs; most other concentrations are less than 30 mg/kg<br>-Area of potential risk appears isolated to former burn pit<br>-Soil at location of maximum concentration (03SS24) consists of sand, gravel, and trace silt and clays; therefore, vegetation is not present and significant numbers of earthworms are not likely to inhabit the area | Acceptable | No |
| MERCURY | 31/32 | 0 26 | 0 07 | 3 6 | 10 | NA | NA | NA | NA | 12 | NA | NA | -Maximum detection is less than the SQG. | Acceptable | No |
| NICKEL | 32/32 | 32 6 | 13 6 | 2 4 | 23 | NA | NA | NA | NA | 50 | NA | NA | -Maximum detection is less than the SQG | Acceptable | No |
| ZINC | 32/32 | 739 | 6 62 | 112 | 32 | NA | NA | NA | NA | 200 | NA | NA | -Four detected concentrations exceed the Canadian SQG, however only maximum concentration is much greater than the SQG, concentrations in three other samples only slightly exceeded the SQG (211 mg/kg, 230 mg/kg, and 211 mg/kg)<br>-The two greatest concentrations are located in a small (30 feet by 60 feet) isolated depression | 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 Alternate benchmarks were only used in the absence of Eco-SSLs
4 See Section 8 6 1 1 for a more detailed Step 3a evaluation
5 Value is based on soil microbial processes

EDQLs - Ecological data quality levels
EEQ - Ecological effects quotient
NA - Not Available or Not Applicable
SQG - Soil Quality Guideline
ORNL - Oak Ridge National Laboratory
NOEC - No Observed Effect Concentration
LOEC - Lowest Observed Effect Concentration
Eco-SSL - U S EPA Ecological Soil Screening Level
S U - Standard Units

TABLE 8-2

STEP 3A EVALUATION FOR RISKS TO BENTHIC ORGANISMS
SHALLOW AND DEEP SEDIMENT COPCs
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern (COPC) | Shallow/Deep | Frequency of Detection | Maximum Detected Concentration | Region V EDQLs[1] | Maximum EEQ | Number of Samples > Screening Level[2] | Step 3a Evaluation: Alternate Benchmarks: Consensus-based: TEC | PEC | Long et al , 1995: ER-L | ER-M | Other Step 3a Factors Considered in Evaluation[3] | Risk Determination (Acceptable/ Unacceptable) | Retained as a COPC? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semivolatile Organics (µg/kg)** | | | | | | | | | | | | | |
| ACENAPHTHENE | shallow | 1/15 | 25 | 6 7 | 3.7 | 1 | NA | NA | NA | NA | -Low frequency of detection (one of 15 shallow sediment samples), detected at downstream location 03SD18 where it does not appear that aquatic receptors have been impacted<br>-Not detected in deep sediment samples | Acceptable | No |
| DI-N-BUTYL PHTHALATE | shallow | 2/15 | 590 | 111 | 5 3 | 1 | NA | NA | NA | NA | -Maximum concentration is less than the new ESL (1,114 ug/kg) | Acceptable | No |
| | deep | 2/15 | 880 | 111 | 8 | 1 | NA | NA | NA | NA | | | |
| DIPHENYLAMINE | shallow | 3/15 | 420 | 35 | 12 | 3 | NA | NA | NA | NA | -Not detected in deep sediment samples<br>-Diphenylamine was not detected in any other media at SWMU 03, source of contamination is burial and burning of waste materials and so it does not appear that sediment concentrations are related to site activities. | Acceptable | No |
| **Energetics (mg/kg)** | | | | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | shallow | 4/15 | 0 69 | NA | NA | NA | NA | NA | NA | NA | -Maximum concentrations are less than NOEC, LC50, and LOEC values of 22 4 mg/kg, 36 8 mg/kg, and 60 8 mg/kg reported by Condor et al., 2004 for TNT and its degradation products (ANTs and DNTs). | Acceptable | No |
| | deep | 5/15 | 2 2 | NA | NA | NA | NA | NA | NA | NA | | | |
| 2-AMINO-4,6-DINITROTOLUENE | shallow | 1/15 | 0 37 | NA | NA | NA | NA | NA | NA | NA | | Acceptable | No |
| | deep | 2/15 | 0 73 | NA | NA | NA | NA | NA | NA | NA | | | |
| 4-AMINO-2,6-DINITROTOLUENE | deep | 1/15 | 0.4 | NA | NA | NA | NA | NA | NA | NA | | Acceptable | No |
| 2,4-DINITROTOLUENE | shallow | 1/15 | 1 1 | 0 1 | 15 | 1 | NA | NA | NA | NA | | Acceptable | No |
| HMX | shallow | 3/15 | 130 | NA | NA | NA | NA | NA | NA | NA | -Maximum concentrations are less than a LOEC reported in the literature in which survival of *Chironomus tentans* was not statistically different from controls at concentrations as high as 146 mg/kg | Acceptable | No |
| | deep | 4/15 | 19 | NA | NA | NA | NA | NA | NA | NA | | | |
| RDX | deep | 2/15 | 0 45 | NA | NA | NA | NA | NA | NA | NA | -Maximum concentration is less than a LOEC in which survival of *Chironomus tentans* was not statistically different from control samples at concentrations as high as 711 mg/kg | Acceptable | No |
| **Pesticides/PCB's (µg/kg)** | | | | | | | | | | | | | |
| METHOXYCHLOR | shallow | 1/15 | 17 | 3 6 | 4 7 | 1 | NA | NA | NA | NA | -Detected concentration is less than the Ecotox Threshold (19 ug/kg) | Acceptable | No |
| **Herbicides (µg/kg)** | | | | | | | | | | | | | |
| 2,4-D | shallow | 7/10 | 20 | 5.8 | 3 5 | 8 | NA | NA | NA | NA | -Maximum concentrations are less than new ESL (1,273 ug/kg). | Acceptable | No |
| | deep | 5/12 | 28 | 5 79 | 4 8 | 5 | NA | NA | NA | NA | | | |
| **Inorganics (mg/kg)** | | | | | | | | | | | | | |
| ALUMINUM | shallow | 15/15 | 23,200 | NA | NA | NA | NA | NA | NA | NA | -Only maximum concentration in deep sediment is greater than TEL (25 500 mg/kg),all other shallow and deep sediment concentrations are less than TEL<br>-Location 03SD11 is poor aquatic habitat | Acceptable | No |
| | deep | 15/15 | 56 900 | NA | NA | NA | NA | NA | NA | NA | | | |
| ANTIMONY | shallow | 8/15 | 7 6 | NA | NA | NA | NA | NA | 2 | 25 | -Four out of 15 shallow sediment samples exceeded the ERL maximum concentration is less than ER-M<br>-Only one location exceeding ER-L is present in perennial portion of LSC<br>-Not detected in deep sediment in perennial portion of LSC<br>-Eliminated as a COPC in surface soil due to background | Acceptable | No |
| | deep | 8/15 | 6 7 | NA | NA | NA | NA | NA | 2 | 25 | | | |
| BARIUM | shallow | 15/15 | 853 | NA | NA | NA | NA | NA | NA | NA | -Maximum concentrations are greater than the AET (48 mg/kg)<br>-Concentrations are greatest in samples collected within the ABG concentrations decrease further downgradient but still exceed upgradient sediment concentrations<br>-Portions of LSC upgradient of Spring C are poor habitat for aquatic receptors and significant impacts are unlikely because the number of receptors is limited by the poor habitat<br>-Perennial portions of LSC are currently supporting a variety of aquatic receptors indicating impacts from barium are not significant | Acceptable | No |
| | deep | 15/15 | 981 | NA | NA | NA | NA | NA | NA | NA | | | |

TABLE 8-2

STEP 3A EVALUATION FOR RISKS TO BENTHIC ORGANISMS
SHALLOW AND DEEP SEDIMENT COPCs
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern (COPC) | Shallow/Deep | Frequency of Detection | Maximum Detected Concentration | Region V EDQLs[1] | Maximum EEQ | Number of Samples > Screening Level[2] | Step 3a Evaluation: Alternate Benchmarks: Consensus-based: TEC | PEC | Long et al., 1995: ER-L | ER-M | Other Step 3a Factors Considered in Evaluation[3] | Risk Determination (Acceptable/ Unacceptable) | Retained as a COPC? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CADMIUM | shallow | 15/15 | 3 5 | 0 6 | 5 9 | 12 | 0 99 | 4 98 | NA | NA | -Maximum concentrations are greater than TEC but less than PEC<br>-Portions of LSC upgradient of Spring C are poor habitat for aquatic receptors and significant impacts are unlikely because the number of receptors is limited by the poor habitat<br>-Perennial portions of LSC are currently supporting a variety of aquatic receptors indicating impacts from cadmium are not significant | Acceptable | No |
| | deep | 14/15 | 4 | 0 6 | 6 7 | 10 | 0 99 | 4.98 | NA | NA | | | |
| COPPER | shallow | 15/15 | 198 | 16 | 12 | 12 | 31 6 | 149 | NA | NA | -The maximum concentrations are greater than the PEC<br>-Portions of LSC upgradient of Spring C are poor habitat for aquatic receptors and significant impacts are unlikely because the number of receptors is limited by the poor habitat<br>-Concentrations at some locations in the perennial portion of LSC are greater than the TEC, concentrations at other locations are greater than the TEC however, those areas are typically wet only during heavy rain events | Acceptable | No |
| | deep | 15/15 | 273 | 16 | 17 | 11 | 31 6 | 149 | NA | NA | | | |
| LEAD | shallow | 15/15 | 653 | 31 | 21 | 12 | 35 8 | 128 | NA | NA | -The maximum concentrations are located upgradient of the OJT within the ABG and exceed the TEC and PEC<br>-Portions of LSC upgradient of Spring C are poor habitat for aquatic receptors and significant impacts are unlikely because the number of receptors is limited by the poor habitat<br>-Perennial portions of LSC are currently supporting a variety of aquatic receptors indicating impacts from lead are not significant<br>-Pattern of elevated concentrations indicate ABG is the source of lead contamination | Acceptable | No |
| | deep | 15/15 | 445 | 31 | 14 | 11 | 35.8 | 128 | NA | NA | | | |
| TIN | shallow | 2/15 | 13.8 | NA | NA | NA | NA | NA | NA | NA | -The detections are located in intermittent portions of LSC where permanent aquatic habitat does not exist. | Acceptable | No |
| | deep | 3/15 | 4 1 | NA | NA | NA | NA | NA | NA | NA | | | |
| ZINC | shallow | 15/15 | 385 | 120 | 3 2 | 9 | 121 | 459 | NA | NA | -Concentrations exceed the TEC in 10 shallow and 8 deep samples<br>-The maximum concentration in deep samples is greater than the PEC<br>-Pattern of elevated concentrations indicate there may be multiple sources of zinc<br>-Portions of LSC upgradient of Spring C are poor habitat for aquatic receptors and significant impacts are unlikely because the number of receptors is limited by the poor habitat<br>-Perennial portions of LSC are currently supporting a variety of aquatic receptors indicating impacts from cadmium are not significant | Acceptable | No |
| | deep | 15/15 | 1,120 | 120 | 9 3 | 8 | 121 | 459 | NA | NA | | | |

Footnotes
1 The assessment endpoint for the EDQL is not known it is the lower value for the protection of either plants invertebrates or wildlife
2 Number of samples with concentrations greater than the screening level
3 See Section 8 6 1 2 for a more detailed Step 3a evaluation

EDQLs - Ecological data quality level
TEC - Threshold Effects Concentration
PEC - Probable Effects Concentration
ER-L - Effects range-low
ER-M - Effects range-median
TEL - Threshold effects level
AET - Apparent Effects Threshold
NA = Not Available or Not Applicable
LOEC = Lowest Observed Effect Concentration
NOEC = No Observed Effect Concentration
LC50 = Lethal Concentration 50
ESL = Ecological Screening Level
OJT = Old Jeep Trail
LSC = Little Sulphur Creek
ABG = Ammunition Burning Grounds

TABLE 8-3

STEP 3A EVALUATION FOR RISKS TO AQUATIC ORGANISMS
LOW-FLOW AND HIGH-FLOW SURFACE WATER COPCs
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern (COPC) | LOW/HIGH FLOW | Frequency of Detection | Maximum Detected Concentration (µg/L) | Region V EDQLs[1] (µg/L) | Maximum EEQ[1] | Number of Samples > Screening Level[2] | Step 3a Evaluation: Chronic AWQC | Step 3a Evaluation: Other Step 3a Factors Considered in Evaluation[3] | Risk Determination (Acceptable/ Unacceptable) | Retained as a COPC? |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics** | | | | | | | | | | |
| BROMOMETHANE | LOW | 3/6 | 1.6 | NA | NA | NA | NA | -Detected in three low-flow samples and not at all in high flow samples<br>-Maximum concentration is less than new ESL of 16 ug/L. | Acceptable | No |
| BIS(2-ETHYLHEXYL)PHTHALATE | HIGH | 2/11 | 6 | 2.1 | 2.9 | 2 | NA | -Two detections are only slightly greater than EDQL<br>-Two detections are located in intermittent portions of LSC and do not support permanent aquatic life; water was not present at these locations during sample collection under low flow conditions.<br>-Bis(2-ethylhexyl)phthalate was not detected in any low flow samples | Acceptable | No |
| **Energetics** | | | | | | | | | | |
| 2,4,6-TRINITROTOLUENE | LOW | 1/6 | 0.56 | NA | NA | NA | NA | -Maximum concentration is less than water quality criterion of 90 ug/L | Acceptable | No |
| 2-AMINO-4,6-DINITROTOLUENE | LOW | 2/6 | 0.75 | NA | NA | NA | NA | -Maximum concentrations are less than secondary chronic value (SCV) of 20 ug/L. | Acceptable | No |
| | HIGH | 1/11 | 1.5 | NA | NA | NA | NA | | | |
| 4-AMINO-2,6-DINITROTOLUENE | LOW | 4/6 | 1.7 | NA | NA | NA | NA | -Maximum concentrations are less than SCV reported for 2-ADNT (used as a surrogate) of 20 ug/L | Acceptable | No |
| | HIGH | 2/11 | 2.9 | NA | NA | NA | NA | | | |
| HMX | LOW | 6/6 | 12 | NA | NA | NA | NA | -Maximum concentrations are less than SCV of 330 ug/L. | Acceptable | No |
| | HIGH | 10/11 | 90 | NA | NA | NA | NA | | | |
| RDX | LOW | 6/6 | 11 | NA | NA | NA | NA | -Maximum concentrations are less than SCV of 190 ug/L. | Acceptable | No |
| | HIGH | 9/11 | 63 | NA | NA | NA | NA | | | |
| NITROCELLULOSE | HIGH | 1/11 | 3,200 | NA | NA | NA | NA | -Maximum concentration is less than mean toxic doses reported in the PAN database for aquatic organisms (10,000 ug/L to 100,000 ug/L) | Acceptable | No |
| **Herbicides** | | | | | | | | | | |
| 2,4-D | HIGH | 2/11 | 0.36 | NA | NA | NA | NA | -The maximum concentration is less than current ESL (220 ug/L) | Acceptable | No |
| **Metals** | | | | | | | | | | |
| CADMIUM | HIGH | 3/11 | 1 4 | 0.66 | 2 | 3 | NA | -Not retained as a COPC in filtered samples (which represents bioavailable portion of water column) | Acceptable | No |
| COPPER | HIGH | 11/11 | 18 4 | 5 | 3 7 | 5 | 9 | -The maximum concentration in filtered samples (7 6 ug/L) is less than AWQC this location (09SW09) is located in a dry stream bed under low-flow conditions | Acceptable | No |
| LEAD | LOW | 6/6 | 20 | 1.3 | 15 | 1 | 2 5 | -The maximum concentration of lead in filtered samples during high flow conditions exceeds the AWQC; this location does not support aquatic life under low flow conditions.<br>-Concentrations at locations collected in the perennial portions of LSC were less than the AWQC. | Acceptable | No |
| | HIGH | 11/11 | 285 | 1 3 | 219 | 6 | 2 5 | | | |

TABLE 8-3

STEP 3A EVALUATION FOR RISKS TO AQUATIC ORGANISMS
LOW-FLOW AND HIGH-FLOW SURFACE WATER COPCs
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE
CRANE, INDIANA
PAGE 2 OF 2

| Chemical of Potential Concern (COPC) | LOW/HIGH FLOW | Frequency of Detection | Maximum Detected Concentration (µg/L) | Region V EDQLs[1] (µg/L) | Maximum EEQ[1] | Number of Samples > Screening Level[2] | Step 3a Evaluation | | Risk Determination (Acceptable/ Unacceptable) | Retained as a COPC? |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Chronic AWQC | Other Step 3a Factors Considered in Evaluation[3] | | |
| IRON | LOW | 6/6 | 154 | NA | NA | NA | 1,000 | -Iron was selected as a COPC in filtered low flow samples only; iron concentrations in unfiltered low and high flow samples and filtered high flow samples were less than background concentrations.<br>-An EDQL for iron is not available; the maximum concentration is less than the AWQC | Acceptable | No |
| ZINC | HIGH | 11/11 | 111 | 59 | 2 | 2 | NA | -Not retained as a COPC in filtered samples (which represents bioavailable portion of water column) | Acceptable | No |

Footnotes:
1 The assessment endpoint for the EDQL is not known; it is the lower value for the protection of either plants, invertebrates, or wildlife.
2 Number of samples with concentrations greater than the screening level.
3 See Section 8 6.1.3 for a more detailed Step 3a evaluation

EDQLs - Ecological data quality levels
EEQ - Ecological Effects Quotient
AWQC - Ambient Water Quality Criterion
NA - Not Available
LSC = Little Sulphur Creek
ESL = Ecological Screening Level

## TABLE 8-4

## EXPOSURE PARAMETERS FOR THE TERRESTRIAL WILDLIFE MODEL
## NSWC CRANE
## CRANE, INDIANA

| Species/Exposure Inputs | Conservative Inputs | | Average Inputs | | Source |
|---|---|---|---|---|---|
| | Values | Units | Values | Units | |
| ***Meadow Vole*** | | | | | |
| Body Weight = BW | 3.290E-02 | kg | 3.663E-02 | kg | U.S. EPA, 1993 |
| Food Ingestion Rate = If | 1.280E-02 | kg/day | 1.190E-02 | kg/day | U.S. EPA, 1993 |
| Water Ingestion Rate = Iw | 7.700E-03 | L/day | 6.400E-03 | L/day | U.S. EPA, 1993 |
| Soil Ingestion Rate - Is | 3.070E-04 | kg/day | 2.860E-04 | kg/day | Beyer, 1993 |
| Home Range = HR | Assume 100% on site | | 3.000E-02 | acres | U.S. EPA, 1993 |
| ***Short-Tailed Shrew*** | | | | | |
| Body Weight = BW | 1.525E-02 | kg | 1.687E-02 | kg | U.S. EPA, 1993 |
| Food Ingestion Rate = If | 1.620E-02 | kg/day | 1.030E-02 | kg/day | U.S. EPA, 1993 |
| Water Ingestion Rate = Iw | 4.300E-03 | L/day | 3.800E-03 | L/day | U.S. EPA, 1993 |
| Soil Ingestion Rate - Is | 2.106E-03 | kg/day | 1.339E-03 | kg/day | Beyer, 1993 |
| Home Range = HR | Assume 100% on site | | 9.700E-01 | acres | U.S. EPA, 1993 |
| ***American Robin*** | | | | | |
| Body Weight = BW | 7.730E-02 | kg | 8.100E-02 | kg | U.S. EPA, 1993 |
| Food Ingestion Rate = If | 1.231E-01 | kg/day | 9.760E-02 | kg/day | U.S. EPA, 1993 |
| Water Ingestion Rate = Iw | 1.210E-02 | L/day | 1.130E-02 | L/day | U.S. EPA, 1993 |
| Soil Ingestion Rate - Is | 1.280E-02 | kg/day | 1.015E-02 | kg/day | Beyer, 1993 |
| Home Range = HR | Assume 100% on site | | 1.190E+00 | acres | U.S. EPA, 1993 |
| ***Bobwhite Quail*** | | | | | |
| Body Weight = BW | 1.620E-01 | kg | 1.770E-01 | kg | U.S. EPA, 1993 |
| Food Ingestion Rate = If | 1.640E-02 | kg/day | 1.440E-02 | kg/day | U.S. EPA, 1993 |
| Water Ingestion Rate = Iw | 2.310E-02 | L/day | 1.840E-02 | L/day | U.S. EPA, 1993 |
| Soil Ingestion Rate - Is | 1.345E-03 | kg/day | 1.181E-03 | kg/day | Beyer, 1993 |
| Home Range = HR | Assume 100% on site | | 2.860E+01 | acres | U.S. EPA, 1993 |
| ***Raccoon*** | | | | | |
| Body Weight = BW | 5.340E+00 | kg | 6.864E+00 | kg | USEPA, 1993 |
| Food Ingestion Rate = If | 1.651E+00 | kg/day | 1.339E+00 | kg/day | USEPA, 1993 |
| Water Ingestion Rate = Iw | 5.698E-01 | L/day | 5.664E-01 | L/day | USEPA, 1993 |
| Sediment Ingestion Rate - Is | 1.552E-01 | kg/day | 1.258E-01 | kg/day | Beyer, 1993 |
| Home Range = HR | Assume 100% on site | | 3.855E+02 | acres | USEPA, 1993 |
| ***Belted Kingfisher*** | | | | | |
| Body Weight = BW | 1.360E-01 | kg | 1.520E-01 | kg | USEPA, 1993 |
| Food Ingestion Rate = If | 7.580E-02 | kg/day | 6.890E-02 | kg/day | USEPA, 1993 |
| Water Ingestion Rate = Iw | 1.870E-02 | L/day | 1.670E-02 | L/day | USEPA, 1993 |
| Soil Ingestion Rate - Is | 1.516E-03 | kg/day | 1.378E-03 | kg/day | Beyer, 1993 |
| Home Range = HR | Assume 100% on site | | 2.185E+00 | km | USEPA, 1993 |

TABLE 8-5

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS - CONSERVATIVE CONCENTRATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE, INDIANA

| | Herbivores | | | | Insectivores | | | |
|---|---|---|---|---|---|---|---|---|
| | Meadow Vole | | Bobwhite Quail | | Short-Tailed Shrew | | American Robin | |
| Parameter | NOAEL EEQ | LOAEL EEQ | NOAEL EEQ | LOAEL EEQ | NOAEL EEQ | LOAEL EEQ | NOAEL EEQ | LOAEL EEQ |
| **Dioxins/Furans** | | | | | | | | |
| TEQ Bird | NA | NA | 4.6E-03 | 4.6E-04 | NA | NA | 3.1E+00 | 3.1E-01 |
| TEQ Mammal | 8.7E-03 | 8 7E-04 | NA | NA | 1.6E+00 | 1.6E-01 | NA | NA |
| **Energetics** | | | | | | | | |
| 1,3,5-Trinitrobenzene | 6 7E-03 | 1.3E-03 | | | 6.2E-03 | 1.2E-03 | | |
| 2,4,6-Trinitrotoluene | 2.7E-02 | 2.7E-03 | | | 1.1E-01 | 1.1E-02 | | |
| 2-Amino-4,6-dinitrotoluene | | | | | | | | |
| 2-Nitrotoluene | 1.1E-04 | 1.1E-05 | | | 4.3E-04 | 4.3E-05 | | |
| 4-Amino-2,6-dinitrotoluene | | | | | | | | |
| Nitrocellulose | | | | | | | | |
| HMX | 2.8E+00 | 1.1E+00 | | | 1.2E+00 | 4.9E-01 | | |
| RDX | 3 2E-02 | 6.4E-03 | | | 3.8E-01 | 7.5E-02 | | |
| **Inorganics** | | | | | | | | |
| Cadmium | 6 0E-02 | 6 0E-03 | 8.8E-02 | 6 4E-03 | 5.3E-01 | 5 3E-02 | 8.7E+00 | 6.3E-01 |
| Chromium | 1.7E-02 | 4 3E-03 | 2.9E-01 | 5 7E-02 | 3 0E-01 | 7.4E-02 | 2.6E+01 | 5.1E+00 |
| Copper | 8 2E-03 | 6 4E-03 | 1.7E-02 | 1.3E-02 | 2.0E-02 | 1 5E-02 | 3.5E-01 | 2.7E-01 |
| Lead | 1.4E-01 | 1.4E-02 | 3.0E+00 | 3.0E-01 | 4 1E-01 | 4.1E-02 | 7.4E+01 | 7.4E+00 |
| Mercury | 1 5E-01 | 8 8E-02 | 2.4E+00 | 2 4E-01 | 4.4E-01 | 2 7E-01 | 8.0E+01 | 8.0E+00 |
| Nickel | 9 3E-03 | 4.6E-03 | 1 3E-02 | 9 1E-03 | 2 5E-02 | 1.2E-02 | 3.4E-01 | 2 4E-01 |
| Zinc | 2.0E-02 | 1 0E-02 | 5 7E-01 | 6.3E-02 | 1.0E-01 | 5.2E-02 | 3.1E+01 | 3.4E+00 |

**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

NA - Not applicable.
EEQ - Ecological Effects Quotient.
TEQ - Toxicity Equivalent.
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration

TABLE 8-6

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS - AVERAGE CONCENTRATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE, INDIANA

| | Herbivores | | | | Insectivores | | | |
|---|---|---|---|---|---|---|---|---|
| | Meadow Vole | | Bobwhite Quail | | Short-Tailed Shrew | | American Robin | |
| Parameter | NOAEL EEQ | LOAEL EEQ | NOAEL EEQ | LOAEL EEQ | NOAEL EEQ | LOAEL EEQ | NOAEL EEQ | LOAEL EEQ |
| **Dioxins/Furans** | | | | | | | | |
| TEQ Bird | NA | NA | 9.5E-04 | 9.5E-05 | NA | NA | 3.1E-01 | 3.1E-02 |
| TEQ Mammal | 1.9E-03 | 1.9E-04 | NA | NA | 1.1E-01 | 1.1E-02 | NA | NA |
| **Energetics** | | | | | | | | |
| HMX | 2.2E+00 | 8.9E-01 | | | 6.2E-01 | 2.5E-01 | | |
| **Inorganics** | | | | | | | | |
| Cadmium | 7.0E-03 | 7.0E-04 | 1.3E-02 | 9.3E-04 | 4.1E-02 | 4.1E-03 | 9.9E-01 | 7.2E-02 |
| Chromium | 9.5E-03 | 2.4E-03 | 1.9E-01 | 3.9E-02 | 4.0E-02 | 1.0E-02 | 4.6E+00 | 9.3E-01 |
| Lead | 2.3E-02 | 2.3E-03 | 1.0E+00 | 1.0E-01 | 9.6E-02 | 9.6E-03 | 2.4E+01 | 2.4E+00 |
| Mercury | 1.2E-02 | 7.0E-03 | 2.4E-01 | 2.4E-02 | 1.8E-02 | 1.1E-02 | 4.7E+00 | 4.7E-01 |
| Zinc | 2.9E-03 | 1.4E-03 | 1.1E-01 | 1.2E-02 | 1.2E-02 | 6.0E-03 | 5.2E+00 | 5.7E-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

NA - Not applicable.
EEQ - Ecological Effects Quotient.
TEQ - Toxicity Equivalent.
NOAEL - No Observed Adverse Effects Concentration.
LOAEL - Lowest Observed Adverse Effects Concentration.

TABLE 8-7

COMPARISON OF VEGETATION CONCENTRATIONS PREDICTED BY FOOD CHAIN-MODEL TO ACTUAL VEGETATION CONCENTRATIONS IN SAMPLES COLLECTED AT ABG IN 1994
NSWC CRANE
CRANE, INDIANA

| Chemical | Concentrations Predicted by Food Chain Model[1] | | Actual Tissue Concentrations in Previous Study[2] |
|---|---|---|---|
| | Predicted Concentration (mg/kg) in Conservative Scenario | Predicted Concentration (mg/kg) in Average Scenario | Average (Range) (mg/kg) |
| Cadmium | 1.16 | 0.156 | 0.32 (0.19 – 0.53) |
| Chromium | 0.664 | 0.309 | 0.34 (0.19 – 0.48) |
| Copper | 5.60 | 0.829 | 5.1 (2.4 – 8.7) |
| Lead | 21.1 | 1.76 | 1.6 (0.33 – 4) |
| Mercury | 0.143 | 0.0131 | Not Detected |
| Nickel | 8.09 | 0.0933 | 3.9 (0.47 – 13) |
| Zinc | 70.8 | 11.1 | 31.1 (12 – 67.7) |

1 See Section 8.6.3.1 of text for methodology used in food chain model. See Appendix H.5 for calculations through which vegetation concentrations were estimated from surface soil data.
2 Samples analyzed in 1995 consisted of hickory nuts, whitegrass, beechnuts, and red maple seedlings (TtNUS, Inc. 1999).

TABLE 8-8

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-CONSERVATIVE CONCENTRATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE, INDIANA

| Parameter | Piscivores | | | |
|---|---|---|---|---|
| | Raccoon | | Belted Kingfisher | |
| | NOAEL EEQ | LOAEL EEQ | NOAEL EEQ | LOAEL EEQ |
| **Semi-Volatiles** | | | | |
| Acenaphthene | 8.9E-03 | 4.4E-03 | 4.4E-04 | 4.4E-05 |
| **Pesticides** | | | | |
| Methoxychlor | 8.8E-02 | 4.4E-02 | | |
| **Energetics** | | | | |
| 2,4,6-Trinitrotoluene | 7.9E-03 | 7.9E-04 | | |
| 2,4-Dinitrotoluene | 8.9E-04 | 1.2E-04 | | |
| 2-Amino-4,6-dinitrotoluene | | | | |
| 4-Amino-2,6-dinitrotoluene | | | | |
| HMX | 9.2E-01 | 3.7E-01 | | |
| RDX | 2.9E-01 | 5.8E-02 | | |
| Nitrocellulose | | | | |
| **Herbicides** | | | | |
| 2,4-D | 5.5E-01 | 1.1E-01 | | |
| **Inorganics** | | | | |
| Cadmium | 3.9E+01 | 3.9E+00 | 1.6E+00 | 1.2E-01 |
| Copper | 3.7E+01 | 2.8E+01 | 1.8E+00 | 1.4E+00 |
| Lead | 5.6E+01 | 5.6E+00 | 2.0E+01 | 2.0E+00 |
| Selenium | 8.1E+00 | 4.9E+00 | 2.7E-01 | 1.3E-01 |
| Zinc | 3.4E+01 | 1.7E+01 | 2.6E+01 | 2.9E+00 |

**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

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

TABLE 8-9

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-AVERAGE CONCENTRATIONS
SWMU 03 - OLD JEEP TRAIL/LITTLE SULPHUR CREEK
NSWC CRANE, INDIANA

| | Piscivores | | | |
|---|---|---|---|---|
| | Raccoon | | Belted Kingfisher | |
| Parameter | NOAEL EEQ | LOAEL EEQ | NOAEL EEQ | LOAEL EEQ |
| **Inorganics** | | | | |
| Cadmium | 1.5E+00 | 1.5E-01 | 7.8E-02 | 5.7E-03 |
| Copper | 3.6E+00 | 2.8E+00 | 2.6E-01 | 2.0E-01 |
| Lead | 6.6E+00 | 6.6E-01 | 2.0E+00 | 2.0E-01 |
| Selenium | 3.3E+00 | 2.0E+00 | 1.8E-01 | 9.1E-02 |
| Zinc | 3.1E+00 | 1.6E+00 | 3.6E+00 | 4.0E-01 |

**Notes:**
- Cells are shaded if the EEQ is greater than 1.0

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

TABLE 8-10

COMPARISON OF AQUATIC ORGANISM CONCENTRATIONS PREDICTED BY FOOD-CHAIN MODEL TO TISSUE CONCENTRATIONS IN SAMPLES COLLECTED AT ABG IN 1995
NSWC CRANE
CRANE, INDIANA

| Chemical | Concentrations Predicted by Food Chain Model[1] | | Actual Tissue Concentrations in Previous Study[2] |
|---|---|---|---|
| | Predicted Concentration (mg/kg) in Conservative Scenario | Predicted Concentration (mg/kg) in Average Scenario | Average (Range) (mg/kg) |
| Cadmium | 4.11 | 0.224 | 0.08 (0.05 – 0.1) |
| Copper | 148 | 25.9 | 9.6 (1.6 – 45.1) |
| Lead | 37.0 | 2.47 | 0.49[3] |
| Selenium | 0.189 | 0.157 | 0.41 (0.2 – 0.67) |
| Zinc | 674 | 111 | 25.7 (13.4 – 42.4) |

1 See Section 8.6.3.1 of text for methodology used in food chain model. See Appendix H.5 for calculations through which vegetation concentrations were estimated from surface soil data.
2 Samples analyzed in 1995 consisted of frogs, crayfish, bass, suckers, and minnows (TtNUS, Inc. 1999).
3 Lead analytical results available only for one frog sample.

TABLE 8-11

STEP 3A EVALUATION FOR RISKS TO WILDLIFE
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern (COPC) | Frequency of Detection[1] | 95% UCL (mg/kg)[1] | Average Concentration (mg/kg)[1][2] | EEQs Using Average Exposure Values | | | | Basis of Wildlife Toxicity Reference Value (TRV) | 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** | | | | | | | | | | | |
| TEQ Mammal | 11/11 | 7.40E-06 | 2.01E-06 | None | NA | None | NA | NA | - NOAEL EEQ is less than 1 0 | Acceptable | No |
| TEQ Bird | 11/11 | 7.50E-06 | 1 92E-06 | None | NA | None | NA | NA | - NOAEL EEQ is less than 1 0 | Acceptable | No |
| HMX | 9/47 | 4 8 | 4 8 | 2 2 | Vole | None | NA | No significant increase in mortality was observed among mice consuming 30 mg/kg-day HMX, but a significant increase in mortality was observed in mice consuming 75 mg/kg-day | -LOAEL EEQ is less than 1 0<br>-Unlikely that herbivorous wildlife will obtain majority of food items from vicinity of any single sample since the home ranges are greater than the area represented by single samples.<br>-Two greatest detections at SWMU 03 are located at 03SS22 and 03SS24, however, these locations are grass covered and do not support vegetation that the meadow vole would feed on With these two locations excluded from the average concentrations; NOAEL EEQs are less than 1 0 | Acceptable | No |
| RDX | 6/48 | 3.4 | 3.4 | None | NA | None | NA | NA | - NOAEL EEQ is less than 1.0 | Acceptable | No |
| Cadmium | 29/32 | 1 2 | 0.9 | None | NA | None | NA | NA | - NOAEL EEQ is less than 1 0 | Acceptable | No |
| Chromium | 32/32 | 26 4 | 25.1 | 4 6 | Robin | None | NA | Black duckling survival was reduced at a dose concentration of 50 mg/kg; no significant impacts were observed at 10 mg/kg, TRVs adjusted for raccoon body weight difference. | -EEQs would be less if fresh weight ingestion factors were used<br>-Location of maximum concentration (03SS24) is skewing average concentration high and is not representative of where insectivorous birds would feed Location 03SS24 is gravel covered and surface soil consists of clayey silt, sand, and subsurface also consists of ash and cinders. Earthworms for which the robin could feed on are not likely present.<br>-Most detections of COPCs are within background ranges.<br>-Calculated doses are closer to NOAEL than LOAEL<br>-Bioavailability of the metals used in the toxicity test to develop the NOAELs and LOAELs are greater than the bioavailability of soil at the site | Acceptable | No |
| Lead | 32/32 | 150.6 | 150.6 | 24.0 | Robin | 2.4 | Robin | Reproduction not impaired at 10 mg/kg (NOAEL) | | | |
| Mercury | 31/32 | 0.1 | 0.1 | 4.7 | Robin | None | NA | Fewer eggs and mallard ducklings produced at a dose level of 0 5 mg/kg, LOAEL was divided by an uncertainty factor of 0.1 to develop a chronic NOAEL. | | | |
| Zinc | 32/32 | 129.6 | 101 2 | 5 2 | Robin | None | NA | LOAEL based on egg hatchability of hens which was <20% of controls | | | |
| **Piscivorous Wildlife** | | | | | | | | | | | |
| Cadmium | 29/30 | 1.8 | 1.3 | 1.5 | Raccoon | None | NA | Fetal implantations were reduced by 28%, fetal survivorship was reduced by 50% and fetal resorptions increased by 400% among rats exposed to 10 mg/kg/d dose of cadmium, no effects were observed at a dose of 1 mg/kg/d | -Home ranges of piscivorous birds and mammals are typically larger than SWMU 03, unlikely that piscivorous receptors will obtain 100 percent of their food from SWMU 03<br>-When area use factors are used in the food chain models (25 percent for the kingfisher and 10 percent for the raccoon) LOAEL based EEQs are less than 1 0 | Acceptable | No |
| Copper | 30/30 | 96 9 | 57 3 | 3 6 | Raccoon | 2 8 | Raccoon | Kit survivorship in mink was not affected at 25 mg/kg (NOAEL), TRVs adjusted for raccoon body weight difference | | | |
| Lead | 30/30 | 210 2 | 120 | 6 6 | 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. | | | |
| Selenium | 4/30 | 0 2 | 0 2 | 3 3 | Raccoon | 2 | Raccoon | Number of second generation young was reduced by 50% among females exposed to 2 5 mg/L selenium in drinking water; no effects were observed at 1.5 mg/L. | | | |
| Zinc | 30/30 | 308 7 | 197 9 | 3 6<br>3.1 | Kingfisher<br>Raccoon | 1 6 | Raccoon | At 4 000 mg/kg, rats showed increased rates of fetal resorption and reduced fetal growth rates; no effects were observed at 2,000 mg/kg | | | |

TABLE 8-11

STEP 3A EVALUATION FOR RISKS TO WILDLIFE
SWMU 03 - JEEP TRAIL
NSWC CRANE
CRANE, INDIANA


| Chemical of Potential Concern (COPC) | Frequency of Detection[1] | 95% UCL (mg/kg)[1] | Average Concentration (mg/kg)[1][2] | EEQs Using Average Exposure Values | | | | Basis of Wildlife Toxicity Reference Value (TRV) | 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 | | | | |

Footnotes.
1 - These columns present the Frequency of Detection and concentrations for soil (for insectivorous/herbivorous wildlife) or sediment (for piscivorous wildlife)
2 - The average concentrations were used except in cases where the 95% UCL was greater than the average concentration and the 95% UCL was then used
3 - See Section 8.6 2 2 for a more detailed Step 3a evaluation

EEQ - Ecological Effects Quotient
NA - Not available or not applicable
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
UCL = Upper 95 Percent Confidence Limit
TRV = Toxicity Reference Value
TEQ = Toxicity Equivalent

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