

9000015

EPA Region 5 Records Ctr.



225269

**HUMAN HEALTH RISK ASSESSMENT REPORT**

**LAKE CALUMET CLUSTER SITE:**  
**ALBURN, U.S. DRUM, AND UNNAMED PARCEL AREAS**

**FINAL REPORT**

Prepared for

City of Chicago Department of Environment  
Chicago, Illinois

By



**MWH**  
MONTGOMERY WATSON HARZA

February 2002

**TABLE OF CONTENT**

LIST OF TABLES..... iii  
LIST OF FIGURES.....iii  
LIST OF ACRONYMS..... vi

EXECUTIVE SUMMARY.....ES-1

1.0 INTRODUCTION..... 1-1

2.0 BACKGROUND.....2-1

    2.1 Site Location .....2-1

    2.2 Site Description.....2-1

    2.3 Site History .....2-1

    2.4 Geology/Hydrogeology.....2-1

        2.4.1 Regional Geology.....2-1

        2.4.2 Regional Hydrogeology .....2-2

        2.4.3 Site Geology.....2-2

        2.4.4 Site Hydrogeology.....2-2

    2.5 Site Investigation .....2-3

        2.5.1 Phase I.....2-3

        2.5.2 Phase II.....2-4

        2.5.3 Phase III.....2-4

        2.5.4 IEPA Site Investigation (SI).....2-4

3.0 SELECTION OF CONTAMINANTS OF POTENTIAL CONCERNS .....3-1

    3.1 Soil .....3-1

    3.2 Sediments.....3-1

    3.3 Surface Water.....3-2

    3.4 Groundwater .....3-2

    3.5 Essential nutrients .....3-2

4.0 EXPOSURE ASSESSMENT.....4-1

    4.1 Receptors.....4-1

    4.2 Exposure Pathway.....4-1

    4.3 Exposure Point Concentration .....4-2

    4.4 Quantification Of Exposure .....4-2

5.0 TOXICITY ASSESSMENT .....5-1

    5.1 Carcinogenic Health Effects Criteria And Assessment .....5-1

    5.2 Noncarcinogenic Health Effects Criteria And Assessment .....5-3

6.0 RISK CHARACTERIZATION .....6-1

    6.1 Carcinogenic Risks .....6-1

    6.2 Noncarcinogenic Hazards .....6-2

    6.3 Risk Characterization.....6-2

6.3.1	Album.....	6-3
6.3.2	U.S. Drum .....	6-3
6.3.3	Unnamed Parcel .....	6-4
7.0	UNCERTAINTIES .....	7-1
7.1	Exposure Assessment.....	7-1
7.2	Toxicity Assessment .....	7-1
7.3	Risk Characterization.....	7-1
8.0	CONCLUSIONS.....	8-1
9.0	REFERENCES.....	9-1

## LIST OF TABLES

- Table 3-1 Contaminants of Potential Concern in Album  
Table 3-2 Contaminants of Potential Concern in U.S. Drum  
Table 3-3 Contaminants of Potential Concern in Unnamed Parcel  
Table 4-1 Parameter Values for Exposure to Soil at the Lake Calumet Cluster Site  
Table 4-2 Exposure Factors for Dermal Contact with Groundwater and Surface Water  
Table 4-3 Exposure Factors for Dermal Contact with Sediment  
Table 4-4 Dermal Adsorption Factors  
Table 4-5 Permeability Constants  
Table 5-1 Toxicity Factors for Chemicals of Potential Concern (COPCs)  
Table 5-2 Critical Effects of Carcinogenic COPCs  
Table 5-3 Critical Effects of Non-Carcinogenic COPCs  
Table 6-1 Carcinogenic Risk and Noncarcinogenic Hazards for Each Media at Album  
Table 6-2 Summary of Carcinogenic COPCs at Album  
Table 6-3 Carcinogenic Risk and Noncarcinogenic Hazards for Each Media at U.S. Drum  
Table 6-4 Summary of Carcinogenic COPCs at U.S. Drum  
Table 6-5 Carcinogenic Risk and Noncarcinogenic Hazards for Soil and Groundwater at Unnamed Parcel  
Table 6-6 Summary of Carcinogenic COPCs at Unnamed Parcel

## LIST OF FIGURES

- Figure 1 Site Location Map  
Figure 2 Sample locations at the Cluster Site  
Figure 3 Conceptual Site Model

## APPENDICES

- Appendix A UCL<sub>95</sub> and EPC of Soil COPCs  
Appendix B Air Concentration Model of Groundwater COPCs  
Appendix C Risk Calculations Tables for Album, U. S. Drum and Unnamed Parcel

**LIST OF ACRONYMS**

<b>ADD</b>	<b>Average Daily Dose</b>
<b>bgs</b>	<b>Below Ground Surface</b>
<b>COPCs</b>	<b>Chemicals of Potential Concern</b>
<b>CSM</b>	<b>Site Conceptual Model</b>
<b>DOE</b>	<b>City of Chicago Department of Environment</b>
<b>E &amp; E</b>	<b>Ecology &amp; Environment, Inc</b>
<b>EDQL</b>	<b>Ecological Data Quality Levels</b>
<b>ELCR</b>	<b>Excess Lifetime Cancer Risks</b>
<b>EPC</b>	<b>Exposure Point Concentration</b>
<b>GPS</b>	<b>Global Positioning System</b>
<b>HHRA</b>	<b>Human Health Risk Assessment</b>
<b>HI</b>	<b>Hazard Index</b>
<b>HQ</b>	<b>Hazard Quotient</b>
<b>IAC</b>	<b>Illinois Administrative Code</b>
<b>IEPA</b>	<b>Illinois Environmental Protection Agency</b>
<b>ISWS</b>	<b>Illinois State Water Survey</b>
<b>LADD</b>	<b>Life Average Daily Dose</b>
<b>LOAEL</b>	<b>Lowest Observed Adverse Effect Level</b>
<b>MF</b>	<b>Modifying Factor</b>
<b>NOAEL</b>	<b>No Observed Adverse Effect Level</b>
<b>PAHs</b>	<b>Polynuclear Aromatic Hydrocarbons</b>
<b>PCBs</b>	<b>Polychlorinated Biphenyls</b>
<b>RAGS</b>	<b>Risk Assessment Guidance for Superfund</b>
<b>RfDs</b>	<b>Reference Doses</b>
<b>RO</b>	<b>Remediation Objectives</b>
<b>SF</b>	<b>Slope Factor</b>
<b>SI</b>	<b>Site Investigation</b>
<b>SVOC</b>	<b>Semivolatile Organic Compound</b>
<b>TACO</b>	<b>Tiered Approach to Corrective Action</b>
<b>TCLP</b>	<b>Toxic Characteristic Leaching Procedure</b>
<b>UCL</b>	<b>Upper-bound Confidence Limit</b>
<b>UF</b>	<b>Uncertainty Factor</b>
<b>USEPA</b>	<b>United States Environmental Protection Agency</b>
<b>VOC</b>	<b>Volatile Organic Compound</b>
<b>XRF</b>	<b>X-Ray Fluorescence</b>

## EXECUTIVE SUMMARY

This report describes and summarizes a human health risk assessment (HHRA) conducted at Alburn Incinerator (Alburn), U.S. Drum II (U.S. Drum), and Unnamed Parcel areas, referred as the Lake Calumet Cluster Site (Cluster Site), in Chicago, Cook County, Illinois. Soil, sediment, surface water and groundwater data collected and analyzed during several investigations at the Cluster Site were used in the HHRA. These site investigations include Phase I, Phase II and Phase III samplings conducted by Ecology & Environment, Inc. (E & E) and Illinois Environmental Protection Agency (IEPA) in 1998 and 1999; and a comprehensive site investigation (SI) conducted by IEPA in 2000. All laboratory-generated data were compiled and used in this risk assessment. The selection of Chemicals of Potential Concerns (COPCs) is based on different screening criteria in each media. For soil contaminants, the Tier I Soil Remediation Objectives (ROs) for residential scenario from IEPA's Tiered Approach to Corrective Action (TACO) were used as the screening criteria. Groundwater contaminants were screened against Class I groundwater ROs from TACO. The selection of COPCs in sediment and surface water were based on the evaluation conducted by E & E. The potential receptors for the Cluster Site include on-site workers, mowers, construction workers, industrial/commercial workers and landscape workers. Completed pathways for each potential receptor exposed to COPCs were identified. Carcinogenic risk and noncarcinogenic hazard for each potential receptor were quantitatively estimated. An excess lifetime cancer risk (ELCR) value and a hazard index (HI) value were estimated to evaluate the carcinogenic risks and noncarcinogenic hazards, respectively.

The risk characterization indicates that in Alburn, U.S. Drum and Unnamed Parcel, risks are primarily due to exposure to soil. Risks due to exposure to sediment, surface water and groundwater are insignificant. In Alburn, risks due to exposure to soil exceeds ELCR of  $1E-06$  for all receptors and the primary COPCs are arsenic, benzo(a)pyrene, total PCBs and vinyl chloride. For noncarcinogenic hazard, exposure to soil for construction workers exceed HI of 1 and the primary COPC is toluene. In U. S. Drum, the carcinogenic risk exceeds  $1E-06$  in soil for all receptors and the primary COPCs are arsenic, benzo(a)pyrene, dibenz(a,h)anthracene and total PCBs. In Unnamed Parcel, the carcinogenic risk due to exposure to contaminants in soil exceeds  $1E-06$  for on-site workers, industrial/commercial workers and mowers and the primary COPCs in soil for carcinogenic risk are arsenic and benzo(a)pyrene. No noncarcinogenic hazard exceeds 1 for all receptors due to exposure to contaminants in U. S. Drum and Unnamed Parcel.

## 1.0 INTRODUCTION

The City of Chicago Department of Environment (DOE) is currently investigating the Lake Calumet Cluster Site (Cluster Site), located in Chicago, Cook County, Illinois. The City has plans for developing this site. Future potential use of the Cluster Site includes use as a solar power generating station. Risk assessments are used to determine the need for remediation and to establish protective clean-up goals in the context of the desired end use for contaminated sites. This human health risk assessment (HHRA) addresses the potential risks associated with the Cluster site that could occur due to exposure to contaminants in the absence of remedial measures.

The HHRA was prepared in accordance with USEPA's "Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual, Part A" (USEPA, 1989), and other supplementary USEPA guidance documents, as listed below:

- Guidance for Data Usability in Risk Assessment, 1992a.
- Exposure Factors Handbook, 1997.
- Supplemental Guidance to RAGS: Calculating the Concentration Term, 1992b.

This HHRA report describes the methodology and assessment of human health risk. The report is organized as follows:

**1.0 Introduction:** Purpose and objectives of the HHRA

**2.0 Background:** Site characterization, description and history, site investigation

**3.0 Data Evaluation and Selection of Contaminants of Potential Concern**

**4.0 Exposure Assessment:** Identification of human receptors; description of the exposure pathways and quantification of exposure from each exposure pathway

**5.0 Toxicity assessment:** Identification of carcinogenic and noncarcinogenic health effects criteria and assessment

**6.0 Risk characterization:** Calculation of carcinogenic risks and noncarcinogenic hazards

**7.0 Uncertainties:** Discussion of uncertainties associated with the HHRA

**8.0 Conclusions:** Summary of the human health risk assessment

**9.0 References**

## 2.0 BACKGROUND

### 2.1 Site Location

The Cluster Site is located in the southeastern edge of Chicago, Illinois (Township 37 North Range 14 East, Section 24). The property is in the Lake Calumet region, a heavily industrialized area of southeast Chicago. Land and Lakes Landfill are located to the west of the property. Paxton I Landfill is to the north of the property. The Norfolk and Western Railroad right-of-way forms the eastern boundary, and 122<sup>nd</sup> Street forms the southern boundary of the site. A site location map is presented as Figure 1.

### 2.2 Site Description

The Cluster Site is approximately 87 acres and consists of unimproved upland with several depressional areas that are seasonally flooded. The National Wetland Inventory Map has identified approximately two acres within the lower depressional areas on site as permanently flooded open water wetlands. The relatively flat dry upland dips gently from west to east and is made up of grasses, weeds, bushes, trees, and paved roadways and yard areas.

### 2.3 Site History

The Lake Calumet region, prior to development in the late 1800s, was composed of wetlands, marshes, bogs, and shallow lakes. To make this region suitable for development, large areas of wetlands were filled in with slag wastes from steel production, dredgings from the Calumet River, fly ash, solid industrial wastes, demolition debris, and household trash (Roadcap and Kelly 1994).

### 2.4 Geology/Hydrogeology

This section describes the regional and site-specific geology and hydrogeology at the Cluster Site. The regional information is derived from geologic literature and available water well drilling logs obtained from the Illinois State Water Survey (ISWS). The site-specific geology and hydrogeology is based on test pits conducted during this site investigation and information obtained from previous site activities, including boring logs and monitoring well data.

#### 2.4.1 Regional Geology

The Cluster Site is located within the Chicago/Calumet Lacustrine Plain, which is a glacially formed, low, crescent-shaped flat surface that slopes gently to Lake Michigan. The Plain extends from the Wilmette, Illinois area to the Indiana-Michigan border and continues northward in a narrow band along the Michigan shore (Chrzastowski and Thompson, 1993). The Chicago/Calumet Lacustrine Plain surface is primarily a wave-scoured ground moraine with fine lake silts and clays covering the surface in former back-barrier settings. The prominent depositional features on the plain are sand and gravelly sand spits, mainland beaches, and beach-ridge/dune complexes. This lowland region drains into Lake Michigan. The bedrock geology of the region consists of Precambrian-age crystalline rock overlain by gently dipping Paleozoic sedimentary bedrock units. The uppermost bedrock unit consists of eastward gently dipping Silurian dolomite. The Racine formation, the youngest formation of the Silurian period,



underlies the area due to the eastward dip of the rock strata. The Racine formation includes a number of organic reefs, which consist of a core of massive, high-purity dolomite flanked by dipping dolomite beds. The bedrock surface topography is an undulating plain as a result of glacial and some lake erosion, in which scattered steep valleys and low bedrock hills occur. Mapping by Piskin and Bergstrom (1975) indicates that the bedrock is overlain by approximately 50 to 100 feet of unconsolidated Quaternary age deposits. According to Chrzastowski and Thompson (1993), the site is filled with a dark gray, silty clay till that is correlative to the Wadsworth Formation. This till unit intertongues with bedded sands and silt, which are assigned to the Henry and Equality Formation.

#### **2.4.2 Regional Hydrogeology**

According to Suter et al. (1959), the four primary aquifers recognized in the Chicago area are the Sand and Gravel Aquifers within the glacial drift, the Shallow Bedrock Aquifers mainly Silurian in age, the Cambrian-Ordovician Aquifer, and the Mt. Simon Aquifer.

The uppermost bedrock aquifer underlying the Lake Calumet region is composed of Silurian dolomites. Suter et al. (1959) have indicated that groundwater in the shallow dolomite occurs in joints, fissures, and solution cavities. Therefore, yields at any given location are unpredictable. The openings in the dolomite mainly occur in the upper part of the rock. Therefore, it is likely there is good connection between the shallow bedrock aquifers and the overlying glacial drift. It follows that where fractured dolomite is overlain by sand and gravel deposits there will be more immediate recharge of the shallow dolomite aquifer than in areas where glacial till rests on the bedrock.

The uppermost aquifer system identified in the vicinity of the Cluster Site is the glacial drift aquifer, composed of unconsolidated Quaternary deposits. In the vicinity of the site, the glacial drift aquifer consists of sands overlying and interbedded with glacial till.

#### **2.4.3 Site Geology**

Based on site investigations, the near surface geology consists of unconsolidated glacial deposits overlain by various fill materials over most of the site. From bottom to top, the following geologic materials, were encountered: Gray/Brown silty clay; Gray silty sand and Fill.

The gray/brown silty clay unit is the lowermost unit encountered at the site and is composed of silty clay with a trace of fine sand and gravel. The silty clay was encountered only in wells at depths ranging from 14.5 to 24 feet. The sand unit is composed of varying percentages of medium to fine grained sand with silt, and exhibits brown to gray color variations. The fill material is composed of various household wastes.

#### **2.4.4 Site Hydrogeology**

The hydrogeology of the site was described using data collected during monitoring well installation performed by Ecology and Environment Inc. (E &E) in 1999 (E & E, 1999a). Groundwater was encountered in all twelve wells at different elevations.

Data collected during monitoring well installation suggest that the aquifer is semi-confined with a head between 1 to 4 feet. Slightly confined conditions may be the result of clay layers within the fill material.

Groundwater in monitoring wells installed by E & E and in test pits performed during a site investigation conducted by IEPA in 2000 stabilized between ground surface and 10 feet below ground surface. In some low areas, the water table in the pits was encountered about 2 feet above ground surface.

Generalized potentiometric contours for fill and sand were developed using data collected during monitoring well installation (MWH, 2001). The contours demonstrate that flow onto the site is from the west and flow within the site is northeast, east, and southeast. Groundwater probably discharges to Indian Ridge Marsh to the east and Big Marsh to the north. Two landfills located northwest and southwest of the site may influence groundwater flow direction. The interaction between groundwater and surface water on the site is very complicated due to the extreme heterogeneity of the fill material and local flow direction may differ from general flow direction on the site.

No hydraulic conductivity tests were performed on site. The value of hydraulic conductivity cited in the literature for fine and medium sand is between  $1 \times 10^{-3}$  cm/s and  $1 \times 10^{-2}$  cm.

## 2.5 Site Investigation

Samples from the Cluster Site were collected and analyzed during several site investigations. These investigations include Phase I, Phase II, and Phase III samplings conducted by EPA's contractor E & E, EPA and IEPA in 1998 and 1999; and a site investigation conducted by IEPA in 2000. Samplings were conducted at three areas at the Cluster Site: Auburn, U.S. Drum and Unnamed Parcel. The media sampled include soil, sediment, surface water and groundwater. Figure 2 shows the sample locations at the Cluster Site.

### 2.5.1 Phase I

Phase I sampling activities were conducted from August 24, 1998 to September 3, 1998 by E & E, USEPA, and IEPA. Sampling included determining the location of site features and potential sample locations using global positioning systems (GPS), screening metal concentrations in surface soils using X-ray fluorescence (XRF), and collecting samples of surface soils, subsurface soils, sediments, surface water, groundwater, and macroinvertebrates. Access to the Auburn area was not available to E & E, USEPA, and IEPA. Therefore, no samplings were conducted at Auburn at this time.

The geographic locations of site features, including parking lots, roads and fence lines, and potential sample locations were demarcated using GPS and screened using XRF. Screening was conducted for molybdenum, strontium, rubidium, lead, arsenic, mercury, zinc, copper, nickel, cobalt, manganese, and chromium.

Sampling included:

- Eighty four surface soil samples and four duplicate samples;
- Five subsurface soil samples and one duplicate;
- Three groundwater samples; and
- Eight surface water, sediment, and macroinvertebrate samples.

Samples were analyzed for total metals, toxicity characteristic leaching procedure (TCLP) metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), pH, and percent moisture. Sample results indicated several discrete areas with contaminant concentrations exceeding human health standards and the ecological threshold.

### 2.5.2 Phase II

Twelve monitoring wells (LC01 to LC07 and LC09 to LC13) were installed in April 1999. Five wells were installed in October 1990 (P01 to P05). Wells were completed to depths of 14 to 16 feet below ground surface (bgs) except LC09 and LC11, which were completed to 20 feet bgs. Pairs of wells were constructed within five feet of each other creating nested well clusters at the following locations: LC09/LC10, and LC11/LC12. E & E (1999b) listed P05/LC07 as a well pair. No construction details are available in the report for P05; however, the other four wells constructed at the same time were placed 10 ft bgs or deeper. The nested wells allow groundwater to be collected from different depths in the same area.

The 12 new wells and 6 existing wells were sampled in May 1999 for total metals, VOCs, SVOCs, pesticides, PCBs, nitrogen, and pH. Field parameters were also collected including temperature, dissolved oxygen, specific conductivity, oxidation/reduction potential, and pH.

### 2.5.3 Phase III

Phase III sampling was performed in May-June 1999 and included: sampling at Auburn to address data gaps from Phase I; obtaining additional surface and subsurface soil data near areas of elevated concentrations identified in Phase I; collecting additional surface water and sediment samples at or near Auburn; and collecting nitrogen data from previous surface water locations. Soil samples included 39 surface samples, 15 subsurface samples between 2 and 3 ft bgs, and 15 subsurface samples between 4 and 6 ft bgs. Samples were analyzed for total metals, VOCs, SVOCs, pesticides, PCBs, pH, and percent moisture. Four surface water samples collected from ponded water in and near Auburn were analyzed for total metals, VOCs, SVOCs, pesticides, PCBs, and pH. Sixteen surface water samples were collected for nitrogen analysis (four in Auburn, eight in Indian Ridge Marsh, and four from large ponds). Seven sediment samples in and near Auburn were analyzed for total metals, VOCs, SVOCs, pesticides, PCBs, and percent moisture/percent solids.

### 2.5.4 IEPA Site Investigation (SI)

IEPA conducted site investigation activities at Auburn from June 19 through 22, 2000; Unnamed Parcel from July 17 through 20, 2000; and U.S. Drum from August 21 through 25, 2000. The investigative activities consisted of using a backhoe to sample a total of 134 test pits, including 44 test pits in Auburn, 39 test pits in Unnamed Parcel, and 51 test pits in U.S. Drum. The SI comprised sampling of soils from test pits. Two or more samples were collected from each of

134 test pit locations in the three areas. Samples were analyzed for inorganics, VOCs, SVOCs, pesticides/herbicides and PCBs. Dioxins were also analyzed in some locations.

### 3.0 SELECTION OF CONTAMINANTS OF POTENTIAL CONCERNS

The laboratory analytical data for samples collected during IEPA SI were generated following analytical procedures detailed in the United States Environmental Protection Agency (USEPA) and Illinois Environmental Protection Agency (IEPA) approved Quality Assurance Project Plans. Available analytical data from the SI were evaluated to determine usability in the risk assessment (EPA, 1992a). All laboratory generated analytical data were compiled and used in this risk assessment except for the screening level data generated during field investigations, which include metal data generated using XRF and groundwater samples collected using a geoprobe during Phase I. Data collected during Phase I, II and III were evaluated by E & E (1999b) and summarized in this section. The selection of contaminants of potential concern (COPCs), carcinogenic risk and noncarcinogenic hazard characterizations are discussed separately on Auburn, U.S. Drum and Unnamed Parcel areas in the Cluster Site.

#### 3.1 Soil

Soil samples collected and analyzed during the comprehensive SI conducted by IEPA during 2000 are used in this HHRA. Metals are naturally occurring in soil. Metal concentrations that do not exceed background levels are not considered in estimating carcinogenic risks and noncarcinogenic hazards. Contaminant concentrations in soil were compared against soil background values. The soil background values were obtained from title 35 of the Illinois Administration Code (IAC) Part 742, *Tiered Approach to Corrective Action Objectives (TACO)*(IEPA 2001). Background concentrations specific for counties within Metropolitan Areas were used in this evaluation. Analytes that were found to be present at concentrations exceeding background concentrations were retained for further evaluation. Chemical concentrations in soils were then screened against the Tier I Soil Remediation Objectives (ROs) from IEPA (2001). The analytical results were compared to ROs for residential scenario. Chemicals detected in soil at concentrations exceeding the residential RO objectives were identified as COPCs.

#### 3.2 Sediments

Seven sediment samples were collected in Auburn, two in U.S. Drum, six in ponds north of Auburn (LHL1) and north of U.S. Drum (LHL2), and eleven just east of the Cluster Site in Indian Ridge Marsh during Phase I, II and III investigations in 1998 and 1999. Sample locations are shown in Figure 2. The samples from the Auburn area (2SED1 through 2SED7) were composite samples scraped with a hand auger along an impenetrable surface suspected to be a former parking lot.

The sediment samples were evaluated by E & E (1999b). E & E (1999b) provided several sediment criteria including the Ontario Ministry of the Environment's guidelines for the protection and management of aquatic sediment quality (Persaud et al., 1993). Based on these evaluation criteria, four COPCs, arsenic, chromium, chrysene, and lead, were selected in Auburn.

### 3.3 Surface Water

Surface water samples were collected during Phase I and Phase III investigations in 1998 and 1999. E & E (1999b) evaluated the surface water analytical data and used the ecological and toxicological (EcoTox) thresholds (USEPA 1996a) as the screening criteria. The analytical result of each chemical was compared to the screening criteria. If it exceeded the screening criteria, the chemical was retained as COPC. In the Auburn area, barium, iron, lead, manganese, and heptachlor are retained as COPCs. The same COPCs exceeded ecological toxicity threshold values in the pond in the southeast corner of U.S. Drum, except iron. In addition, 4,4'-DDD, 4,4'-DDE and Endrin were selected as COPCs in U.S. Drum area.

### 3.4 Groundwater

Groundwater data in the E & E Report (1999b) were compared to TACO Class I Groundwater ROs. Chemicals exceeding the groundwater ROs included inorganic, VOCs and SVOCs. Based upon data collected in 1998 and 1999, benzene, lead, and manganese exceed Class I groundwater ROs in virtually the entire Cluster Site. Benzene, toluene, ethylbenzene, and xylenes are primary contaminations in LC07 (Auburn), which is near the former incinerator. SVOC and inorganic contaminants (iron, lead, and manganese) were also detected in this area. Groundwater in the Auburn area to the east of LC07, southern portions of U.S. Drum (LC06 and LC05) and Unnamed Parcel (LC13) areas also contain other elevated inorganics.

### 3.5 Essential nutrients

Calcium, potassium, magnesium, iron and sodium were detected in all media. Since these inorganic constituents are essential nutrients for human being and information regarding adverse impacts from these inorganic constituents is not available, these essential nutrients are eliminated from further considerations as COPCs.

COPCs selected for soil, sediment, surface water and groundwater for Auburn, U.S. Drum and Unnamed Parcel of the Cluster Site are listed in Tables 3-1 through Table 3-3.

Table 3-1. Contaminants of Potential Concern in Auburn

Soil	Sediment	Surface Water	Groundwater
Antimony	Arsenic	Barium	Antimony
Arsenic	Chromium	Lead	Arsenic
Barium	Chrysene	Manganese	Barium
Beryllium	Lead	Heptachlor	Beryllium
Cadmium			Cadmium
Chromium			Chromium
Lead			Lead
Manganese			Manganese
Benzene			Mercury
Benzo(a)anthracene			Nickel
Benzo(a)pyrene			Thallium
Benzo(b)fluoranthene			Vanadium
Bis(2-chloroethyl)ether			Zinc

**Table 3-1. Contaminants of Potential Concern in Alburn**

Soil	Sediment	Surface Water	Groundwater
Carbon disulfide Chlorobenzene Dibenzo(a,h)anthracene Ethylbenzene Heptachlor Methylene chloride Indeno(1,2,3-cd)pyrene Tetrachloroethene Trichloroethane Toluene Total PCBs Vinyl chloride Xylenes			Benzene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Bis(2-chloroethyl)ether Bis(2-ethylhexyl)phthalate Chlorobenzene Chrysene Dibenzo(a,h)anthracene 2,4-dimethylphenol Ethylbenzene Indeno(1,2,3-cd)pyrene Methylene chloride Naphthalene N-Nitrochloroethene Toluene Xylene

**Table 3-2. Contaminants of Potential Concern in U.S. Drum**

Soil	Sediment	Surface Water	Groundwater
Antimony Arsenic Beryllium Chromium Lead Manganese Benzene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Bis(2-ethylhexyl)phthalate Chlorobenzene Chloroform Dibenzo(a,h)anthracene 1,2-Dichloroethane Ethylbenzene Indeno(1,2,3-cd)pyrene Tetrachloroethene Toluene, Total PCBs Vinyl chloride, Xylenes	None	Barium Lead Manganese 4,4'-DDD 4,4'-DDE Endrin Heptachlor	Antimony Arsenic Barium Beryllium Cadmium Chromium Lead Manganese Mercury Nickel Vanadium Benzene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Chrysene Dibenzo(a,h)anthracene Indeno(1,2,3-cd)pyrene

**Table 3-3. Contaminants of Potential Concern in Unnamed Parcel**

<b>Soil</b>	<b>Sediment</b>	<b>Surface Water</b>	<b>Groundwater</b>
Arsenic, Beryllium Chromium Lead Manganese Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chlorobenzene Dibenzo(a,h)anthracene 1,2-Dibromo-3-Chloropropane 1,1-Dichloroethane 1,2-Dichloroethane Ethylbenzene Indeno(1,2,3-cd)pyrene alpha-BHC, Heptachlor Methylene Chloride Trichloroethene, Toluene 1,1,1-Trichloroethane, Xylenes	None	None	Arsenic Cadmium Chromium Lead Manganese Mercury Nickel Vanadium Zinc Benzene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Bis(2-ethylhexyl)phthalate Chrysene Indeno(1,2,3-cd)pyrene



## 4.0 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to identify human receptors that are potentially exposed to site contaminants, to describe the exposure pathway, and the amount of the chemical intake resulting from such exposures, if any. The exposure assessment identifies the various media in which chemicals are found or transported, the location where exposure occurs, and the estimated magnitude, frequency, and duration of exposure.

### 4.1 Receptors

Future potential use of the Cluster Site includes use as a solar power generating station. Potential receptors for the Lake Calumet Cluster Site include on-site worker, mower, construction workers, industrial/commercial workers, and landscape worker. Specific activities of the receptors are discussed below.

- On-site Worker—Maintenance work on the solar panels.
- Mower—An adult mows the site twice a year.
- Landscape Maintenance Worker—Sows prairie grass or conducts other landscape maintenance work.
- Construction Worker—Typical construction work including grading and excavation of soils, building construction, and installment of solar panels.
- Industrial/Commercial Worker—Typical maintenance workers engaged in routine activities.

### 4.2 Exposure Pathway

An exposure pathway describes the course a chemical takes from the source to the receptor and is defined by four elements: 1) A source and mechanism of release; 2) An environmental transport medium; 3) A point of potential exposure with the contaminated medium; and 4) A route of exposure at the exposure point. When all these elements are present, a pathway is considered complete. Only complete exposure pathways are selected for evaluation in a risk assessment. A conceptual site model (CSM) has been developed to aid in identification of potential exposure pathways, as shown in Figure 3. The primary sources of contamination at the Cluster Site are past site activities and the existing landfills. Release mechanisms such as spills, leaks, runoff, percolation, and particulate emissions transfer contaminants to soil, air, and water. The complete and significant pathways are listed below.

- Dermal contact with groundwater by on-site workers, construction workers, and industrial/commercial workers
- Dermal contact with surface water and sediment by on-site workers, construction workers, and industrial/commercial workers
- Ingestion, inhalation (particulate and volatile emissions), and dermal contact of surface and subsurface soils by all potential receptors (It is assumed that due to construction



**Table 4-1**  
**Parameter Values for Exposure to Soil at the Lake Calumet Cluster Site**

Exposure Factor	On-site Worker	Mower	Landscape Worker	Construction Worker	Industrial/ Commercial Worker
Soil Ingestion Rate <sup>a</sup> (mg/day)	50	480	50	480	50
Fraction Ingested <sup>b</sup> (unitless)	0.5	1	0.5	1	0.5
Inhalation Rate <sup>c</sup> (m <sup>3</sup> /hour)	1.1	1.7	1.1	2.8	1.1
Exposure rate <sup>d</sup> (hours/day)	5 <sup>b</sup>	8	8	8	8
Body Surface Area <sup>e</sup> , (cm <sup>2</sup> )	3,300	3,300	3,300	3,300	3,300
Soil Adherence Factor <sup>e</sup> (mg/cm <sup>2</sup> )	0.2	0.2	0.2	0.2	0.2
Particulate Emission Factor (kg/m <sup>3</sup> )	8.00E-10	8.00E-09	8.00E-10	8.00E-09	8.00E-10
Exposure Frequency (days/year)	50 <sup>b</sup>	10 <sup>d</sup>	20 <sup>b</sup>	30 <sup>a</sup>	250 <sup>a</sup>
Exposure Duration <sup>a</sup> (years)	25 <sup>b</sup>	25 <sup>b</sup>	25 <sup>b</sup>	1 <sup>a</sup>	25 <sup>a</sup>
Body Weight <sup>a</sup> (kg)	70	70	70	70	70
Averaging Time for Noncarcinogens (days)	9,125	9,125	9,125	40 <sup>a</sup>	9,125

Notes:

<sup>a</sup> Tiered Approach to Corrective Action Objectives, IEPA, World Wide Web, 2000.

<sup>b</sup> Assumed based on activity patterns and time spent on-site

<sup>c</sup> U. S. EPA, Exposure Factors Handbook, 1997. Inhalation rates based on light, moderate, and heavy activities.

<sup>d</sup> Based on Expected working assignments at the Facility. Steve Hogan, Spire Corporation.

<sup>e</sup> U.S.EPA Region 9.

**Table 4-2**  
**Exposure Factors for Dermal Contact with Groundwater and Surface Water**

Exposure Factor	On-site Worker	Construction Worker	Industrial/ Commercial Worker
Body Surface Area <sup>a</sup> (cm <sup>2</sup> )	3,300	3,300	3,300
Exposure Frequency <sup>b</sup> (days/year)	5	5	5
Exposure Duration <sup>c</sup> (years)	25	1	25
Body Weight <sup>d</sup> (kg)	70	70	70
Averaging Time for Noncarcinogens (days)	9,125	40 <sup>d</sup>	9,125

Notes:

- <sup>a</sup> U.S.EPA Region 9, www, 2000.
- <sup>b</sup> Mark Johnson, USEPA Region 5
- <sup>c</sup> Assumed value based on activity patterns
- <sup>d</sup> Tiered Approach to Corrective Action Objectives, IEPA, 2000

**Table 4-3**  
**Exposure Factors for Dermal Contact with Sediment**

Exposure Factor	On-site Worker	Construction Worker	Industrial/ Commercial Worker
Body Surface Area <sup>a</sup> (cm <sup>2</sup> )	3,300	3,300	3,300
Soil Adherence Factor <sup>a</sup> (mg/cm <sup>2</sup> )	0.2	0.2	0.2
Exposure Frequency <sup>c</sup> (days/year)	5	5	5
Exposure Duration <sup>d</sup> (years)	25	1	25
Body Weight <sup>d</sup> (kg)	70	70	70
Averaging Time for Noncarcinogens (days)	9,125	40 <sup>e</sup>	9,125

Notes:

- <sup>a</sup> U.S.EPA Region 9, www, 2000.
- <sup>b</sup> Mark Johnson, USEPA Region 5
- <sup>c</sup> Assumed value based on activity patterns
- <sup>d</sup> Tiered Approach to Corrective Action Objectives, IEPA, 2000

Dermal adsorption factors were developed following guidance in IEPA (1994). Dermal adsorption factor of 0.01 was selected for all inorganic constituents. For Polynuclear Aromatic Hydrocarbons (PAHs), exposure doses via dermal contact were assumed to be same as those via ingestion. Dermal adsorption factors for other organics are listed in Table 4-4.

**Table 4-4. Dermal Adsorption Factors**

COPC	Henry's Law Constant <sup>a</sup> (unitless)	Octanol/Water Partition Coefficient <sup>a</sup> (unitless)	Dermal Adsorption Factors <sup>b</sup> (unitless)
Inorganics	NA	NA	0.01
Bis(2-ethylhexyl)phthalate	4.2E-06	2E+08	0.4
Tetrachloroethene	7.5E-01	4.7E+02	0.03
Trichloroethene	4.2E-01	5.1E+02	0.03
Vinyl chloride	1.1E+0	3E+01	0.03

Notes:

a EPA (1996b)

b IEPA (1994)

Permeability constant were developed in an EPA document (1992c). Permeability constant of 0.001 was selected for all inorganic constituents and the value for organic constituents are listed in Table 4-5.

**Table 4-5. Permeability Constants**

COPC	Permeability Constants <sup>c</sup> (cm/hr)
Inorganics	1.0E-03
Bis(2-ethylhexyl)phthalate	3.3E-02
Benzene	2.1E-02
Benzo(a)pyrene	1.2E+00
Benzo(a)anthracene	8.0E-01
Benzo(b)fluoranthene	1.2E+00
Chrysene	8.1E-01
Dibenzo(a,h)anthracene	2.7E+00
1,1-Dichloroethene	1.6E-02
trans-1,2-dichloroethene	1.0E-02
Indeno(1,2,3-cd)pyrene	1.9E+00
Tetrachloroethene	4.8E-02
Trichloroethene	1.6E-02
Vinyl chloride	7.3E-03

Note:

c EPA (1992c)

For VOC contaminants in groundwater, the values of their diffusion coefficients in water are needed in the model for calculating the concentration of groundwater contaminants in air. The diffusion coefficients of these VOCs are available in (EPA 1996b) and listed in Table 4-6.

Table 4-6. Diffusion Coefficients in Water (cm<sup>2</sup>/sec)

COPC	Diffusion Coefficients <sup>a</sup> (unitless)
Benzene	9.80E-06
Methylene Chloride	1.17E-05
Chlorobenzene	8.70E-06
Ethylbenzene	7.80E-06
Toluene	8.60E-06
Xylenes	2.20E-05

Notes:

a EPA (1996b)

## 5.0 TOXICITY ASSESSMENT

### 5.1 Carcinogenic Health Effects Criteria And Assessment

USEPA's Carcinogenic Assessment Group has estimated the excess lifetime cancer risks associated with various levels of exposure to potential human carcinogens by developing cancer slope factors (SFs). The SFs are generally derived using conservative (health protective) assumptions. Cancer SFs developed by USEPA were used in this risk assessment. The toxicity values for potential carcinogenic effects of the COPCs are listed in Table 5-1.

Table 5-1. Toxicity Factors for COPCs<sup>a</sup>

Chemical	Slope Factor (mg/kg-day)		Reference Dose (mg/kg-day)	
	Oral	Inhalation	Oral	Inhalation
Antimony	NA	NA	4.00E-04	NA
Arsenic	1.50E+00	NA	3.00 E-04	NA
Barium	NA	NA	7.00E-02	1.43E-04 <sup>b</sup>
Beryllium	NA	NA	2.00E-03	5.71E-06
Cadmium <sup>b</sup>	NA	NA	5.00E-04	NA
Chromium	NA	NA	1.50E+00	NA
Manganese	NA	NA	4.60E-02	1.43E-05
Mercury	NA	NA	NA	8.6E-05
Nickel	NA	NA	2.00E-02	NA
Thallium	NA	NA	8.00E-05	NA
Vanadium	NA	NA	7.00E-03 <sup>b</sup>	NA
Zinc	NA	NA	3.00E-01	NA
alpha-BHC	6.30E+00	6.30E+00	NA	NA
Benzene	5.50E-02	2.90E-02	NA	NA
Benzo(a)anthracene	7.30E-01 <sup>c</sup>	3.10E-01 <sup>c</sup>	NA	NA
Benzo(b)fluoranthene	7.30E-01 <sup>c</sup>	3.10E-01 <sup>c</sup>	NA	NA
Benzo(k)fluoranthene	7.30E-02 <sup>c</sup>	3.10E-02 <sup>c</sup>	NA	NA
Benzo(a)pyrene	7.30E+00 <sup>c</sup>	3.10E+00 <sup>c</sup>	NA	NA
Bis(2-Chloroethyl) Ether	1.10E+00	1.16E+00 <sup>d</sup>	NA	NA
Bis(2-ethylhexyl)phthalate	1.40E-02	NA	2.00E-02	NA
Chrysene	7.30E-03 <sup>c</sup>	3.10E-03 <sup>c</sup>	NA	NA
Carbon Disulfate	NA	NA	1.00E-01	2.00E-01
Chlorobenzene	NA	NA	2.00E-02	5.71E-03
Chloroform	6.10E-03	8.05E-02 <sup>d</sup>	1.00E-02	NA
Dibenz(a,h)anthracene	7.30E+00 <sup>c</sup>	3.10E+00 <sup>c</sup>	NA	NA
1,2-Dibromo-3-Chloropropane	1.4E+00 <sup>b</sup>	2.40E-3 <sup>b</sup>	NA	NA
1,1-Dichloroethane	NA	NA	1.00E-01 <sup>b</sup>	1.43E-01
2,4 -Dimethylphenol	NA	NA	2.00E-02	NA
4,4'-DDD	2.40E-01	NA	NA	NA
4,4'-DDE	3.40E-01	NA	NA	NA
Ethylbenzene	NA	NA	1.00E-01	2.86E-01

Table 5-1. Toxicity Factors for COPCs<sup>a</sup>

Chemical	Slope Factor (mg/kg-day)		Reference Dose (mg/kg-day)	
	Oral	Inhalation	Oral	Inhalation
Heptachlor	4.50E+00	4.55E+00 <sup>d</sup>	5.00E-04	4.50E+00
Indeno(1,2,3-cd)pyrene	7.30E-01 <sup>c</sup>	3.10E-01 <sup>c</sup>	NA	NA
Methylene Chloride	7.50E-03	1.65E-03 <sup>d</sup>	6.00E-02	8.57E-01 <sup>b</sup>
Naphthalene	NA	NA	2.00E-02	8.57E-04
N-Nitrosodiphenylamine	4.90E-03	NA	NA	NA
Tetrachloroethene <sup>e</sup>	5.2E-02	2.0E-03	1.00E-02 <sup>d</sup>	NA
Toluene	NA	NA	2.00E-01	1.14E-01
1,1,1-Trichloroethane <sup>e</sup>	NA	NA	2.00E-02	6.29E-01
Trichloroethene <sup>e</sup>	1.1E-02	6.0E-03	NA	NA
Total PCBs	2.00E+00	2.00E+00	NA	NA
Vinyl chloride	7.2E-01	1.6E-02	3.0E-03	2.9E-02
Xylenes	2.00E+00	NA	NA	NA

Notes:

<sup>a</sup> Source: Integrated Risk Information System (IRIS)

<sup>b</sup> Source: Health Effects and Environmental Effects Summary Table (HEAST) as referenced in the Risk Assessment Information System (RAIS), Oak Ridge National Laboratory, 2001.

<sup>c</sup> USEPA Region 9 Preliminary Remediation Goals, 2001

<sup>d</sup> RAIS, Oak Ridge National Laboratory, 2001.

<sup>e</sup> Mark Johnson, USEPA, Region 5, Personal Communication with Pinaki Banerjee, MWH, 2000.



The critical effects of each carcinogenic COPC are listed in Table 5-2.

**Table 5-2. Critical Effects of Carcinogenic COPCs\***

COPCs	Effects/Target Organs
Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Chrysene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, 1,2-Dibromo-3-Chloropropane (ingestion only)	Gastrointestinal System
1,2-Dibromo-3-Chloropropane (ingestion only), Bis(2-Chloroethyl) Ether, Bis(2-ethylhexyl)phthalate, chloroform (ingestion only), DDD, DDE, Heptachlor, alpha-BHC, Methylene chloride, Tetrachloroethene, Trichloroethene, Vinyl chloride	Liver
Benzene	Circulatory System
Arsenic, Beryllium (Inhalation only), Cadmium (Inhalation only), Chromium (Inhalation only), Methylene chloride, Nickel, Vinyl chloride	Respiratory System (Lungs)

Note:

\* Tiered Approach to Corrective Action Objectives (IEPA, 1997).

## 5.2 Noncarcinogenic Health Effects Criteria And Assessment

Health effects for chemicals exhibiting noncarcinogenic effects are generally developed using reference doses (RfDs). The RfD is an estimate of the daily exposure to the human population that is likely to be without an appreciable risk during a lifetime. The uncertainty associated with the RfD is at least one order of magnitude and may be as high as several orders of magnitude. RfDs are expressed in units of dose (mg/kg-day) and are developed by USEPA. Table 5-1 lists the RfDs for potential noncarcinogenic effects for the COPCs.

The RfDs are selected by identifying the lowest reliable no observed effect level (NOAEL) or lowest observed adverse effect level (LOAEL) in the scientific literature, then applying a suitable uncertainty factor (UF) and a modifying factor (MF), to allow differences between the study conditions and the human exposure situation to which the RfDs are to be applied.

Each COPC exerts noncarcinogenic effect on specific target organs or mode of action. For example, mercury is known to affect central nervous systems while barium affects the circulatory or reproductive systems. In evaluating health effects due to exposure to multiple COPCs, consideration is given to the COPCs with similar target organ effect. The critical effects of each non-carcinogenic COPC are listed in Table 5-3.

Table 5-3. Critical Effects of Non-Carcinogenic COPCs

COPC	Effects/Target Organs
Cadmium (ingestion only) <sup>a</sup> , Chlorobenzene <sup>a</sup> , 1,1-Dichloroethane <sup>a</sup> , Ethylbenzene <sup>a</sup> , Toluene (ingestion only) <sup>a</sup> , Vanadium <sup>b</sup>	Kidney
2,4-Dimethylphenol <sup>a</sup> , Toluene <sup>a</sup> , Xylenes <sup>a</sup> , Manganese <sup>a</sup> , Mercury <sup>a</sup>	Central Nervous System
Carbon disulfide <sup>a</sup> , Ethylbenzene (inhalation only) <sup>a</sup> , Antimony, Barium <sup>a</sup> , 2,4-Dimethylphenol <sup>a</sup> , Zinc <sup>a</sup>	Circulatory System, Reproductive System
Naphthalene <sup>a</sup> , Toluene <sup>a</sup> , Vanadium <sup>b</sup> , Nickel <sup>b</sup>	Respiratory System
Chlorobenzene (ingestion only), Ethylbenzene, Toluene	Liver

Notes:

<sup>a</sup> Tiered Approach to Corrective Action Objectives (IEPA, 1997).

<sup>b</sup> Agency for Toxic Substance and Disease Registry ([www.ATSDR.gov](http://www.ATSDR.gov), 2001).

Toxicity factors are not currently available for lead; therefore, exposure to lead was not evaluated in this HHRA. Health effects from exposure to lead are estimated based on blood-lead levels. Blood-lead levels are estimated based on lead uptake through diet and exposure to water, soil, and air. IEPA has set a remediation objective of 400 mg/kg for lead in soil for residents and workers (IEPA, 2001). Soil locations where lead concentrations exceed 400 mg/kg were identified in Harza (2001).

## 6.0 RISK CHARACTERIZATION

Carcinogenic risks and noncarcinogenic hazards were characterized for each chemical, multiple chemicals within each exposure pathway, and for exposures attributable to multiple pathways, as appropriate.

### 6.1 Carcinogenic Risks

Quantitative human risk estimates were derived by combining the estimates of chemical intake derived in Section 4.0 (Exposure Assessment) with the health effects criteria presented in Section 5.0 (Toxicity Assessment). For potential carcinogenic chemicals, excess lifetime cancer risks (ELCR) are estimated by multiplying the cancer slope factor by the estimated daily chemical intake. The estimated ELCR represents a high-end probability that an individual could contract cancer due to exposure to the potential carcinogen under the specified exposure conditions.

ELCRs are calculated using equation (13):

$$\text{ELCR} = \text{LADD} \times \text{SF} \quad (13)$$

The intake is assumed to occur by inhalation, ingestion, and dermal contact. Therefore, additivity of effects is assumed such that the total ELCR for each chemical is obtained by summing the chemical specific risk estimated for both pathways as it relates to a specific medium. The total ELCR for exposure to multiple chemicals is expressed as:

$$\text{ELCR}_e = \text{ELCR}_1 + \text{ELCR}_2 + \text{ELCR}_3 + \dots + \text{ELCR}_i \quad (14)$$

where:

ELCR<sub>e</sub> = Total exposure via a specific pathway  
ELCR<sub>i</sub> = ELCR estimate for the *i*th chemical

The total ELCR equals risks via all appropriate pathways, and is expressed as:

$$\text{Total ELCR} = \text{ELCR}_{e1} + \text{ELCR}_{e2} + \dots + \text{ELCR}_{ei} \quad (15)$$

where:

ELCR<sub>ei</sub> = ELCR resulting from the *i*th pathway.

Carcinogenic risks are expressed as a probability for a receptor to develop cancer. A risk level of  $1 \times 10^{-6}$  (1E-06) represents a high-end probability of 1 in 1,000,000. USEPA generally uses a potential upper-bound risk estimate of 1E-06 as a point of departure, while a risk range of 1E-04 to 1E-06 is used as a target range for making risk management decisions. USEPA (1991) states that the upper boundary of the risk range is not a discrete line at 1E-04. A specific risk estimate around 1E-04 may be acceptable at some sites.



6.3.1 Alburn

The carcinogenic risks and noncarcinogenic hazards for exposure to each of the media at Alburn area are presented in Table 6-1.

Table 6-1. Carcinogenic Risk and Noncarcinogenic Hazards for Each Media at Alburn

	On-site worker	Construction Worker	Industrial/Commercial Worker	Mower	Landscape Worker
Soil					
Total ELCR	5E-06	2E-06	2E-05	1E-05	2E-06
Total HI	2E-02	3E+00	2E-01	4E-02	8E-01
Groundwater					
Total ELCR	8E-07	3E-08	8E-07	NA	NA
Total HI	1E-02	1E-01	1E-02	NA	NA
Surface Water					
Total ELCR	3E-09	1E-10	3E-09	NA	NA
Total HI	4E-05	4E-04	4E-05	NA	NA
Sediment					
Total ELCR	2E-07	9E-09	2E-07	NA	NA
Total HI	1E-03	1E-02	1E-03	NA	NA

In Table 6-1, the shaded cells indicate that the total ELCR exceeds 1.0E-06 or total HI exceeds 1.0. Risks are primarily due to exposure to soil. Risk due to exposure to sediment, surface water and groundwater are insignificant. The carcinogenic risks represented by ELCR exceed 1E-06 for all receptors. The noncarcinogenic risks represented by HI are equal to or exceed 1E+00 for construction workers. COPC that contributed significantly to carcinogenic risks (risks exceeding 1E-06) and the corresponding receptors are listed in Table 6-2. For noncarcinogenic hazards exceeding 1, the primary COPC is toluene and the corresponding receptor is construction worker.

Table 6-2. Summary of Carcinogenic COPCs at Alburn

Carcinogenic COPCs	Receptors
Arsenic	Industrial/Commercial Worker, Mower
Benzene	Industrial/Commercial Worker
Benzo(a)pyrene	Industrial/Commercial Worker, Mower
Total PCBs	Industrial/Commercial Worker
Vinyl Chloride	Industrial/Commercial Worker, Mower

6.3.2 U.S. Drum

At the U.S. Drum area, no COPCs were selected in sediment samples. Therefore, only soil, surface water and groundwater are considered as the exposure media in the U.S. Drum. The carcinogenic risks and noncarcinogenic hazards for exposure to each media are presented in Table 6-3.

## 7.0 UNCERTAINTIES

Uncertainties are introduced at various points throughout the HHRA process, a product of the uncertainties associated with all data and the assumptions used. Specific areas of uncertainty are related to data evaluation; exposure assessment; toxicity assessment; and risk characterization are discussed in this section.

### 7.1 Exposure Assessment

The exposure estimates used in this HHRA are conservative and, to be health protective, are designed to overestimate actual risks when there is an uncertainty. Several of the factors contributing to uncertainty result in probable overestimation of exposure:

- The directed (biased) nature of the sampling plan, which focuses on the most contaminated parts of the site;
- The use of maximum concentrations as EPCs for groundwater, sediment and surface water data available from multiple sampling rounds;
- The use of steady state assumptions for the source concentration estimates (i.e. the COPC concentrations are not subject to decrease due to attenuation and/or degradation for the duration of the exposure period);
- The exposure parameter values for receptors.

Another factor which could lead to over or underestimation of exposures is the use of one-half MDL to estimate the nondetects.

### 7.2 Toxicity Assessment

Basic uncertainties underlying the assessment of the toxicity of a chemical include:

- Uncertainties involved in extrapolating from underlying scientific studies to the exposure scenarios being evaluated, including variable responses to chemical exposures in human and species and between species.

These uncertainties could either under- or overestimate the true toxicity of chemicals present. The toxicity assessment process compensates for these uncertainties through the use of uncertainty factors and modifying factors when deriving RfDs for noncarcinogens, and the use of 95% confidence limit when deriving the SFs for carcinogens.

### 7.3 Risk Characterization

When discussing uncertainties associated with the overall risk assessment, the cumulative effect of conservative assumptions throughout the process and the likelihood of the exposures

postulated and estimated in the exposure assessment actually occurring should be considered. The cumulative effect of conservative assumptions may substantially overestimate true risks. The nature of risk estimation process ensures that the true risks are more likely to be overestimated than underestimated.

## 8.0 CONCLUSIONS

The HHRA was conducted to assess the potential adverse human health effects that could occur due to exposure to contaminants in each media (soil, sediment, surface water and groundwater) at the Cluster Site. The exposure and risk assessment of carcinogenic risk and noncarcinogenic hazard are performed separately at three areas in the Cluster site, which are Alburn, U.S. Drum and Unnamed Parcel. Carcinogenic risks and noncarcinogenic hazard due to exposure to contaminants in each media at the three areas are summarized below:

In Alburn area, exposures to soil, sediment, surface water and groundwater are discussed. Risk due to exposure to contaminants in soil exceeds carcinogenic risk of  $1E-06$  for all receptors. COPCs that contributed significantly to carcinogenic risks (exceeding  $1E-06$ ) are arsenic, benzene, benzo(a)pyrene, total PCBs and vinyl chloride. For noncarcinogenic hazard, among all receptors, the exposure to contaminants in soil for construction worker exceeds HI of  $1E+00$  and the primary contributed COPC is toluene. The exposure to contaminants in other media (including sediment, surface water and groundwater) do not exceed carcinogenic risk of  $1E-06$  or noncarcinogenic hazard of 1 for all receptors.

In U. S. Drum area, no COPCs were selected in sediment samples. Therefore, only exposure to contaminants in soil, surface water and groundwater are discussed. The carcinogenic risk exceeds  $1E-06$  in soil for all receptors and the primary COPCs are arsenic, benzo(a)pyrene, dibenz(a,h)anthracene and total PCBs. No noncarcinogenic hazard exceeds 1 for all receptors due to exposure to contaminants in soil. The exposures to contaminants in surface water and groundwater do not exceed carcinogenic risk of  $1E-06$  or noncarcinogenic hazard of 1 for all receptors.

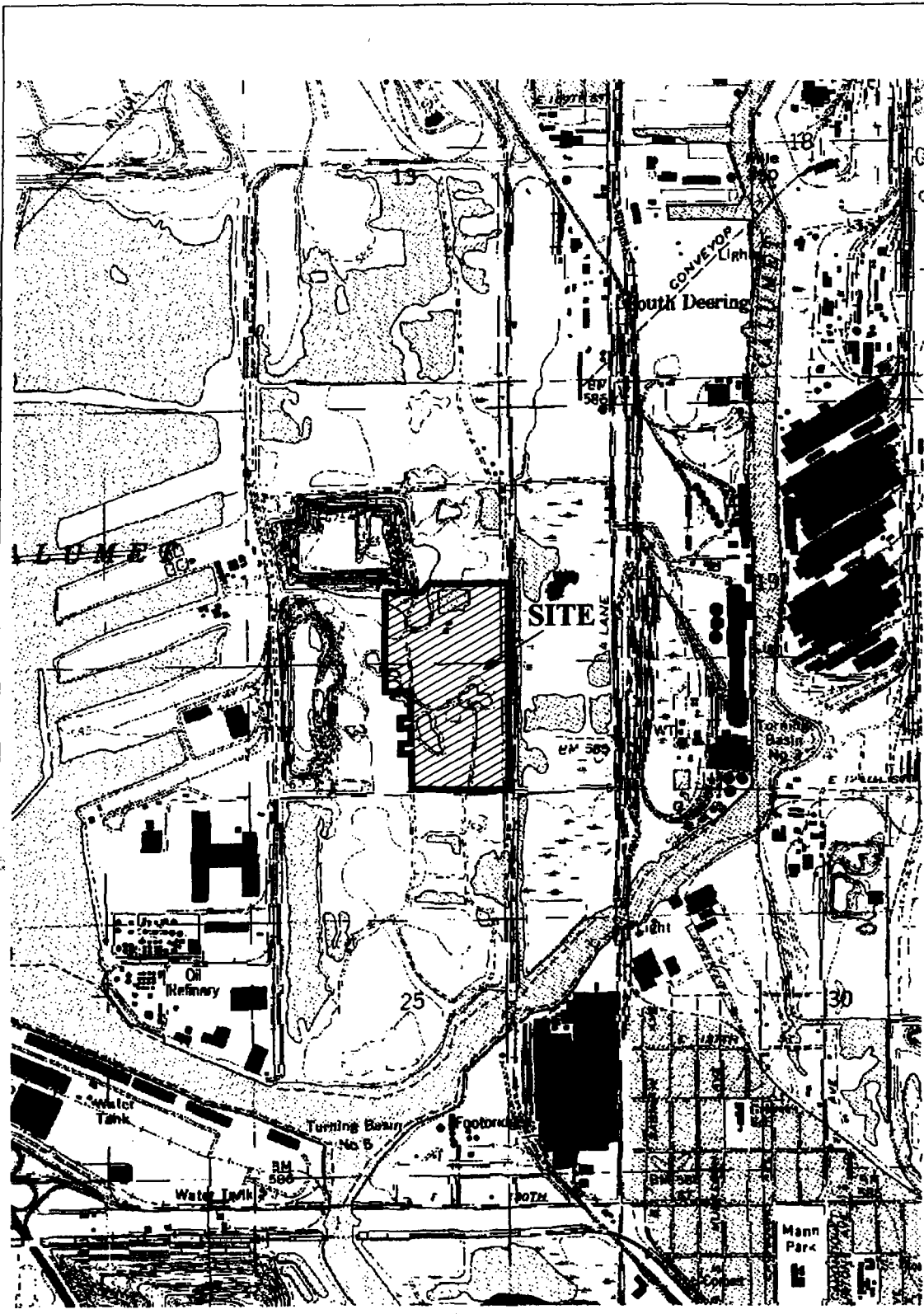
In Unnamed Parcel area, no COPCs were selected in sediment and surface water. The carcinogenic risk due to exposure to contaminants in soil exceeds  $1E-06$  for on-site worker, industrial/commercial worker and mower. The primary COPCs in soil for carcinogenic risk are arsenic and benzo(a)pyrene. No noncarcinogenic hazard exceeds 1 for all receptors due to exposure to contaminants in soil. The exposures to contaminants in groundwater do not exceed carcinogenic risk of  $1E-06$  or noncarcinogenic hazard of 1 for all receptors.



## 9.0 REFERENCES

- Agency for Toxic Substances and Disease Registry, 2001. [www.ATSDR.gov](http://www.ATSDR.gov).
- Chrzastowski M. J. and T. A. Thompson. 1993. *Late Wisconsinan and Holocene Coastal Evolution of the Southern Shore of Lake Michigan*. Illinois Department of Energy and Natural Resources, State Geological Survey Division: Champaign, Ill. Reprint 1993D.
- Ecology and Environment, Inc. (E & E). 1999a. *Results of Phase I Sampling Activities for Lake Calumet Site*. Chicago, Illinois, March 10, 1999.
- Ecology and Environment, Inc. (E & E). 1999b. *The Nature and Extent of Contamination at the Lake Calumet Cluster Site*. Chicago, Illinois, November 30, 1999.
- Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Van Nostrand Reinhold.
- Harza Engineering Company, 2001. Comprehensive Site investigation Report. Lake Calumet Cluster Site: Auburn, U.S. Drum, and Unnamed Parcel Areas.
- Illinois Environmental Protection Agency, 1994. Interim Default Values for the Estimation of the Dermal Absorption of Chemicals from Soil.
- Illinois Environmental Protection Agency, 2001. Illinois Tiered Approach to Cleanup Objectives (TACO) Guidance Objectives.
- Johnson, Mark, U.S. Environmental Protection Agency, Region V. 2000. Personal Communication (e-mail) with Pinaki Banerjee, Harza. March 3 and March 17, 2000.
- MWH. 2001. Comprehensive Site Investigation Report- Lake Calumet Cluster Site: Auburn, U.S. Drum and Unnamed Parcel Areas. Final.
- Persaud, D.R. Jaagumagi and A. Hayton. 1993. *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. ISBN 0-7729-9248-7. Ontario Ministry of the Environment. Toronto, Canada.
- Piskin K. and R. E. Bergstrom. 1975. *Glacial Drift in Illinois: Thickness and Character*. Illinois Department of Registration and Education, State Geological Survey Division: Urbana, Ill. Circular 490.
- Risk Assessment Information System (RAIS), 2001. Oak Ridge National Laboratory. <http://risk.lsd.ornl.gov/index.shtml>



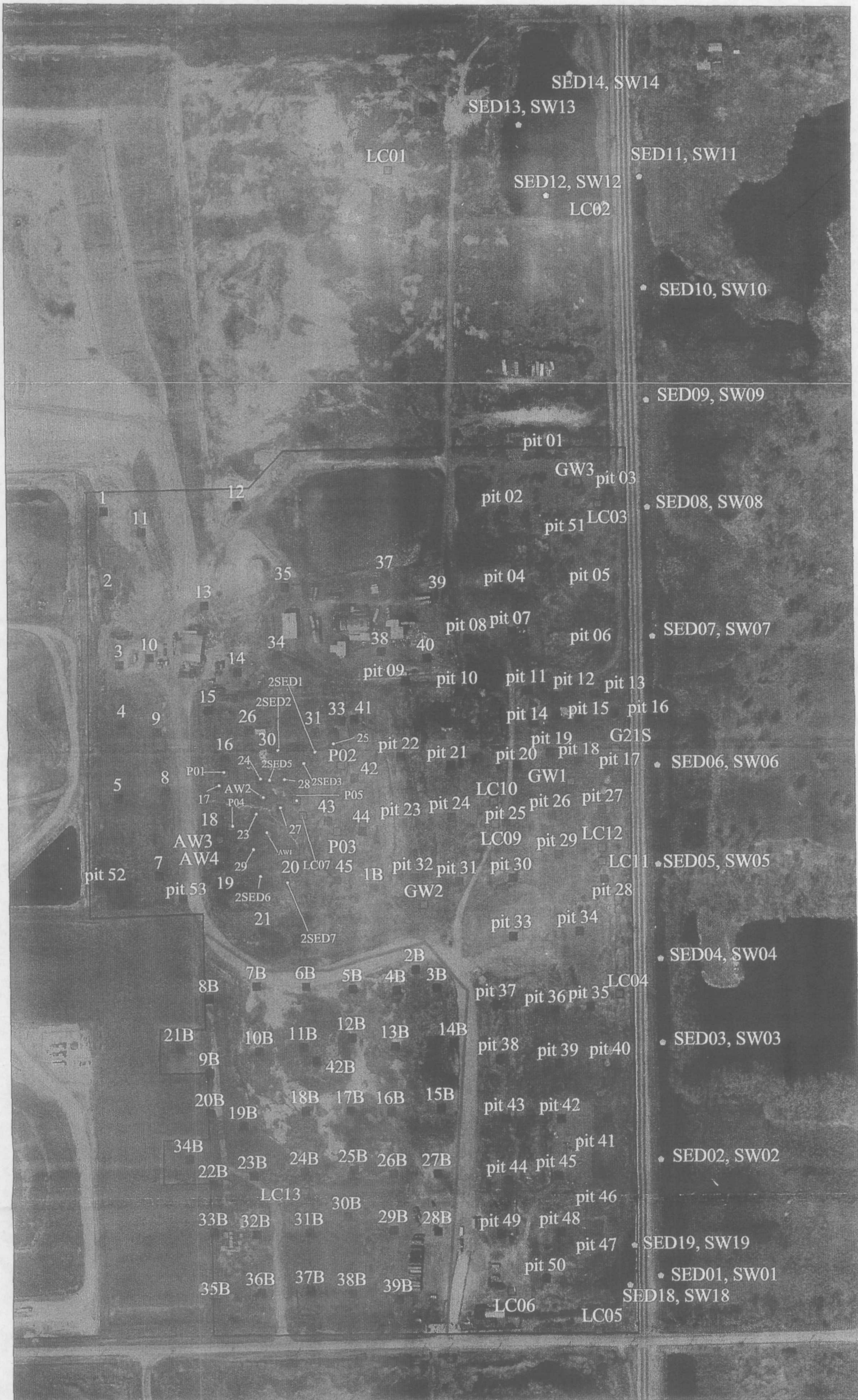


C:\Project\Number\17600-17690\17631\gis\project\loc\_revision\_72701\USGS Site Map\_MWH.Logo

**SOURCE:**  
 USGS Lake Calumet, Illinois,  
 7.5 Minute Quadrangle, 1965, Revised 1997



Figure 1  
**SITE LOCATION MAP**  
 LAKE CALUMET CLUSTER SITE  
 Chicago, Illinois



**LEGEND**

- Groundwater (E&E, November 1999)
- ▲ Sediment (E&E, November 1999)
- Sediment & Surface Water (E&E, November 1999)
- Surface Water (E&E, November 1999)
- Test Pit
- Area Boundaries (Album, U.S. Drum and Unnamed Parcel)

200 0 200 400 Feet

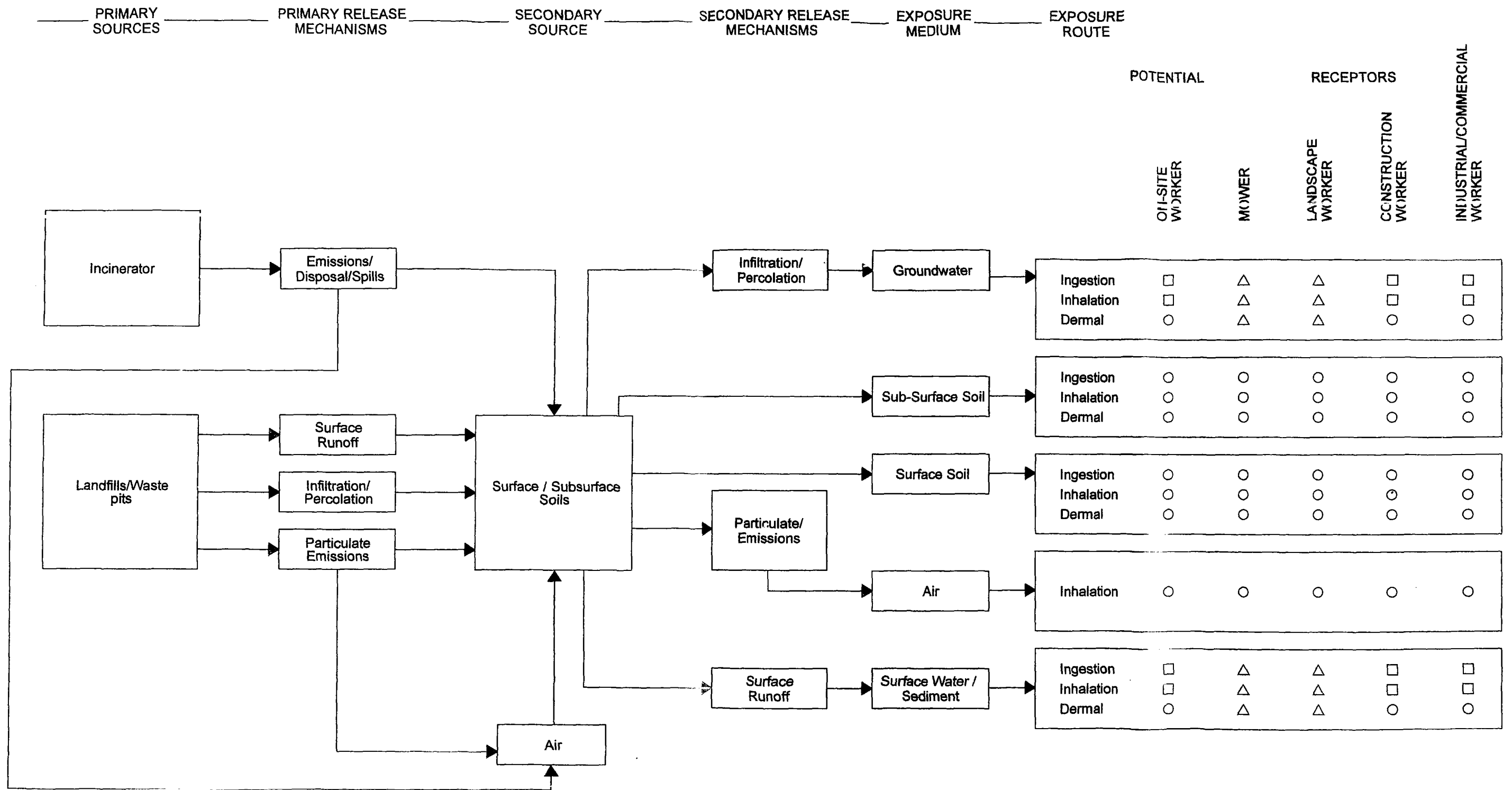


Figure 2  
**TEST PITS, MONITORING WELLS, SOIL BORINGS,  
 SEDIMENT AND SURFACE WATER SAMPLE LOCATIONS**  
 LAKE CALUMET CLUSTER SITE  
 Chicago, Illinois

O:\ProjectNumber\17600-17699\17631\gis\project\loc\_revison\_72701\Figure2\_Risk Report Layout\_MWHLogo







LEGEND:  
 ○ Pathway Complete and Significant  
 □ Pathway Complete but Insignificant  
 △ Pathway Incomplete

C:\H0005\11B\PNK-FIG3.DGN



Figure 3  
**CONCEPTUAL SITE MODEL**  
 LAKE CALUMET CLUSTER SITE  
 Chicago, Illinois

**APPENDIX A**

**UCL<sub>95</sub> and EPCs of Soil COPCs**

Table 1. UCL 95 and EPCs For Soil COPCs in Alburn (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DetFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
1,2,4-Trichlorobenzene	385000	3	8651.99	44187.423	5.59913	2.8781027	90	73	19	2.90	1.665	4.8	16406	73586.4	73586
1,2-Dibromo-3-Chloropropane	385000	4.5	8581.22	44194.76	5.75717	2.634513	90	60	33	2.65	1.665	4.44	16336	35187.2	35187
1,2-Dichlorobenzene	385000	1	8441	44214.881	5.44861	2.8241714	90	80	11	2.80	1.665	4.66	16200	50586.1	50586
1,2-Dichloroethane	385000	4.5	8481.46	44211.241	5.50256	2.7939762	90	89	1	2.80	1.665	4.66	16239	48321.8	48322
1,4-Dichlorobenzene	385000	1	8401.54	44222.645	5.36224	2.7989062	90	64	29	2.80	1.665	4.66	16162	42682.5	42683
2,2'-Oxybis(1-Chloro)Propane	8800	150	841.167	1397.7496	6.05268	1.0160839	90	77	14	1.00	1.665	2.31	1086	913.483	913.48
2,4,5-Trichlorophenol	22000	120	2070.06	3494.8716	6.91583	1.0514441	90	80	11	1.05	1.665	2.36	2683	2279.52	2279.5
2,4,6-Trichlorophenol	8800	150	834.833	1401.6117	6.02188	1.0330619	90	81	10	1.05	1.665	2.36	1081	910.509	910.51
2,4-Dichlorophenol	8800	150	806.167	1395.9903	5.9825	1.0193097	90	82	9	1.00	1.665	2.31	1051	855.04	855.04
2,4-Dimethylphenol	51000	27	1370.16	5469.9041	5.98959	1.2404864	90	61	32	1.25	1.665	2.58	2330	1209.83	1209.8
2,4-Dinitrophenol	22000	375	2775.27	4182.8211	7.20776	1.0875845	91	49	46	1.10	1.665	2.42	3505	3216.68	3216.7
2,4-Dinitrotoluene	8800	120	846.978	1429.4892	6.01354	1.0488653	91	78	14	1.05	1.665	2.36	1096	920.221	920.22
4-Methylphenol	29000	23	1400.39	3486.7151	6.11746	1.3784106	90	38	58	1.40	1.665	2.76	2012	1756.04	1756
4-Nitroaniline	22000	375	2178.42	3620.2585	6.96337	1.0461832	92	78	15	1.05	1.664	2.36	2807	2379.36	2379.4
4-Nitrophenol	22000	375	2192.72	3557.896	7.00871	1.0295713	90	72	20	1.05	1.665	2.36	2817	2431.74	2431.7
Acenaphthene	130000	22	3805.99	15719.637	6.44467	1.5818984	91	10	89	1.60	1.665	3.01	6549	3632.03	3632
Acenaphthylene	25000	21	1324.14	3537.4719	5.98336	1.3857354	90	17	81	1.40	1.665	2.76	1945	1554.62	1554.6
Acetone	385000	5	9018.43	44343.553	6.20465	2.3506628	90	50	44	2.35	1.665	4.02	16800	21354.1	21354
Acetophenone	8800	20	790.344	1416.8243	5.79498	1.22196	90	71	21	1.20	1.665	2.53	1039	961.652	961.65
Aldrin	150	0.41	6.24092	17.057114	0.82959	1.16978	87	59	32	1.15	1.665	2.47	9.286	6.20528	6.2053
alpha-BHC	170	0.077	8.82587	21.319347	0.99986	1.4246565	86	36	58	1.45	1.666	2.82	12.65	11.5949	11.595
alpha-Chlordane	2000	0.29	38.7469	225.23413	1.20939	1.5449323	87	33	62	1.55	1.665	2.94	78.96	18.0544	18.054
alpha-Endosulfan	37	0.8	4.39943	6.6374882	0.78023	1.0545876	87	62	29	1.05	1.665	2.36	5.585	4.97673	4.9767
Aluminum	35900000	2670000	1.1E+07	5631594.4	16.093	0.4616525	94	0	100	0.45	1.664	1.84	1E+07	1.2E+07	1E+07
Anthracene	56000	31	2562.97	7212.5883	6.62221	1.4710709	91	7	92	1.45	1.665	2.82	3821	3434.54	3434.5
Antimony	1020000	360	26579.8	130973.14	8.25393	1.4211826	94	5	95	1.40	1.664	2.76	49056	15845.5	15846
Arochlor 1016	440	15	63.7529	95.420829	3.55252	0.9285622	85	76	11	0.95	1.666	2.26	80.99	67.5047	67.505
Arochlor 1221	900	31	128.876	192.45476	4.25996	0.9261603	85	76	11	0.95	1.666	2.26	163.6	136.567	136.57
Arochlor 1232	440	15	63.7529	95.420829	3.55252	0.9285622	85	76	11	0.95	1.666	2.26	80.99	67.5047	67.505
Arochlor 1242	5900	15	182.094	679.2844	3.82207	1.278648	85	69	19	1.30	1.666	2.64	304.8	149.588	149.59
Arochlor 1248	10000	15	504.059	1293.8224	4.57624	1.7352889	85	44	48	1.75	1.666	3.2	737.8	802.498	802.5
Arochlor 1254	7900	15	498.142	1265.0058	4.53002	1.7123324	88	47	47	1.70	1.665	3.14	722.7	714.659	714.66
1,1,1-Trichloroethane	385000	1	14580.1	66902.384	5.50815	2.9414263	90	81	10	2.95	1.665	4.88	26320	85319.5	85320
1,1,1,2-Tetrachloroethane	385000	4.5	8485.34	44210.505	5.58713	2.7056453	90	81	10	2.70	1.665	4.52	16243	37890.5	37891
1,1,2-Trichloro-1,2,2-Trifluoroethane	385000	4.5	8503.68	44207.494	5.54092	2.791776	90	87	3	2.80	1.665	4.66	16261	49850.1	49850
1,1,2-Trichloroethane	385000	4.5	8483.96	44210.765	5.51631	2.7923738	90	89	1	2.80	1.665	4.66	16242	48733.5	48734
1,1-Dichloroethane	385000	2	8385.11	44203.45	5.48578	2.8038879	90	78	13	2.80	1.665	4.66	16142	49094.2	49094
1,1-Dichloroethene	385000	4.5	8485.04	44210.564	5.55633	2.7436898	90	85	6	2.75	1.665	4.59	16243	42379.9	42380
2,6-Dinitrotoluene	8800	150	825.165	1396.299	6.00603	1.0317168	91	83	9	1.05	1.665	2.36	1069	893.364	893.36
2-Chloronaphthalene	8800	150	834.611	1401.6265	6.02188	1.032457	90	81	10	1.05	1.665	2.36	1081	909.803	909.8
2-Chlorophenol	8800	150	821.556	1404.6725	5.99107	1.0340265	90	85	6	1.05	1.665	2.36	1068	883.981	883.98

Table 1. UCL % and EPCs For Sed COPCs in Albem (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DefFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
2-Hexanone	385000	2	9866.66	45519.462	5.98685	2.7440429	86	47	45	2.75	1.666	4.59	18042	67314	67314
2-Methylnaphthalene	95000	26	4710.24	13548.611	6.72061	1.8362894	90	2	98	1.85	1.665	3.33	7088	8564.56	8564.6
2-Methylphenol	8800	22	828.911	1504.4244	5.79245	1.2402673	90	62	31	1.25	1.665	2.58	1093	993.038	993.04
2-Nitroaniline	22000	375	2067.22	3497.3904	6.91629	1.0384581	90	84	7	1.05	1.665	2.36	2681	2242.52	2242.5
2-Nitrophenol	8800	150	828.278	1402.9846	6.00647	1.0345437	90	83	8	1.05	1.665	2.36	1074	898.299	898.3
3,3'-Dichlorobenzidine	8800	170	1076.59	1629.3154	6.33119	1.0235727	88	46	48	1.00	1.665	2.31	1366	1221.82	1221.8
3-Nitroaniline	22000	375	2106.59	3566.5421	6.91908	1.048116	91	84	8	1.05	1.665	2.36	2729	2273.72	2273.7
4,6-Dinitro-2-methylphenol	22000	375	2278.96	3661.7291	7.0329	1.0489486	91	71	22	1.05	1.665	2.36	2918	2550.59	2550.6
4-Bromophenyl phenyl ether	8800	150	860.11	1397.0405	6.07049	1.0347908	91	78	14	1.05	1.665	2.36	1104	956.61	956.61
4-Chloro-3-methylphenol	8800	150	820.22	1397.1349	5.99484	1.0327634	91	83	9	1.05	1.665	2.36	1064	884.607	884.61
4-Chloroaniline	8800	150	890.333	1515.196	6.03347	1.0626106	90	77	14	1.05	1.665	2.36	1156	957.14	957.14
4-Chlorophenyl phenyl ether	8800	150	830.278	1402.3999	6.01418	1.0302317	90	82	9	1.05	1.665	2.36	1076	900.252	900.25
Arochlor 1260	5500	15	182.186	620.4437	3.95139	1.2975089	86	64	26	1.30	1.666	2.64	293.6	174.988	174.99
Arsenic	151000	3000	15166	20218.46	9.32004	0.677644	94	0	100	0.70	1.664	2.03	18636	16186.5	16187
Atrazine	8800	150	871.111	1431.1604	6.06809	1.040136	90	75	17	1.05	1.665	2.36	1122	962.29	962.29
Barium	2860000	28900	305560	397103.09	12.1246	0.9953581	94	0	100	1.00	1.664	2.31	4E+05	383858	383858
Benzaldehyde	8800	40	703.589	1212.9062	5.84742	1.0407002	90	78	13	1.05	1.665	2.36	916.4	772.304	772.3
Benzene	385000	2	9341.45	43131.672	5.67872	2.8902396	90	34	62	2.90	1.665	4.8	16910	83033.3	83033
Benzo(a)anthracene	67000	30	3384.92	8317.2912	7.00853	1.4739825	90	5	94	1.45	1.665	2.82	4844	5092.73	5092.7
Benzo(a)pyrene	37000	22	2766.36	5944.6242	6.87294	1.4717994	90	4	96	1.45	1.665	2.82	3799	4429.79	4429.8
Benzo(b)fluoranthene	72000	31	4031.88	9681.1403	7.1782	1.4555737	90	4	96	1.45	1.665	2.82	5766	5841.66	5841.7
Benzo(g,h,i)perylene	25000	31	1938.93	3937.8977	6.62987	1.347698	90	5	94	1.35	1.665	2.7	2630	2762.2	2762.2
Benzo(k)fluoranthene	40000	34	2377.51	5690.6004	6.72196	1.338636	91	13	86	1.35	1.665	2.7	3370	2977.89	2977.9
Benzyl Butyl Phthalate	59000	23	2345.53	6981.9133	6.33121	1.5461681	89	38	57	1.55	1.665	2.94	3578	3016.64	3016.6
Beryllium	8400	350	1401.06	1194.1159	7.02269	0.6279639	94	0	100	0.65	1.664	1.99	1606	1554.88	1554.9
beta-BHC	180	0.074	7.27133	21.980143	0.79495	1.2684168	86	57	34	1.25	1.665	2.58	11.21	7.06928	7.0693
beta-Endosulfan	44	0.21	5.42733	8.1638103	1.07406	1.0390765	86	48	44	1.05	1.665	2.36	6.892	6.5533	6.5533
Biphenyl (Diphenyl)	26000	21	1150	3206.2108	5.84934	1.4532498	90	15	83	1.45	1.665	2.82	1713	1540.46	1540.5
Bis(2-Chloroethoxy) Methane	8800	150	821.056	1405.5627	5.98337	1.0407552	90	86	4	1.05	1.665	2.36	1068	884.632	884.63
Bis(2-Chloroethyl) Ether	8800	150	819.833	1405.6918	5.98243	1.0384316	90	87	3	1.05	1.665	2.36	1066	881.356	881.36
Bis(2-Ethylhexyl) Phthalate	93000	56	7989.29	15478.653	7.55462	1.8194062	90	42	53	1.80	1.665	3.27	10705	18764.5	18764
Bromodichloromethane	385000	4	8484.72	44210.627	5.51428	2.7978532	90	89	1	2.80	1.665	4.66	16243	49519.3	49519
Bromoform	385000	4.5	8417.4	43968.737	5.58396	2.7509219	91	85	7	2.75	1.665	4.59	16089	44267	44267
Bromomethane	385000	3	8485.62	44210.451	5.58235	2.7210155	90	82	9	2.70	1.665	4.52	16244	39605.8	39606
Cadmium	142000	110	5484.73	16800.504	7.1915	1.5638154	92	13	86	1.55	1.664	2.94	8400	7310.07	7310.1
Calcium	346000000	4870000	9.7E+07	71018952	18.1489	0.7394294	92	0	100	0.75	1.664	2.07	1E+08	1.2E+08	1E+08
Caprolactam	8800	38	965.244	1557.2586	6.12788	1.1051479	90	59	34	1.10	1.665	2.42	1239	1120.5	1120.5
Carbazole	35000	20	1444.92	4076.0525	6.11825	1.3862051	90	17	81	1.40	1.665	2.76	2160	1780.53	1780.5
Carbon disulfide	385000	1	8383.14	44183.132	5.37697	2.9707524	90	61	32	2.95	1.665	4.88	16136	82852.8	82853
Chlorobenzene	385000	3	6597.43	40850.408	5.46848	2.7643624	90	72	20	2.75	1.665	4.59	13766	41504.7	41505
Chloroethane	385000	4.5	8839.02	44166.354	5.74887	2.8979763	90	60	33	2.90	1.665	4.8	16589	91443	91443



Table 1. UCL 95 and EPCs For Soil COPCs in Alburn (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DetFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
Chloromethane	385000	4.5	8484.81	44210.609	5.52755	2.7802586	90	88	2	2.80	1.665	4.66	16243	47364.2	47364
Chromium	1730000	13200	198441	317243.17	11.3665	1.2441442	94	0	100	1.25	1.664	2.58	3E+05	261271	261271
Chrysene	74000	31	3620.01	8893.4731	7.14024	1.4450911	90	4	96	1.45	1.665	2.82	5181	5521.9	5521.9
cis-1,2-Dichloroethene	385000	1	7456.41	41808.029	5.51848	2.8236627	90	63	30	2.80	1.665	4.66	14793	54155.1	54155
Cobalt	84200	235	9814.35	11612.76	8.77534	1.0445352	93	3	97	1.05	1.664	2.36	11818	14442.9	14443
Copper	5010000	14000	251135	596920.56	11.5145	1.2135896	94	0	100	1.20	1.664	2.53	4E+05	287401	287401
Cyanide	218000	90	6457.61	30331.153	7.13503	1.302213	90	3	97	1.30	1.665	2.64	11780	4218.96	4219
Cyclohexane	385000	1	8504.43	44207.213	5.60298	2.7625858	90	78	13	2.75	1.665	4.59	16262	47206.8	47207
delta-BHC	36	0.16	3.80581	5.960652	0.65554	1.0604652	86	50	42	1.05	1.666	2.36	4.876	4.43434	4.4343
DI-N-Butyl Phthalate	34000	16	1090.37	3732.502	5.53708	1.5743346	89	19	79	1.55	1.665	2.94	1749	1437.35	1437.4
DI-N-Octylphthalate	8800	21	1103.63	1760.1662	6.21719	1.195133	87	36	59	1.20	1.665	2.53	1418	1417.7	1417.7
Dibenz(a,h)Anthracene	11000	22	1049.79	1859.4188	5.99569	1.3667014	90	18	80	1.35	1.665	2.7	1376	1511.46	1511.5
Dibenzofuran	77000	23	2315.12	8622.7179	6.31194	1.4950343	91	16	82	1.50	1.665	2.88	3820	2653.2	2653.2
Dichlorodifluoromethane	385000	4.5	9199.85	44561.866	5.58713	2.8377398	90	81	10	2.85	1.665	4.73	17019	62111.8	62112
Dieldrin	290	0.45	22.3455	39.249834	2.0194	1.5158534	89	16	82	1.50	1.665	2.88	29.27	37.8581	37.858
Diethyl Phthalate	8800	30	813.1	1427.326	5.91405	1.1258529	90	70	22	1.15	1.665	2.47	1064	936.957	936.96
Dimethyl Phthalate	8800	150	817.5	1395.4622	6.00567	1.019485	90	81	10	1.00	1.665	2.31	1062	875.28	875.28
Endosulfan sulfate	190	0.26	9.87663	22.463489	1.41515	1.1811628	89	41	54	1.20	1.665	2.53	13.84	11.3666	11.367
Endrin	280	0.18	13.7189	34.779132	1.53757	1.3364549	89	39	56	1.35	1.665	2.7	19.86	16.699	16.699
Endrin aldehyde	350	0.5	14.0882	38.832268	1.68537	1.2121617	89	27	70	1.20	1.665	2.53	20.94	15.5854	15.585
Endrin ketone	78	0.37	7.30784	11.894515	1.34374	1.001623	88	54	39	1.00	1.665	2.31	9.419	8.10917	8.1092
Ethylbenzene	5000000	1	97775.2	558622.88	6.59097	3.6171507	90	17	81	3.60	1.665	5.83	2E+05	4723348	5E+06
Fluoranthene	230000	22	8491.31	26801.327	7.62817	1.6879303	91	3	97	1.70	1.665	3.14	13168	14924	14924
Fluorene	96000	28	3036.19	10882.73	6.64781	1.4792364	90	9	90	1.50	1.665	2.88	4946	3617.78	3617.8
gamma-BHC	220	0.12	6.12736	23.740534	0.7709	1.0957285	87	47	46	1.10	1.665	2.42	10.37	5.24161	5.2416
gamma-Chlordane	520	0.57	21.4013	64.469069	1.66832	1.4880237	90	39	57	1.50	1.665	2.88	32.71	25.2757	25.276
Heptachlor	64	0.9	3.91701	7.8097555	0.71512	0.9342149	87	70	20	0.95	1.665	2.26	5.311	3.97001	3.97
Heptachlor epoxide	110	0.17	10.5927	18.635213	1.31749	1.4714803	88	28	68	1.45	1.665	2.82	13.9	17.2037	17.204
Hexachlorobenzene	8800	150	841.222	1399.8861	6.03728	1.0321687	90	79	12	1.05	1.665	2.36	1087	923.584	923.58
Hexachlorobutadiene	8800	150	821.056	1405.5627	5.98337	1.0407552	90	86	4	1.05	1.665	2.36	1068	884.832	884.83
Hexachlorocyclopentadiene	8800	150	921.778	1445.3934	6.1374	1.0458963	90	66	27	1.05	1.665	2.36	1175	1039.07	1039.1
Hexachloroethane	8800	150	814.333	1407.2126	5.96797	1.039895	90	88	2	1.05	1.665	2.36	1061	870.341	870.34
Indeno(1,2,3-CD)pyrene	24000	20	1874.54	3382.9666	6.61401	1.3878428	90	6	93	1.40	1.665	2.76	2468	2931.22	2931.2
Iron	405000000	7970000	5.2E+07	55034274	17.4575	0.738418	92	0	100	0.75	1.664	2.07	6E+07	5.9E+07	6E+07
Isophorone	8800	33	801.7	1439.1721	5.90753	1.0846488	90	73	19	1.10	1.665	2.42	1054	874.358	874.36
Isopropylbenzene	170000	1	5898.31	20907.349	5.64583	2.9465667	90	37	59	2.95	1.665	4.88	9567	99670.7	99671
Lead	6730000	15300	549498	955779.1	12.4175	1.2874305	94	0	100	1.30	1.664	2.64	7E+05	805069	805069
Magnesium	52300000	883000	1.9E+07	10896983	16.5443	0.7545205	94	0	100	0.75	1.664	2.07	2E+07	2.4E+07	2E+07
Manganese	40500000	156000	3173261	5858092.5	14.1261	1.2088966	92	0	100	1.20	1.664	2.53	4E+06	3901427	4E+06
Mercury	3800	15	411.33	586.57617	5.44968	1.0294423	94	2	98	1.05	1.664	2.36	512	508.554	508.55
Methoxychlor	300	1.8	42.8978	65.424071	2.99067	1.120287	91	56	38	1.10	1.665	2.42	54.31	49.5731	49.573

Table 1. UCL 95 and EPCs For Soil COPCs in Alburn (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DetFreq	tStdDev	tStat	hStat	UCL	lnUCL	EPC
Methyl acetate	385000	5	8497.97	44208.657	5.55845	2.748912	90	84	7	2.75	1.665	4.59	16256	43192.9	43193
Methyl ethyl ketone	385000	4	8579.39	44205.664	5.66349	2.7017626	90	76	16	2.70	1.665	4.52	16336	40394.8	40395
Methyl isobutyl ketone	385000	4	8575.61	44195.265	5.66039	2.783009	90	74	18	2.80	1.665	4.66	16331	54583.1	54583
Methylcyclohexane	385000	1	12217.3	56967.219	5.63259	2.9173374	90	42	53	2.90	1.665	4.8	22214	86972.6	86973
Methylene chloride	400000	2	8884.02	47037.78	5.65414	2.785822	90	35	61	2.80	1.665	4.66	17138	54745.5	54745
N-Nitrosodl-N-Propylamine	8800	150	901.611	1485.93	6.07579	1.0560201	90	74	18	1.05	1.665	2.36	1162	989.937	989.94
N-Nitrosodiphenylamine	8800	150	864.663	1412.3376	6.07867	1.0276602	89	67	25	1.05	1.665	2.36	1114	958.47	958.47
Naphthalene	670000	24	19992.9	85370.447	7.51978	2.0881689	90	1	99	2.10	1.665	3.67	34973	36782.6	36783
Nickel	568000	10500	56988.3	88886.58	10.5223	0.7745366	94	0	100	0.80	1.664	2.11	72242	59392	59392
Nitrobenzene	8800	150	821.056	1405.5627	5.98337	1.0407552	90	86	4	1.05	1.665	2.36	1068	884.832	884.83
p,p'-DDD	1900	0.64	62.1799	211.14529	2.53283	1.7347316	90	16	82	1.75	1.665	3.2	99.23	102.095	102.09
p,p'-DDE	460	0.62	36.8025	66.324216	2.42728	1.5936549	88	13	85	1.60	1.665	3.01	48.58	67.4371	67.437
p,p'-DDT	780	0.54	56.929	111.82062	2.70677	1.6909835	88	20	77	1.70	1.665	3.14	76.78	110.504	110.5
Pentachlorophenol	22000	375	2419.28	3794.7343	7.05492	1.0920442	90	66	27	1.10	1.665	2.42	3085	2781.7	2781.7
Phenanthrene	360000	31	11193.7	41267.153	7.77697	1.6724867	90	1	99	1.65	1.665	3.07	18435	16651.6	16652
Phenol	17000	37	1245.99	2635.7526	6.12047	1.2493431	90	58	36	1.25	1.665	2.58	1709	1397.68	1397.7
Potassium	7980000	117000	1747133	1194743.8	14.1686	0.6719928	94	1	99	0.65	1.664	1.99	2E+06	2048851	2E+06
Pyrene	170000	20	8175.67	21517.183	7.79102	1.6225259	90	1	99	1.60	1.665	3.01	11951	15134.8	15135
Selenium	9700	255	2245.99	1840.766	7.36892	0.8972666	91	15	84	0.90	1.665	2.21	2567	2922.23	2922.2
Silver	37100	110	1882.07	4782.6861	6.30796	1.4460577	94	40	57	1.45	1.664	2.82	2703	2383.87	2383.9
Sodium	11900000	57600	1457464	1423093.3	13.9245	0.7747516	94	0	100	0.80	1.664	2.11	2E+06	1783953	2E+06
Styrene	385000	4.5	8489.74	44209.88	5.54303	2.7671367	90	86	4	2.75	1.665	4.59	16248	45122.4	45122
Tetrachloroethene	360000	3	7518.21	39793.45	5.52334	2.8298609	90	63	30	2.85	1.665	4.73	14501	56761.6	56762
Thallium	13700	240	2587.37	2882.7756	7.38929	0.9708415	93	14	85	0.95	1.664	2.26	3085	3258.1	3258.1
Toluene	3700000	2	71264.6	407745.43	6.32246	3.4480268	89	27	70	3.45	1.665	5.61	1E+05	1669512	2E+06
Toxaphene	2300	80	328.294	491.34204	5.19168	0.9284949	85	76	11	0.95	1.666	2.26	417.1	347.68	347.68
trans-1,2-Dichloroethene	385000	2	8468.59	44213.631	5.44979	2.8085616	90	85	6	2.80	1.665	4.66	16227	48095.1	48095
trans-1,3-Dichloropropene	385000	4.5	8484.79	44210.611	5.52552	2.7830762	90	89	1	2.80	1.665	4.66	16243	47706.6	47707
Trichloroethene	385000	1	13660	62290.349	5.53945	2.9260946	90	59	34	2.95	1.665	4.88	24590	83496.1	83496
Trichlorofluoromethane	385000	1	8484.74	44210.621	5.50658	2.8149909	90	88	2	2.80	1.665	4.66	16243	51998.8	51999
Vanadium	343000	11800	52691.5	64423.317	10.4905	0.7816688	94	0	100	0.80	1.664	2.11	63747	57942	57942
Vinyl chloride	385000	2	8477.01	44212.015	5.48747	2.8137394	90	86	4	2.80	1.665	4.66	16235	50804	50804
Xylenes	25000000	2	419816	2709426.6	7.45369	3.9429286	89	9	90	3.95	1.665	6.35	9E+05	5.9E+07	3E+07
Zinc	4350000	54400	681779	829308.2	12.888	1.0460711	92	0	100	1.05	1.664	2.36	8E+05	885607	885607

Table 2. UCL 95 and EPCs For Soil COPCs in U.S. Drum (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DefFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
1,1,1-Trichloroethane	14500	5.5	730.7248	1798.094	4.7252	2.298826	109	97	11	2.30	1.6606	3.95	1016.7	3794.5	3794
1,1,2,2-Tetrachloroethane	15000	5.5	876.289	2554.705	4.7237	2.287159	109	104	5	2.30	1.6606	3.95	1282.6	3672.1	3672
1,1,2-Trichloro-1,2,2-Trifluoroethane	16000	5.5	976.6422	2866.942	4.7364	2.340501	109	102	6	2.35	1.6606	4.02	1432.6	4361.6	4362
1,1,2-Trichloroethane	15000	5.5	876.0459	2554.788	4.7046	2.306032	109	107	2	2.30	1.6606	3.95	1282.4	3789.4	3789
1,1-Dichloroethane	15000	1	873.9266	2558.351	4.612	2.443407	109	92	16	2.45	1.6606	4.159	1280.8	5296.6	5297
1,1-Dichloroethene	15000	5.5	887.0963	2553.616	4.7364	2.305867	109	102	6	2.30	1.6606	3.95	1293.3	3910.1	3910
1,2,3,4,6,7,8-Heptachlorodibenzo-P-Dioxin	3.757	2.455	3.36475	0.615473	1.199	0.202615	4	0	100	0.20	2.353	2.747	4.0889	4.6682	3.757
1,2,3,4,6,7,8-Heptachlorodibenzofuran	2.171	1.186	1.6345	0.489667	0.457	0.303352	4	0	100	0.30	2.353	3.256	2.2106	2.9247	2.171
1,2,3,4,7,8,9-Heptachlorodibenzofuran	3.003	1.64	2.2615	0.677413	0.7817	0.303367	4	0	100	0.30	2.353	3.256	3.0585	4.0468	3.003
1,2,3,4,7,8-Hexachlorodibenzofuran	5.505	1.545	2.77525	1.865439	0.8772	0.590029	4	0	100	0.60	2.353	5.547	4.9699	18.932	5.505
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	2.095	0.9685	1.656375	0.508276	0.4624	0.351068	4	1	75	0.35	2.353	3.596	2.2544	3.5	2.095
1,2,3,6,7,8-Hexachlorodibenzofuran	5.531	0.7765	2.085625	2.306108	0.3621	0.922404	4	3	25	0.90	2.353	8.109	4.7988	165.01	5.531
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	2.059	0.9515	1.627875	0.499695	0.445	0.351245	4	1	75	0.35	2.353	3.596	2.2158	3.4411	2.059
1,2,3,7,8-Pentachlorodibenzofuran	2.038	1.1175	1.380375	0.441875	0.2892	0.285682	4	2	50	0.30	2.353	3.256	1.9002	2.3798	2.038
1,2,4-Trichlorobenzene	15000	2	880.711	2556.394	4.668	2.364313	109	95	13	2.35	1.6606	4.02	1287.3	4347.8	4348
1,2-Dibromo-3-Chloropropane	15000	2	876.1514	2554.752	4.6964	2.325605	109	103	6	2.35	1.6606	4.02	1282.5	4024.3	4024
1,2-Dibromoethane	15000	5.5	876.289	2554.705	4.7237	2.287159	109	104	5	2.30	1.6606	3.95	1282.6	3672.1	3672
1,2-Dichlorobenzene	15000	1	885.2752	2564.522	4.8089	2.225292	109	80	27	2.25	1.6606	3.881	1293.2	3347.1	3347
1,2-Dichloroethane	14500	2	974.7523	2530.86	4.7582	2.393948	109	95	13	2.40	1.6606	4.089	1377.3	5248.3	5248
1,2-Dichloropropane	15000	5.5	876.078	2554.777	4.7085	2.301497	109	106	3	2.30	1.6606	3.95	1282.4	3758.4	3758
1,3-Dichlorobenzene	120000	1	2098.904	11722.31	4.7843	2.451737	109	98	10	2.45	1.6606	4.159	3963.4	6444.1	6444
1,4-Dichlorobenzene	130000	2	2424.936	12684.68	5.1253	2.468252	109	58	47	2.45	1.6606	4.159	4442.5	9500.6	9501
2,2'-Oxybis(1-Chloro)Propane	48000	190	4495.648	7493.723	7.3083	1.528418	108	89	18	1.55	1.6608	2.945	5693.2	7416.4	7416
2,3,4,6,7,8-Hexachlorodibenzofuran	5.539	0.7775	2.29075	2.192506	0.5368	0.83955	4	2	50	0.85	2.353	7.678	4.8702	100.55	5.539
2,3,4,7,8-Pentachlorodibenzofuran	1.998	1.096	1.3535	0.433059	0.2696	0.285556	4	2	50	0.30	2.353	3.256	1.863	2.3329	1.998
2,3,7,8-Tetrachlorodibenzofuran	2.14	0.469	1.47475	0.77091	0.2369	0.701615	4	1	75	0.70	2.353	6.391	2.3817	21.584	2.14
2,4,5-Trichlorophenol	120000	470	11085.42	18731.41	8.1513	1.574716	108	101	6	1.60	1.6608	3.009	14079	18943	18943
2,4,6-Trichlorophenol	48000	190	4427.5	7515.937	7.2441	1.560119	108	99	8	1.55	1.6608	2.945	5628.6	7370.5	7371
2,4-Dichlorophenol	48000	76	4421.907	7519.051	7.2206	1.588351	108	99	8	1.60	1.6608	3.009	5623.5	7661.5	7661
2,4-Dimethylphenol	48000	22	3968.074	6599.958	7.0023	1.748154	108	75	31	1.75	1.6608	3.2	5022.8	8700.6	8701
2,4-Dinitrophenol	210000	470	17741.11	30114.24	8.5813	1.617603	108	34	69	1.60	1.6608	3.009	22554	31574	31574
2,4-Dinitrotoluene	48000	190	4423.75	7518.013	7.2313	1.573189	108	101	6	1.55	1.6608	2.945	5625.2	7454.7	7455
2,6-Dinitrotoluene	48000	190	4419.861	7520.039	7.2237	1.578146	108	100	7	1.60	1.6608	3.009	5621.7	7539.9	7540
2-Chloronaphthalene	48000	37	4421.685	7519.197	7.2132	1.603436	108	100	7	1.60	1.6608	3.009	5623.3	7825.1	7825
2-Chlorophenol	48000	190	4441.343	7514.274	7.2377	1.575912	108	100	7	1.60	1.6608	3.009	5642.2	7614.5	7614
2-Hexanone	15000	5.5	878	2542.968	4.753	2.278131	110	104	5	2.30	1.6604	3.95	1280.6	3677	3677
2-Methylnaphthalene	76000	26	4267.472	10491.59	6.7591	1.826536	108	11	90	1.85	1.6608	3.333	5944.2	8231.7	8232
2-Methylphenol	48000	21	4330.657	7546.821	7.0907	1.689254	108	89	18	1.70	1.6608	3.136	5536.7	8347	8347
2-Nitroaniline	120000	470	11085.42	18731.41	8.1513	1.574716	108	101	6	1.60	1.6608	3.009	14079	18943	18943
2-Nitrophenol	48000	190	4423.75	7518.013	7.2313	1.573189	108	101	6	1.55	1.6608	2.945	5625.2	7454.7	7455
3,3'-Dichlorobenzidine	48000	190	4423.75	7518.013	7.2313	1.573189	108	101	6	1.55	1.6608	2.945	5625.2	7454.7	7455
3-Nitroaniline	120000	470	11085.42	18731.41	8.1513	1.574716	108	101	6	1.60	1.6608	3.009	14079	18943	18943

Table 2. UCL 95 and EPCs For Soil COPCs in U.S. Drum (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDef	DefFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
4,6-Dinitro-2-methylphenol	120000	180	11244.86	18877.15	8.1428	1.602874	108	99	8	1.60	1.6608	3.009	14262	19802	19802
4-Bromophenyl phenyl ether	48000	190	4488.565	7570.422	7.2377	1.581263	108	100	7	1.60	1.6608	3.009	5698.4	7691	7691
4-Chloro-3-methylphenol	48000	61	4348.759	7507.945	7.1975	1.586844	108	98	9	1.60	1.6608	3.009	5548.6	7465.6	7466
4-Chloroaniline	48000	28	4419.019	7539.464	7.129	1.691988	108	92	15	1.70	1.6608	3.136	5623.9	8720.6	8721
4-Chlorophenyl phenyl ether	48000	190	4400.138	7487.186	7.234	1.566138	109	102	6	1.55	1.6606	2.945	5591	7362.4	7362
4-Methylphenol	48000	20	4496.833	8302.411	6.9712	1.846778	108	54	50	1.85	1.6608	3.333	5823.7	10632	10632
4-Nitroaniline	120000	470	11085.42	18731.41	8.1513	1.574716	108	101	6	1.60	1.6608	3.009	14079	18943	18943
4-Nitrophenol	120000	470	13057.64	21247.57	8.2091	1.65457	108	92	15	1.65	1.6608	3.072	16453	23607	23607
Acenaphthene	48000	43	3717.815	7525.487	6.8365	1.703576	108	31	71	1.70	1.6608	3.136	4920.5	6661.7	6662
Acenaphthylene	48000	20	4240.481	7612.295	6.7607	1.982187	108	62	43	2.00	1.6608	3.533	5457	12116	12116
Acetone	31000	5.5	1982.991	5390.989	5.8837	1.932006	109	13	88	1.95	1.6606	3.466	2840.5	4422.6	4423
Acetophenone	48000	32	4346.019	7536.331	7.1069	1.698723	108	93	14	1.70	1.6608	3.136	5550.4	8645.5	8646
Aldrin	200	0.95	6.487019	24.0247	0.6821	1.054307	104	93	11	1.05	1.6617	2.361	10.402	4.4067	4.407
alpha-BHC	400	0.95	7.031429	38.99586	0.7467	0.966617	105	74	30	0.95	1.6615	2.256	13.354	4.1692	4.169
alpha-Chlordane	200	0.6	7.77028	22.77186	0.9623	1.155201	107	45	58	1.15	1.661	2.47	11.427	6.7312	6.731
alpha-Endosulfan	7400	0.84	84.22537	713.745	1.1954	1.608963	108	65	40	1.60	1.6608	3.009	198.29	19.254	19.25
Aluminum	2.3E+07	1060000	8793670	3769275	15.882	0.505713	109	0	100	0.50	1.6606	1.876	9E+06	1E+07	1E+07
Anthracene	68000	22	4245.324	8799.777	6.9898	1.79209	108	26	76	1.80	1.6608	3.267	5651.6	9523.4	9523
Antimony	218000	1100	12518.18	35054.42	8.2105	1.23042	55	0	100	1.25	1.6749	2.58	20435	12082	12082
Arochlor 1016	3950	19	91.15238	388.2896	3.5659	0.909984	105	95	10	0.90	1.6615	2.206	154.11	65.154	65.15
Arochlor 1221	8000	38	185.0429	786.5451	4.2745	0.910714	105	95	10	0.90	1.6615	2.206	312.58	132.45	132.5
Arochlor 1232	3950	19	91.15238	388.2896	3.5659	0.909984	105	95	10	0.90	1.6615	2.206	154.11	65.154	65.15
Arochlor 1242	45000	19	3125.28	6607.676	6.1293	2.307287	109	29	73	2.30	1.6606	3.95	4176.3	15805	15805
Arochlor 1248	3950	19	166.2333	559.5608	3.7653	1.199022	105	91	13	1.20	1.6615	2.525	256.96	119.23	119.2
Arochlor 1254	64000	19	1908.171	6485.509	5.7042	2.075019	108	31	71	2.10	1.6608	3.672	2944.6	5397.5	5398
Arochlor 1260	64000	19	1431.307	8149.737	4.462	1.794306	106	65	39	1.80	1.6613	3.267	2746.3	768	768
Arsenic	82500	840	14394.86	14122.15	9.2574	0.799268	109	0	100	0.80	1.6606	2.112	16641	16971	16971
Atrazine	48000	190	4488.565	7570.422	7.2377	1.581263	108	100	7	1.60	1.6608	3.009	5698.4	7691	7691
Barium	1740000	20500	284247.7	312374.1	12.087	0.978922	109	0	100	1.00	1.6606	2.306	333933	356099	4E+05
Benzaldehyde	48000	22	4516.333	7634.496	7.1947	1.651539	108	91	16	1.65	1.6608	3.072	5736.4	8510.6	8511
Benzene	20000	2	897.5963	2706.935	4.8309	2.104176	109	24	78	2.10	1.6606	3.672	1328.2	2411.8	2412
Benzo(a)anthracene	100000	37	5626.444	12407.75	7.387	1.70308	108	21	81	1.70	1.6608	3.136	7609.4	11541	11541
Benzo(a)pyrene	55000	25	5234.787	9798.884	7.2697	1.778284	108	22	80	1.80	1.6608	3.267	6800.8	12240	12240
Benzo(b)fluoranthene	71000	20	5381.944	10632.37	7.2617	1.821134	108	21	81	1.80	1.6608	3.267	7081.1	13294	13294
Benzo(g,h,i)perylene	48000	37	4274.315	7540.581	7.0332	1.797582	108	21	81	1.80	1.6608	3.267	5479.4	10062	10062
Benzo(k)fluoranthene	65000	30	5173.917	9768.715	7.2096	1.825215	108	27	75	1.85	1.6608	3.333	6735.1	12880	12880
Benzyl Butyl Phthalate	63000	24	4590.778	9207.154	7.1158	1.716947	108	61	44	1.70	1.6608	3.136	6062.2	9047.8	9048
Beryllium	2500	30	638.1651	470.3233	6.1583	0.860267	109	13	88	0.85	1.6606	2.159	712.97	818.17	818.2
beta-BHC	400	0.95	8.251887	40.58897	0.7938	1.059487	106	70	34	1.05	1.6613	2.361	14.801	4.9487	4.949
beta-Endosulfan	1500	1.3	21.8281	147.6765	1.3056	1.050499	105	84	20	1.05	1.6615	2.361	45.773	8.1706	8.171
Biphenyl (Diphenyl)	48000	21	3698.481	6756.238	6.6907	1.891932	108	47	56	1.90	1.6608	3.4	4778.2	8975.5	8975
Bis(2-Chloroethoxy) Methane	48000	190	4423.75	7518.013	7.2313	1.573189	108	101	6	1.55	1.6608	2.945	5625.2	7454.7	7455

Table 2. UCL 95 and EPCs For Soil COPCs in U.S. Drum (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DetFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
Bis(2-Chloroethyl) Ether	48000	190	4423.75	7518.013	7.2313	1.573189	108	101	6	1.55	1.6608	2.945	5625.2	7454.7	7455
Bis(2-Ethylhexyl) Phthalate	480000	41	25327.25	66309.33	8.1731	2.142423	109	13	88	2.15	1.6606	3.742	35874	76068	76068
Bromodichloromethane	15000	4	876	2554.804	4.6971	2.315485	109	106	3	2.30	1.6606	3.95	1282.4	3858.2	3858
Bromoform	30000	5.5	1170.22	3662.728	4.8	2.404687	109	92	16	2.40	1.6606	4.089	1752.8	5638.6	5639
Bromomethane	30000	5.5	1223.183	4246.486	4.9208	2.315313	109	73	33	2.30	1.6606	3.95	1898.6	4823	4823
Cadmium	161000	90	5324.45	16218.94	7.3379	1.568977	109	17	84	1.55	1.6606	2.945	7904.2	8211.6	8212
Calcium	2.1E+08	2080000	61194128	46579755	17.647	0.798315	109	0	100	0.80	1.6606	2.112	7E+07	7E+07	7E+07
Caprolactam	48000	33	4266.87	7509.485	7.1479	1.616513	108	91	16	1.60	1.6608	3.009	5467	7514.5	7515
Carbazole	48000	23	3805.37	7425.866	6.7222	1.828845	108	39	64	1.85	1.6608	3.333	4992.1	7973.6	7974
Carbon disulfide	30000	2	1051.495	3539.53	4.9767	2.163225	109	68	38	2.15	1.6606	3.742	1614.5	3279.1	3279
Carbon tetrachloride	16000	5.5	976.6422	2866.942	4.7364	2.340501	109	102	6	2.35	1.6606	4.02	1432.6	4361.6	4362
Chlorobenzene	120000	2	2395.702	11941.09	5.0611	2.428013	109	61	44	2.45	1.6606	4.159	4295	7945.4	7945
Chloroethane	30000	5	1338.376	4395.59	4.8746	2.421207	109	79	28	2.40	1.6606	4.089	2037.5	6363.8	6364
Chloroform	15000	5.5	796.3486	2232.878	4.6751	2.286645	109	102	6	2.30	1.6606	3.95	1151.5	3493.2	3493
Chloromethane	29000	5.5	1036.06	3477.049	4.7576	2.358393	109	97	11	2.35	1.6606	4.02	1589.1	4678.7	4679
Chromium	1070000	3300	116278.9	182597	10.916	1.182847	109	0	100	1.20	1.6606	2.525	145322	147754	1E+05
Chrysene	100000	27	5503.102	12143.28	7.3567	1.739773	108	15	86	1.75	1.6608	3.2	7443.7	12190	12190
cis-1,2-Dichloroethene	15000	1	918.055	2589.043	4.5874	2.477045	109	79	28	2.50	1.6606	4.228	1329.9	5785	5785
cis-1,3-Dichloropropene	15000	5.5	876.0459	2554.788	4.7046	2.306032	109	107	2	2.30	1.6606	3.95	1282.4	3789.4	3789
Cobalt	52500	550	9642.661	6723.944	8.969	0.694693	109	2	98	0.70	1.6606	2.025	10712	11449	11449
Copper	6010000	10700	258911.9	650642.6	11.496	1.280329	109	0	100	1.30	1.6606	2.64	362401	308935	3E+05
Cyanide	14700	70	918.9216	2111.306	5.714	1.260589	102	31	70	1.25	1.6621	2.58	1266.4	927.18	927.2
Cyclohexane	15000	2	910.5046	2595.658	4.7322	2.301777	109	62	43	2.30	1.6606	3.95	1323.4	3851.1	3851
delta-BHC	200	0.58	4.946509	19.65667	0.665	0.953466	106	78	26	0.95	1.6613	2.256	8.1182	3.779	3.779
Di-N-Butyl Phthalate	48000	24	3873.556	6746.679	6.8269	1.8675	108	54	50	1.85	1.6608	3.333	4951.8	9628.2	9628
Di-N-Octylphthalate	50000	74	4802.796	8781.319	7.2391	1.611017	108	81	25	1.60	1.6608	3.009	6206.2	8146.5	8146
Dibenz(a,h)Anthracene	48000	20	3888.639	7392.38	6.7289	1.896069	108	40	63	1.90	1.6608	3.4	5070	9411.2	9411
Dibenzofuran	48000	21	3879.778	7380.215	6.7259	1.915476	108	36	67	1.90	1.6608	3.4	5059.2	9798.8	9799
Dibromochloromethane	30000	5.5	1054.991	3556.857	4.7364	2.346335	109	102	6	2.35	1.6606	4.02	1620.7	4431.7	4432
Dichlorodifluoromethane	15000	2	875.9817	2554.81	4.6908	2.325592	109	106	3	2.35	1.6606	4.02	1282.3	4001.6	4002
Dieldrin	395	1.9	10.36934	39.04617	1.3962	0.990541	106	91	14	1.00	1.6613	2.306	16.67	8.2461	8.246
Diethyl Phthalate	48000	21	4048.009	7271.366	7.0321	1.688544	108	82	24	1.70	1.6608	3.136	5210.1	7860.7	7861
Dimethyl Phthalate	48000	20	4406.231	7527.031	7.1694	1.653167	108	97	10	1.65	1.6608	3.072	5609.1	8323.7	8324
Endosulfan sulfate	395	1.9	9.090654	38.46238	1.2776	0.907664	107	96	10	0.90	1.661	2.206	15.267	6.5798	6.58
Endrin	395	1.9	9.237864	39.19742	1.2688	0.916931	103	94	9	0.90	1.6619	2.206	15.657	6.6158	6.616
Endrin aldehyde	395	1.9	10.70048	40.47026	1.3176	1.000947	105	92	12	1.00	1.6615	2.306	17.262	7.7285	7.728
Endrin ketone	395	1.1	14.43585	44.61628	1.5984	1.154907	106	53	50	1.15	1.6613	2.47	21.635	12.728	12.73
Ethylbenzene	260000	1	8914.454	33533.19	5.4836	3.0716	109	20	82	3.05	1.6606	5.02	14248	118753	1E+05
Fluoranthene	340000	21	10112.68	34807.38	7.9021	1.666916	109	11	90	1.65	1.6606	3.072	15649	17752	17752
Fluorene	48000	22	3826.514	7268.363	6.9545	1.741717	109	27	75	1.75	1.6606	3.2	4982.6	8164.8	8165
gamma-BHC	200	0.95	4.822115	19.86272	0.6111	0.927839	104	93	11	0.95	1.6617	2.256	8.0586	3.4826	3.483
gamma-Chlordane	200	0.95	8.44619	24.4258	0.9107	1.221819	105	79	25	1.20	1.6615	2.525	12.407	7.0966	7.097

Table 2. UCL 95 and EPCs For Soil COPCs in U.S. Drum (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DetFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
Heptachlor	640	0.67	36.39339	84.53663	1.9284	1.835364	109	37	66	1.85	1.6606	3.333	49.84	66.774	66.77
Heptachlor epoxide	200	0.75	6.096667	20.67361	0.7871	1.069312	105	83	21	1.05	1.6615	2.361	9.4487	4.9844	4.984
Hexachlorobenzene	48000	69	4485.546	7572.135	7.2215	1.603008	108	99	8	1.60	1.6608	3.009	5695.7	7884.1	7884
Hexachlorobutadiene	48000	28	4393.083	7476.529	7.2244	1.595908	108	91	16	1.60	1.6608	3.009	5587.9	7801.6	7802
Hexachlorocyclopentadiene	85000	205	7731.378	12262.77	7.8449	1.562868	98	4	96	1.55	1.663	2.945	9791.4	13814	13814
Hexachloroethane	48000	190	4423.75	7518.013	7.2313	1.573189	108	101	6	1.55	1.6608	2.945	5625.2	7454.7	7455
Indeno(1,2,3-CD)pyrene	48000	28	4490.815	7672.909	7.0516	1.860214	108	31	71	1.85	1.6608	3.333	5717	11864	11864
Iron	2.6E+08	3700000	58171193	54597986	17.511	0.873347	109	0	100	0.85	1.6606	2.159	7E+07	7E+07	7E+07
Isophorone	48000	22	4351.602	7520.401	7.1468	1.656493	108	92	15	1.65	1.6608	3.072	5553.5	8191	8191
Isopropylbenzene	15000	1	1088.647	2461.064	5.0635	2.326423	109	34	69	2.35	1.6606	4.02	1480.1	5822.3	5822
Lead	5090000	10300	552611	839481.6	12.295	1.50751	109	0	100	1.50	1.6606	2.881	686136	1E+06	1E+06
Magnesium	6.4E+07	1170000	14029358	10022227	16.14	0.882509	109	0	100	0.90	1.6606	2.206	2E+07	2E+07	2E+07
Manganese	3.1E+07	110000	2287670	5499833	13.636	1.144567	109	0	100	1.15	1.6606	2.47	3E+06	2E+06	2E+06
Mercury	6000	25	506.422	843.5483	5.4454	1.27224	109	17	84	1.25	1.6606	2.58	640.59	713.78	713.8
Methoxychlor	7300	7.9	101.5562	711.371	3.0324	0.984501	105	73	30	1.00	1.6615	2.306	216.9	42.081	42.08
Methyl acetate	31000	3	1263.606	3957.613	4.8774	2.33024	109	47	57	2.35	1.6606	4.02	1893.1	4883.8	4884
Methyl ethyl ketone	30000	5	1057.518	3543.368	5.0568	2.047561	109	50	54	2.05	1.6606	3.603	1621.1	2598.9	2599
Methyl isobutyl ketone	15000	1	879.867	2554.82	4.6276	2.45242	109	85	22	2.45	1.6606	4.159	1286.2	5519.7	5520
Methylcyclohexane	15000	1	911.8636	2560.235	4.7045	2.308438	110	36	67	2.30	1.6604	3.95	1317.2	3798.2	3798
Methylene chloride	15000	1	873.8991	2450.938	4.6753	2.337395	109	66	39	2.35	1.6606	4.02	1263.7	4068.5	4069
N-Nitrosod-N-Propylamine	48000	190	4450.602	7510.609	7.2441	1.575967	108	99	8	1.60	1.6608	3.009	5650.9	7664.3	7664
N-Nitrosodiphenylamine	48000	24	4038.287	7205.214	6.9881	1.710335	108	72	33	1.70	1.6608	3.136	5189.8	7857.7	7858
Naphthalene	110000	27	7521.761	17568.94	7.114	2.009678	109	8	93	2.00	1.6606	3.533	10316	18336	18336
Nickel	470000	2600	49107.34	60018.02	10.415	0.838661	109	0	100	0.85	1.6606	2.159	58654	56435	56435
Nitrobenzene	48000	190	4425.046	7518.059	7.2274	1.578656	108	100	7	1.60	1.6608	3.009	5626.5	7575.2	7575
Octachlorodibenzo-P-Dioxin	4.196	2.39	3.05525	0.823635	1.0915	0.255617	4	0	100	0.25	2.353	3.001	4.0243	4.7923	4.196
Octachlorodibenzofuran	9.845	2.756	4.954	3.336962	1.4566	0.589258	4	0	100	0.60	2.353	5.547	8.8799	33.696	9.845
p,p'-DDD	3700	1.3	122.2028	392.0719	3.2335	1.78384	109	18	83	1.80	1.6606	3.267	184.56	218.16	218.2
p,p'-DDE	730	1.1	61.52339	95.83597	2.9149	1.797288	109	35	68	1.80	1.6606	3.267	76.767	163.2	163.2
p,p'-DDT	395	1.5	14.05524	41.6042	1.572	1.173508	105	82	22	1.15	1.6615	2.47	20.801	12.741	12.74
Pentachlorophenol	120000	310	16470.84	25380.21	8.4336	1.700087	107	57	47	1.70	1.661	3.136	20546	32748	32748
Phenanthrene	170000	40	7902.945	17864.05	7.8333	1.665623	109	8	93	1.65	1.6606	3.072	10744	16529	16529
Phenol	48000	30	4363.343	7503.011	7.1307	1.679365	108	80	26	1.70	1.6608	3.136	5562.4	8518.1	8518
Potassium	4410000	240000	1601165	898629.8	14.11	0.634286	109	0	100	0.65	1.6606	1.986	2E+06	2E+06	2E+06
Pyrene	160000	30	7108.752	18006.52	7.6808	1.678751	109	7	94	1.70	1.6606	3.136	9972.8	14714	14714
Selenium	11200	150	2277.294	1830.751	7.3965	0.899124	109	9	92	0.90	1.6606	2.206	2568.5	2956.1	2956
Silver	24200	135	3465.183	4267.507	7.4944	1.199629	109	21	81	1.20	1.6606	2.525	4134	4941.8	4942
Sodium	8530000	43150	1151001	1340175	13.563	0.857654	109	1	99	0.85	1.6606	2.159	1E+06	1E+06	1E+06
Styrene	15000	5.5	915.1881	2578.867	4.7629	2.299948	109	102	6	2.30	1.6606	3.95	1325.4	3952	3952
Tert-Butyl Methyl Ether	30000	5.5	1115.128	3572.252	4.8127	2.397853	109	90	17	2.40	1.6606	4.089	1683.3	5602.7	5603
Tetrachloroethene	28000	1	1094.005	3658.935	4.6351	2.448188	109	63	42	2.45	1.6606	4.159	1676	5494.9	5495
Thallium	3000	230	901.05	580.0476	6.6097	0.62761	100	49	51	0.65	1.6626	1.986	997.49	1024.4	1024

Table 2. UCL 95 and EPCs For Soil COPCs in U.S. Drum (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DefFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
Toluene	730000	2	11654.45	74502.54	5.3254	2.616781	109	14	87	2.60	1.6606	4.372	23505	18958	18958
Toxaphene	20000	95	465.9524	1966.794	5.205	0.908605	105	95	10	0.90	1.6615	2.206	784.85	335.05	335.1
trans-1,2-Dichloroethene	15000	1	895.5183	2560.827	4.6456	2.420451	109	97	11	2.40	1.6606	4.089	1302.8	5050.4	5050
trans-1,3-Dichloropropene	15000	5.5	876.0459	2554.788	4.7046	2.306032	109	107	2	2.30	1.6606	3.95	1282.4	3789.4	3789
Trichloroethene	15000	1	807.7661	2229.338	4.6288	2.345331	109	74	32	2.35	1.6606	4.02	1162.4	3968.9	3969
Trichlorofluoromethane	30000	2	1413.055	4393.498	4.9013	2.544836	109	66	39	2.55	1.6606	4.3	2111.9	9821.2	9821
Vanadium	253000	1600	31255.96	43354	9.9366	0.830116	109	0	100	0.85	1.6606	2.159	38152	34670	34670
Vinyl chloride	30000	5.5	1053.5	3541.18	4.7697	2.347269	109	96	12	2.35	1.6606	4.02	1616.7	4593.5	4594
Xylenes	950000	2	39499.22	140287.9	6.3638	3.393862	109	10	91	3.40	1.6606	5.534	61813	1E+06	1E+06
Zinc	9250000	23600	871733.9	1457734	12.804	1.38248	109	0	100	1.40	1.6606	2.761	1E+06	1E+06	1E+06



Table 3. UCL 95 and EPCs For Soil COPCs in Unnamed Parcel (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DefFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	1.398	0.27	0.685	0.4922046	-0.556	0.677574	4	1	75	0.70	2.353	6.391	1.2641	8.7893	1.398
1,2,3,4,7,8-Hexachlorodibenzofuran	3.178	0.291	1.81425	1.2406808	0.2845	1.064582	4	0	100	1.05	2.353	9.4151	3.2739	763.62	3.178
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	1.338	0.484	0.71975	0.4128263	-0.428	0.481364	4	0	100	0.50	2.353	4.721	1.2054	2.719	1.338
1,2,3,6,7,8-Hexachlorodibenzofuran	3.193	0.146	1.4905	1.2653449	-0.058	1.316321	4	2	50	1.30	2.353	11.604	2.9792	15181	3.193
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	1.315	0.476	0.70775	0.4054827	-0.444	0.480875	4	0	100	0.50	2.353	4.721	1.1848	2.6701	1.315
1,2,3,7,8,9-Hexachlorodibenzofuran	4.083	0.187	1.67588	1.6939224	0.0154	1.286819	4	3	25	1.30	2.353	11.604	3.6688	12897	4.083
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	1.0425	0.413	0.72388	0.2597609	-0.376	0.385185	4	3	25	0.40	2.353	3.9355	1.0295	1.7744	1.0425
1,2,3,7,8-Pentachlorodibenzofuran	0.463	0.277	0.34	0.086325	-1.101	0.23744	4	3	25	0.25	2.353	3.001	0.4416	0.5162	0.463
1,2,4-Trichlorobenzene	2000000	1	64308	331757.41	3.2857	2.564741	81	14	83	2.55	1.667	4.2999	125745	2459.3	2459.3
1,2-Dibromo-3-Chloropropane	1000000	5	27510	146718.61	3.1977	2.438309	81	51	37	2.45	1.667	4.1585	54680	1486.2	1486.2
1,2-Dibromoethane	1000000	5	32193.4	165871.13	3.0777	2.465325	81	64	21	2.45	1.667	4.1585	62910	1426.3	1426.3
1,2-Dichlorobenzene	2000000	2	64282.9	331762.22	3.1159	2.632227	81	6	93	2.65	1.667	4.4437	125720.3	2665	2665
Arochlor 1254	41000	19.5	925.926	4559.7681	5.2225	1.510458	81	35	57	1.50	1.667	2.881	1770.3	943.62	943.62
Arochlor 1260	2800	19.5	270.079	430.05175	4.9687	1.128843	82	34	59	1.15	1.666	2.4704	349.22	370.81	370.81
Arsenic	99900	1100	18854.2	13732.224	9.6163	0.737515	83	0	100	0.75	1.666	2.0685	21366	23313	23313
Barium	10800000	4000	715273	1649867.9	12.603	1.224828	83	0	100	1.25	1.666	2.58	1E+06	892895	892895
Benzaldehyde	7500	52	919.607	1474.3744	6.113	1.057917	84	76	10	1.05	1.666	2.3608	1187.6	1039.7	1039.7
Benzene	2000000	1	63564.9	329771.74	3.2975	2.761949	82	1	99	2.75	1.666	4.5875	124252	5011.4	5011.4
Benzo(a)anthracene	310000	81	6079.06	33915.926	6.7561	1.530133	84	9	89	1.55	1.666	2.9448	12244	4543.2	4543.2
Benzo(a)pyrene	250000	74	5238.27	27410.015	6.7413	1.50594	84	10	88	1.50	1.666	2.881	10221	4236.2	4236.2
Benzo(b)fluoranthene	350000	44	7158.49	38493.61	6.9122	1.570759	84	8	90	1.55	1.666	2.9448	14156	5730.7	5730.7
Benzo(g,h,i)perylene	55000	66	1980.61	6290.8802	6.3281	1.407916	84	13	85	1.40	1.666	2.7606	3124.1	2311.9	2311.9
Benzo(k)fluoranthene	150000	54	3953.37	16943.932	6.6957	1.487562	84	14	83	1.50	1.666	2.881	7033.4	3914.9	3914.9
Benzyl Butyl Phthalate	43000	48	1782.17	5165.8393	6.2162	1.383023	84	46	45	1.40	1.666	2.7606	2721.2	1981.6	1981.6
Beryllium	3000	140	1013.98	564.48863	6.7406	0.660045	83	8	90	0.65	1.666	1.9855	1117.2	1215.8	1215.8
beta-BHC	370	0.81	32.2279	50.346638	2.6613	1.367315	81	17	79	1.35	1.667	2.7004	41.551	55.084	55.084
Biphenyl (Diphenyl)	7500	50	805.083	1403.7012	5.9402	1.112017	84	59	30	1.10	1.666	2.4156	1060.2	947.01	947.01
Bis(2-Chloroethyl) Ether	14000	200	1553.04	2652.8789	6.4823	1.178338	84	46	45	1.20	1.666	2.5252	2035.3	1813.8	1813.8
1,1,1-Trichloroethane	52000000	1	773903	5806820.1	2.9179	2.954548	84	35	58	2.95	1.666	4.8751	2E+06	7069.8	7069.8
1,1,2,2-Tetrachloroethane	1000000	5	24542.8	139938.3	3.0883	2.417397	81	62	23	2.40	1.667	4.089	50457	1230.7	1230.7
1,1,2-Trichloro-1,2,2-Trifluoroethane	1000000	5	31417.5	163911.13	3.0379	2.439326	83	66	20	2.45	1.666	4.1585	61396	1253	1253
1,1,2-Trichloroethane	1000000	5	31417.1	163911.21	2.9973	2.451276	83	71	14	2.45	1.666	4.1585	61395	1245.7	1245.7
1,1-Dichloroethane	1000000	5	26477.4	143897.02	2.9966	2.415057	83	69	17	2.40	1.666	4.089	52795	1100.4	1100.4
1,1-Dichloroethene	1000000	5	31417	163911.22	2.9878	2.455152	83	72	13	2.45	1.666	4.1585	61395	1247.9	1247.9
1,2,3,4,6,7,8-Heptachlorodibenzo-P-Dioxin	1.902	0.901	1.3355	0.4255541	0.252	0.314019	4	0	100	0.30	2.353	3.2555	1.8362	2.4389	1.902
1,2,3,4,6,7,8-Heptachlorodibenzofuran	3.684	0.376	1.552	1.4618374	0.1144	0.937349	4	0	100	0.95	2.353	8.5433	3.2719	177.17	3.684
1,2,3,4,7,8,9-Heptachlorodibenzofuran	2.5485	0.52	1.51013	0.8383329	0.2657	0.670256	4	1	75	0.65	2.353	5.969	2.4964	16.447	2.5485
1,2-Dichloroethane	1000000	3	24074.1	137184.45	2.9856	2.431565	83	67	19	2.45	1.666	4.1585	49164	1162.7	1162.7
1,2-Dichloropropane	1000000	5	31417.2	163911.19	3.0057	2.44883	83	70	16	2.45	1.666	4.1585	61395	1247.2	1247.2
1,3-Dichlorobenzene	2000000	2	65990.9	335811.31	3.3386	2.64366	79	13	84	2.65	1.667	4.4437	128977	3509.5	3509.5
1,4-Dichlorobenzene	2000000	1	48062.1	288572.01	3.3568	2.686496	82	5	94	2.70	1.666	4.5156	101168	4078	4078



Table 3. UCL95 and EPCs For Soil COPCs in Unnamed Parcel (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DetFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
2,2'-Oxybis(1-Chloro)Propane	14000	170	1606.67	2628.5963	6.6258	1.093824	84	27	68	1.10	1.666	2.4156	2084.5	1833.6	1833.6
2,3,4,6,7,8-Hexachlorodibenzofuran	3.197	0.1465	1.4925	1.2668137	-0.056	1.315312	4	2	50	1.30	2.353	11.604	2.9829	15087	3.197
2,3,4,7,8-Pentachlorodibenzofuran	0.908	0.272	0.5165	0.2880654	-0.773	0.542221	4	1	75	0.55	2.353	5.134	0.8554	2.6671	0.908
2,3,7,8-Tetrachlorodibenzofuran	1.677	0.271	0.817	0.6051352	-0.408	0.750233	4	0	100	0.75	2.353	6.8185	1.5289	16.888	1.677
2,4-Dimethylphenol	7500	150	976.488	1520.1842	6.1757	1.048135	84	81	4	1.05	1.666	2.3608	1252.8	1093	1093
2,4-Dinitrophenol	38000	490	3589.52	6307.4679	7.4544	1.066735	84	40	52	1.05	1.666	2.3608	4736.1	4023.1	4023.1
2-Chloronaphthalene	120000	99	2277.61	13063.072	6.1821	1.163377	84	81	4	1.15	1.666	2.4704	4652.2	1305.4	1305.4
2-Hexanone	2000000	5.5	47460.3	277859.7	3.2279	2.571188	81	47	42	2.55	1.667	4.2999	98916	2367.4	2367.4
2-Methylnaphthalene	44000	55	2812.19	6310.3599	6.5495	1.590975	84	16	81	1.60	1.666	3.0086	3959.3	4190	4190
2-Methylphenol	68000	150	1667.98	7442.0539	6.1918	1.122083	84	82	2	1.10	1.666	2.4156	3020.8	1235	1235
3,3'-Dichlorobenzidine	11000	195	1208.99	2098.3232	6.3008	1.108883	84	68	19	1.10	1.666	2.4156	1590.4	1352.3	1352.3
3-Nitroaniline	19000	490	2401.43	3675.7289	7.1326	1.008031	84	79	6	1.00	1.666	2.306	3069.6	2686	2686
4,6-Dinitro-2-methylphenol	38000	490	3032.38	5293.3121	7.3059	1.046674	84	58	31	1.05	1.666	2.3608	3994.6	3377.4	3377.4
4-Bromophenyl phenyl ether	11000	195	1136.55	2059.8747	6.2265	1.099616	84	77	8	1.10	1.666	2.4156	1511	1239.7	1239.7
4-Chloro-3-methylphenol	7500	195	940.298	1477.6195	6.1617	1.023891	84	83	1	1.00	1.666	2.306	1208.9	1038	1038
4-Chloroaniline	7500	195	958.274	1470.8352	6.21	1.009403	84	79	6	1.00	1.666	2.306	1225.6	1069.5	1069.5
4-Chlorophenyl phenyl ether	11000	195	1136.55	2059.8747	6.2265	1.099616	84	77	8	1.10	1.666	2.4156	1511	1239.7	1239.7
4-Methylphenol	25000	42	1153.57	2977.0404	5.9828	1.276679	84	49	42	1.30	1.666	2.6402	1694.7	1296.9	1296.9
4-Nitroaniline	36000	500	3157.62	5088.8955	7.4381	0.982465	84	42	50	1.00	1.666	2.306	4082.7	3531.3	3531.3
4-Nitrophenol	27000	490	2963.93	5196.0202	7.1986	1.099417	84	71	15	1.10	1.666	2.4156	3908.4	3276.3	3276.3
Acenaphthene	11000	55	1097.64	1878.7714	6.109	1.245236	84	32	62	1.25	1.666	2.58	1439.2	1389.8	1389.8
Acenaphthylene	11000	48	997.369	1822.5576	6.0315	1.216112	84	60	29	1.20	1.666	2.5252	1328.7	1221.7	1221.7
Acetone	2000000	5	52049.5	285069.46	4.9583	2.269435	84	19	77	2.25	1.666	3.8805	103869	4915.1	4915.1
Acetophenone	7500	74	940.345	1477.8637	6.1533	1.040015	84	80	5	1.05	1.666	2.3608	1209	1057.4	1057.4
Aldrin	210	1	13.0125	27.690798	1.5751	1.325165	80	60	25	1.35	1.667	2.7004	18.173	17.387	17.387
alpha-BHC	17000	1	221.92	1899.671	1.5403	1.519708	80	49	39	1.50	1.667	2.881	575.95	24.231	24.231
alpha-Chlordane	115	1	14.1599	23.4967	1.8238	1.265103	81	39	52	1.25	1.667	2.58	18.511	19.865	19.865
alpha-Endosulfan	530	0.1	16.2935	66.225017	1.2174	1.478046	80	57	29	1.50	1.667	2.881	28.635	16.262	16.262
Aluminum	42500000	697000	9476386	7070022.4	15.839	0.721245	83	0	100	0.70	1.666	2.025	1E+07	1E+07	1E+07
Anthracene	75000	47	2365.08	8617.0583	6.2114	1.487931	84	24	71	1.50	1.666	2.881	3931.5	2413.6	2413.6
Antimony	33400	830	10834.2	8280.4986	8.9329	0.954988	83	0	100	0.95	1.666	2.256	12349	15166	15166
Arochlor 1242	38000	19.5	1476.83	5085.7857	5.1722	1.931108	80	51	36	1.95	1.667	3.4664	2424.6	2416.1	2416.1
Arochlor 1248	6500	19.5	256.885	794.16306	4.3598	1.316051	78	76	3	1.30	1.667	2.6402	406.81	276.39	276.39
Bis(2-Ethylhexyl) Phthalate	95000	86	13510.5	20479.374	8.3506	1.750942	84	2	98	1.75	1.666	3.2	17233	36262	36262
Bromodichloromethane	1000000	5	31800.1	164882.53	3.0055	2.465097	82	71	13	2.45	1.666	4.1585	62143	1316.7	1316.7
Bromoform	1000000	5	31417.1	163911.21	2.9973	2.451276	83	71	14	2.45	1.666	4.1585	61395	1245.7	1245.7
Bromomethane	1000000	5	31419.7	163910.72	3.1541	2.422652	83	51	39	2.40	1.666	4.089	61398	1316.5	1316.5
Cadmium	60800	110	5870.96	8735.5568	8.0383	1.259258	83	6	93	1.25	1.666	2.58	7468.6	9798.2	9798.2
Calcium	4.51E+08	7E+06	6.4E+07	73674150	17.598	0.812541	83	0	100	0.80	1.666	2.112	8E+07	7E+07	7E+07
Caprolactam	14000	69	1165.64	1956.9152	6.3948	1.036313	84	52	38	1.05	1.666	2.3608	1521.4	1339.9	1339.9
Carbazole	23000	58	1283.51	2991.2423	6.0591	1.31083	84	39	54	1.30	1.666	2.6402	1827.3	1477.5	1477.5

Table 3. UCL 95 and EPCs For Soil COPCs in Unnamed Parcel (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DefFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
Carbon disulfide	1000000	1	31056.6	162954.26	3.0001	2.627113	84	24	71	2.65	1.666	4.4437	60678	2281	2281
Carbon tetrachloride	1000000	5.5	31417.2	163911.18	3.014	2.445189	83	69	17	2.45	1.666	4.1585	61395	1244.4	1244.4
Chlorobenzene	2000000	1	49247.8	291888.15	3.6688	2.68205	80	2	98	2.70	1.667	4.5156	103645	5586.5	5586.5
Chloroethane	1000000	6	31432.1	163908.38	3.3093	2.392552	83	35	58	2.40	1.666	4.089	61410	1410.7	1410.7
Chloroform	1000000	2	31416.9	163911.25	2.9653	2.467649	83	72	13	2.45	1.666	4.1585	61395	1265.4	1265.4
Chloromethane	1000000	3	31422.2	163910.22	3.2001	2.426185	83	46	45	2.45	1.666	4.1585	61400	1418.6	1418.6
Chromium	1620000	5900	151886	232148.63	11.297	1.123936	83	0	100	1.10	1.666	2.4156	194344	204520	204520
Chrysene	310000	71	6420.31	33955.709	6.9448	1.509124	84	8	90	1.50	1.666	2.881	12593	5222.6	5222.6
cis-1,2-Dichloroethene	1000000	1	31416.5	163911.33	2.8784	2.524851	83	63	24	2.55	1.666	4.2999	61395	1429	1429
cis-1,3-Dichloropropene	1000000	5	31417.1	163911.21	2.9973	2.451276	83	71	14	2.45	1.666	4.1585	61395	1245.7	1245.7
Cobalt	27200	600	11248.2	5360.3641	9.1886	0.611784	83	2	98	0.60	1.666	1.946	12229	13456	13456
Copper	6540000	3900	432372	844294.73	12.286	1.131709	83	0	100	1.15	1.666	2.4704	586788	559779	559779
Cyclohexane	5400000	1	83446.8	599800.03	3.2161	2.702551	84	34	60	2.70	1.666	4.5156	192477	3668.5	3668.5
delta-BHC	115	0.46	8.92833	18.026594	1.2889	1.234747	78	75	4	1.25	1.667	2.58	12.332	11.181	11.181
Di-N-Butyl Phthalate	7500	66	947.69	1487.2792	6.0678	1.179812	84	48	43	1.20	1.666	2.5252	1218	1200.8	1200.8
Di-N-Octylphthalate	7500	46	1072.76	1808.4589	6.1456	1.150595	84	66	21	1.15	1.666	2.4704	1401.5	1235.8	1235.8
Dibenz(a,h)Anthracene	59000	33	1592	6512.3757	6.0221	1.337977	84	36	57	1.35	1.666	2.7004	2775.8	1500.9	1500.9
Dibenzofuran	7500	48	1055.04	1728.4817	6.0823	1.260974	84	37	56	1.25	1.666	2.58	1369.2	1386.3	1386.3
Dibromochloromethane	1000000	5	31417.1	163911.21	2.9973	2.451276	83	71	14	2.45	1.666	4.1585	61395	1245.7	1245.7
Dichlorodifluoromethane	1000000	5	31430.7	163908.65	3.2407	2.402755	83	42	49	2.40	1.666	4.089	61408	1373.6	1373.6
Dieldrin	175	1.95	22.5821	30.698492	2.488	1.15571	81	36	56	1.15	1.667	2.4704	28.267	32.299	32.299
Diethyl Phthalate	7500	68	923.881	1490.7769	6.0308	1.15781	84	66	21	1.15	1.666	2.4704	1194.9	1113.3	1113.3
Dimethyl Phthalate	7500	140	940.238	1477.7802	6.1585	1.028882	84	83	1	1.05	1.666	2.3608	1208.9	1047.8	1047.8
Endosulfan sulfate	940	0.28	34.0312	117.03737	2.1313	1.437608	81	59	27	1.45	1.667	2.8208	55.705	37.263	37.263
Endrin	225	1.95	18.1051	34.735772	2.024	1.231803	79	74	6	1.25	1.667	2.58	24.62	23.163	23.163
Endrin aldehyde	1100	1.1	31.0944	126.88891	2.0175	1.340177	80	64	20	1.35	1.667	2.7004	54.742	27.735	27.735
Endrin ketone	225	1.95	17.6367	34.292104	2.0033	1.223888	79	70	11	1.20	1.667	2.5252	24.069	22.246	22.246
Ethylbenzene	1800000	1	46056.3	248761.95	3.1347	2.703214	81	12	85	2.70	1.667	4.5156	92123	3474.3	3474.3
Fluoranthene	610000	57	12042.4	56942.212	7.3893	1.697125	84	5	94	1.70	1.666	3.1362	22393	12255	12255
Fluorene	18000	44	1482.12	2972.5822	6.2442	1.337118	84	27	68	1.35	1.666	2.7004	2022.5	1871.5	1871.5
gamma-BHC	115	0.22	8.549	16.694184	1.3168	1.22622	80	65	19	1.25	1.667	2.58	11.66	11.297	11.297
gamma-Chlordane	115	0.37	14.9133	23.4209	1.7259	1.442438	84	49	42	1.45	1.666	2.8208	19.171	24.848	24.848
Heptachlor	2800	1	44.0462	314.49906	1.4148	1.405798	79	72	9	1.40	1.667	2.7606	103.03	17.157	17.157
Heptachlor epoxide	90	1	8.39231	15.297316	1.2834	1.197645	78	68	13	1.20	1.667	2.5252	11.28	10.436	10.436
Hexachlorobenzene	11000	195	1136.55	2059.8747	6.2265	1.099616	84	77	8	1.10	1.666	2.4156	1511	1239.7	1239.7
Hexachlorobutadiene	14000	200	1568.81	2645.9458	6.5236	1.157144	84	41	51	1.15	1.666	2.4704	2049.8	1820.4	1820.4
Hexachlorocyclopentadiene	14000	195	1082.5	1995.8719	6.21	1.071185	84	79	6	1.05	1.666	2.3608	1445.3	1166	1166
Hexachloroethane	7500	98	940.274	1477.8293	6.156	1.033951	84	83	1	1.05	1.666	2.3608	1208.9	1052	1052
Indeno(1,2,3-CD)pyrene	140000	57	3027.81	15317.846	6.3769	1.418759	84	15	82	1.40	1.666	2.7606	5812.2	2473.1	2473.1
Iron	4.3E+08	1E+06	9.5E+07	77809396	18.057	0.870047	83	0	100	0.85	1.666	2.159	1E+08	1E+08	1E+08
Isophorone	7500	65	939.583	1478.1911	6.1501	1.042847	84	83	1	1.05	1.666	2.3608	1208.3	1058	1058

Table 3. UCL 95 and EPCs For Soil COPCs in Unnamed Parcel (unit: ug/kg)

Analyte Name	Max Value	Min Value	Average	Standard Deviation	In Ave.	In Standard Deviation	Number	NonDet	DetFreq	tStdDev	tStat	hStat	UCL	InUCL	EPC
Isopropylbenzene	2000000	1	47384.4	291530.07	4.11	2.538581	80	4	95	2.55	1.667	4.2999	101715	5220.4	5220.4
Lead	5710000	20400	880148	1019037.8	13.117	1.199868	83	0	100	1.20	1.666	2.5252	1E+06	1E+06	1E+06
Magnesium	1.38E+08	751000	1E+07	15703791	15.755	0.856729	83	0	100	0.85	1.666	2.159	1E+07	1E+07	1E+07
Manganese	13000000	112000	1270783	1740408.7	13.626	0.871117	83	0	100	0.85	1.666	2.159	2E+06	1E+06	1E+06
Mercury	3800	25	634.458	558.61546	6.0952	0.925245	83	2	98	0.95	1.666	2.256	736.62	857.25	857.25
Methoxychlor	1150	0.54	71.119	163.71989	3.1593	1.485786	81	40	51	1.50	1.667	2.881	101.44	114.62	114.62
Methyl acetate	1100000	5	31413.8	165761.36	3.179	2.421664	83	47	43	2.40	1.666	4.089	61730	1345.8	1345.8
Methyl ethyl ketone	2000000	1	57312.7	303872.65	3.9912	2.523816	84	5	94	2.50	1.666	4.228	112550	4218.7	4218.7
Methyl isobutyl ketone	480000	3	13018.9	68346.818	3.2026	2.4305	81	36	56	2.45	1.667	4.1585	25676	1460.1	1460.1
Methylcyclohexane	13000000	2	194151	1462879.7	3.6468	2.557092	83	16	81	2.55	1.666	4.2999	461701	3396.1	3396.1
Methylene chloride	1000000	5	28892	157284.5	3.061	2.398146	84	79	6	2.40	1.666	4.089	57483	1110.8	1110.8
N-Nitrosodi-N-Propylamine	14000	195	1241.13	2243.0996	6.276	1.12556	84	71	15	1.15	1.666	2.4704	1648.9	1359.2	1359.2
N-Nitrosodiphenylamine	7000	150	901.488	1340.5811	6.1812	0.983325	84	65	23	1.00	1.666	2.306	1145.2	1005.8	1005.8
Naphthalene	330000	70	10067	41254.105	6.8874	1.813666	84	15	82	1.80	1.666	3.2666	17566	9724.7	9724.7
Nickel	669000	4800	76598.8	94897.104	10.873	0.81362	83	0	100	0.80	1.666	2.112	93955	88764	88764
Octachlorodibenzo-P-Dioxin	2.148	0.456	1.055	0.7551702	-0.119	0.659047	4	0	100	0.65	2.353	5.969	1.9435	10.695	2.148
Octachlorodibenzofuran	1.816	0.791	1.32975	0.5272036	0.2211	0.419485	4	0	100	0.40	2.353	3.9355	1.95	3.5333	1.816
p,p'-DDD	1100	0.32	89.7101	164.20729	3.5244	1.599865	83	9	89	1.60	1.666	3.0086	119.74	207.63	207.63
p,p'-DDE	790	0.39	48.5721	88.816733	3.2408	1.245543	84	5	94	1.25	1.666	2.58	64.717	78.982	78.982
p,p'-DDT	570	1.95	25.4881	69.382141	2.1664	1.31251	80	63	21	1.30	1.667	2.6402	38.418	30.497	30.497
Pentachlorophenol	36000	110	3133.33	5210.2162	7.2998	1.117137	84	55	35	1.10	1.666	2.4156	4080.4	3714.7	3714.7
Phenanthrene	210000	52	7831.21	25797.881	7.3149	1.683282	84	3	96	1.70	1.666	3.1362	12521	11059	11059
Phenol	97000	61	2022.81	10573.837	6.1877	1.161476	84	78	7	1.15	1.666	2.4704	3944.9	1309.2	1309.2
Potassium	3380000	162000	945361	637223.68	13.559	0.646161	83	0	100	0.65	1.666	1.9855	1E+06	1E+06	1E+06
Pyrene	440000	50	10078.2	48688.998	7.3124	1.633955	84	4	95	1.65	1.666	3.0724	18929	9880.6	9880.6
Selenium	20000	230	2818.13	2682.44	7.5906	0.912938	83	9	89	0.90	1.666	2.206	3308.7	3750.9	3750.9
Silver	639000	110	10949.2	69932.081	7.486	1.446047	83	10	88	1.45	1.666	2.8208	23739	7958.1	7958.1
Sodium	23600000	563000	1656277	2623052.3	14.044	0.574127	83	0	100	0.55	1.666	1.911	2E+06	2E+06	2E+06
Styrene	2000000	5	66846.6	337898.23	3.5392	2.579577	78	13	83	2.60	1.667	4.3718	130637	3468.4	3468.4
Tert-Butyl Methyl Ether	1000000	5	31417	163911.22	2.9878	2.455152	83	72	13	2.45	1.666	4.1585	61395	1247.9	1247.9
Tetrachloroethene	1000000	1	31800.2	164882.52	2.8827	2.568481	82	55	33	2.55	1.666	4.2999	62143	1649.8	1649.8
Thallium	26000	355	6109.4	5228.6028	8.3613	0.910754	83	4	95	0.90	1.666	2.206	7065.7	8086.1	8086.1
Toluene	8900000	2	248928	1355421.7	3.1294	2.905797	84	41	51	2.90	1.666	4.8032	495313	7210.3	7210.3
trans-1,2-Dichloroethene	1000000	5	31416.9	163911.25	2.9768	2.458483	83	72	13	2.45	1.666	4.1585	61395	1246.2	1246.2
trans-1,3-Dichloropropene	1000000	5	31044	162956.68	3.0269	2.43291	84	67	20	2.45	1.666	4.1585	60666	1208.3	1208.3
Trichloroethene	460000	1	12982.7	69678.602	2.8176	2.398191	83	60	28	2.40	1.666	4.089	25726	876.69	876.69
Trichlorofluoromethane	1000000	1	30676.6	162019.21	2.5635	2.654188	85	34	60	2.65	1.666	4.4437	59950	1591.9	1591.9
Vanadium	73400	1800	24734.9	13373.421	9.9656	0.608229	83	0	100	0.60	1.666	1.946	27181	29182	29182
Vinyl chloride	1000000	1	31416.8	163911.27	2.9339	2.491264	83	67	19	2.50	1.666	4.228	61395	1339.8	1339.8
Xylenes	5600000	3	149996	796775.91	4.0799	2.911321	81	9	89	2.90	1.667	4.8032	297547	19560	19560
Zinc	9990000	18700	1333653	1732384.7	13.468	1.195292	83	0	100	1.20	1.666	2.5252	2E+06	2E+06	2E+06

**APPENDIX B**

**Air Concentration Model of Groundwater COPCs**

## Air Concentration Model for Groundwater COPCs

Calculations of air concentrations are based on the assumption that during construction work, soil is excavated and groundwater is exposed to the air. The exposed area is modeled as a shallow pond with dimensions of 2 m x 2 m x 0.5 m. And  $EPC_{air}$  is calculated using a "box model" approach, described in U.S. EPA (1986), by using the following equation,

$$EPC_{air} = \frac{E}{W \times U \times H} \quad (1)$$

where:

H = Mixing height = 2 m (height of an average man)

U = Average wind speed within mixing zone = 4.6 m/s (U.S. Dept. of Commerce 2000)

W = Width dimension of the pond = 2 m

E = Emission rate (g/s)

The emission rate is determined by using the following equations (Thomas, 1990):

$$E = K_1 \times C \times A \quad (2)$$

where:

$K_1$  = Liquid phase mass transfer coefficient (cm/hour)

C = Concentration of chemical in liquid phase (mg/L)

A = Contaminated area (cm<sup>2</sup>) = 200 x 200 (cm<sup>2</sup>)

$K_1$  is calculated from:

$$(K_v^c)_{env} = \frac{K_1}{Z} \quad (3)$$

where:

$(K_v^c)_{env}$  = Overall liquid phase exchange coefficient (hour<sup>-1</sup>)

Z = Depth of the pond (cm) = 50 cm

$(K_v^c)_{env}$  for ponds is estimated by the equation:

$$(K_v^c)_{env} = \frac{D^c}{D^o} (K_v^o)_{Ponds} \quad (4)$$

where:

$D^c$  = Diffusion coefficient of the chemical in water ( $\text{cm}^2/\text{sec}$ )

$D^o$  = Diffusion coefficient of oxygen in water ( $\text{cm}^2/\text{sec}$ )  
=  $2.20 \times 10^{-5} \text{ cm}^2/\text{sec}$  (Thomas, 1990 and EPA 1996)

$(K^o)_{\text{reac}}$  = Oxygen reaeration coefficient ( $\text{hour}^{-1}$ ) = 0.008

**References:**

Thomas, R.G. 1990. Volatilization from Water. In Handbook of Chemical Property Estimation Methods: environmental mental behavior of organic compounds.

U. S. Department of Commerce, 2000.

(<http://www.ncdc.noaa.gov/ol/climate/online/ccd/avgwind.html>)

U.S. EPA, 1986. Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup. OHEA-E-187

U. S. EPA, 1996. Technical Background Document for Soil Screening Guidance. EPA/540/R-95/128.

**Table B-1.**  
**AIR CONCENTRATION OF GROUNDWATER CONTAMINANTS**

COPC	$C_{liquid}$ (mg/L)	$D_{l,w}$ (cm <sup>2</sup> /sec)	$D_o$ (cm <sup>2</sup> /sec)	$(Kv^o)_{ponds}$ (hr <sup>-1</sup> )	$(Kv^o)_{ponds}$ (hr <sup>-1</sup> )	$K_L$ (cm/hour)	$E$ (g/sec)	$C_{air}$ (g/m <sup>3</sup> )
Benzene	2.4	9.80E-06	2.20E-05	8.00E-03	3.56E-03	1.78E-01	4.75152E-06	1.72E-07
Methylene chloride	0.2	1.17E-05	2.20E-05	8.00E-03	4.25E-03	2.13E-01	4.01818E-07	1.46E-08
Chlorobenzene	0.2	8.70E-06	2.20E-05	8.00E-03	3.16E-03	1.58E-01	2.98788E-07	1.08E-08
Ethylbenzene	5.8	7.80E-06	2.20E-05	8.00E-03	2.84E-03	1.42E-01	9.13939E-06	3.31E-07
Methylene chloride	0.2	1.17E-05	2.20E-05	8.00E-03	4.25E-03	2.13E-01	4.01818E-07	1.46E-08
Toluene	38.0	8.60E-06	2.20E-05	8.00E-03	3.13E-03	1.56E-01	6.60202E-05	2.39E-06
Xylenes	18.0	1.00E-05	2.20E-05	8.00E-03	3.64E-03	1.82E-01	3.63636E-05	1.32E-06

Parameters of model pond	
Length (m)	2
Width (m)	2
Depth (m)	0.5
Area (m <sup>2</sup> )	4
CF(m/cm)	100
CF(hour/sec)	3600
H (Mixing Height of Man, m)	2
Average wind speed (m/s)	4.6

**APPENDIX C**

**Risk Calculations Tables for Alburn, U. S. Drum and  
Unnamed Parcel**



**Table A-1.**  
**TOXICITY FACTORS FOR CHEMICALS OF POTENTIAL CONCERN FOR LAKE CALUMET CLUSTER SITE:**  
**ALBURN**

Carcinogenic Risk									
COPC	Ingestion Slope Factor (kg-day/mg)	EPC for Soil (ug/kg)	EPC for Sediment (ug/kg)	EPC for SW (ug/L)	EPC for GW (ug/L)	EPC for GW In air (g/m <sup>3</sup> )	Particulate	Dermal Slope	Volatile (URF)
							Inhalation Slope Factor (kg-day/mg)	Factor (kg-day/mg)	Inhalation Risk Factor (m <sup>3</sup> /ug)
Arsenic	1.50E+00	1.62E+04	1.04E+05		1.22E+02			1.50E+00	4.30E-03
Beryllium		1.55E+03			6.30E+00			0.00E+00	0.00E+00
Benzene	5.50E-02	8.30E+04			2.40E+03	1.72E-07	2.90E-02	5.50E-02	8.29E-06
Benzo(a)anthracene	7.30E-01	5.09E+03			8.00E+00		3.10E-01	7.30E-01	8.86E-05
Benzo(b)fluoranthene	7.30E-01	5.84E+03			1.00E+01		3.10E-01	7.30E-01	8.86E-05
Benzo(k)fluoranthene	7.30E-02				9.00E+00		3.10E-02	7.30E-02	8.86E-06
Benzo(a)pyrene	7.30E+00	4.43E+03			8.00E+00		3.10E+00	7.30E+00	8.86E-04
Chrysene	7.30E-03		1.10E+03		8.00E+00		3.10E-03	7.30E-03	8.86E-07
Dibenz(a,h)anthracene	7.30E+00	1.51E+03			8.00E-01		3.10E+00	7.30E+00	8.86E-04
Indeno(1,2,3-cd)pyrene	7.30E-01	2.93E+03			2.00E+00		3.10E-01	7.30E-01	8.86E-05
Bis(2-Chloroethyl) Ether	1.10E+00	8.81E+02			2.80E+02		1.16E+00	1.10E+00	3.31E-04
Bis(2-ethylhexyl)phthalate	1.40E-02				7.90E+01			1.40E-02	
Heptachlor	4.50E+00			3.00E-01			4.50E+00	4.50E+00	1.29E-03
Methylene chloride	7.50E-03	5.47E+04			1.70E+02	1.46E-08	1.65E-03	7.50E-03	4.71E-07
N-Nitrosodiphenylamine	4.90E-03				6.00E+00			4.90E-03	0.00E+00
Tetrachloroethene	5.20E-02	5.68E+04					2.00E-03	5.20E-02	5.71E-07
Trichloroethene	1.10E-02	8.35E+04					6.00E-03	1.10E-02	1.71E-06
Vinyl Chloride	7.20E-01	5.08E+04					1.80E-02	7.20E-01	4.57E-06
Total PCBs	2.00E+00	1.94E+03					2.00E+00	2.00E+00	5.71E-04
Noncarcinogenic Risk									
COPC	Ingestion Reference Dose (mg/kg-day)	EPC for Soil (ug/kg)	EPC for Sediment (ug/kg)	EPC for SW (ug/L)	EPC for GW (ug/L)	EPC for GW In air (g/m <sup>3</sup> )	Inhalation	Dermal	Volatile Inhalation Ref.
							Reference Dose (mg/kg-day)	Reference Dose (mg/kg-day)	Dose (ug/m <sup>3</sup> )
Antimony	4.00E-04	1.58E+04			6.80E+00			4.00E-04	0.00E+00
Arsenic	3.00E-04	1.62E+04	1.04E+05		1.22E+02			3.00E-04	0.00E+00
Barium	7.00E-02	3.84E+05		3.58E+02	4.85E+03		1.43E-04	7.00E-02	5.01E-01
Beryllium	2.00E-03	1.55E+03			6.30E+00		5.71E-06	2.00E-03	2.00E-02
Cadmium	5.00E-04	7.31E+03			2.19E+01			5.00E-04	0.00E+00
Chromium	1.50E+00	2.61E+05	6.37E+05		3.52E+02			1.50E+00	0.00E+00
Manganese	4.80E-02	3.90E+06		2.78E+03	4.07E+03		1.43E-05	4.80E-02	5.01E-02
Mercury					3.60E+00		8.80E-05	0.00E+00	3.01E-01
Nickel	2.00E-02				2.18E+02			2.00E-02	0.00E+00
Thallium	8.00E-05				2.60E+00			8.00E-05	0.00E+00
Vanadium	7.00E-03				2.54E+02			7.00E-03	0.00E+00
Zinc	3.00E-01				6.94E+03			3.00E-01	0.00E+00
Bis(2-ethylhexyl)phthalate	2.00E-02				7.90E+01			2.00E-02	0.00E+00
Carbon disulfide	1.00E-01	8.29E+04					2.00E-01	1.00E-01	7.00E+02
Chlorobenzene	2.00E-02	4.15E+04			1.70E+02	1.08E-08	5.71E-03	2.00E-02	2.00E+01
2,4-Dimethylphenol	2.00E-02				3.20E+02			2.00E-02	0.00E+00
Ethylbenzene	1.00E-01	4.72E+06			5.80E+03	3.31E-07	2.86E-01	1.00E-01	1.00E+03
Heptachlor	5.00E-04	3.97E+00		3.00E-01				5.00E-04	0.00E+00
Methylene chloride	6.00E-02	5.47E+04			1.70E+02	1.46E-08	8.57E-01	6.00E-02	3.00E+03
Naphthalene	2.00E-02				4.20E+02		8.57E-04	2.00E-02	3.00E+00
Tetrachloroethene	1.00E-02	5.68E+04						1.00E-02	0.00E+00
Trichloroethene	6.00E-03	8.35E+04						6.00E-03	0.00E+00
Toluene	2.00E-01	1.67E+06			3.80E+04	2.39E-06	1.14E-01	2.00E-01	3.99E+02
Vinyl Chloride	3.00E-03	5.08E+04					2.90E-02	3.00E-03	1.02E+02
Xylenes	2.00E+00	2.50E+07			1.80E+04	1.32E-06		2.00E+00	0.00E+00

**Table A-1.**  
**TOXICITY FACTORS FOR CHEMICALS OF POTENTIAL CONCERN FOR LAKE CALUMET CLUSTER SITE:**  
**ALBURN**

**Note:**

**COPC:** Contaminants of potential concern

**EPC:** Exposure point concentration

**Table A-2.  
SOIL INGESTION EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
ALBURN**

<b>Carcinogenic Risk</b>					
$LADD = EPC \times FI \times IRS \times EF \times ED \times CF / (BW \times ATc)$					
EPC=exposure point concentration (ug/kg)					
FI=fraction ingested from contaminated source					
IRS=soil ingestion rate (mg/day)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
CF=conversion factor 10 <sup>-9</sup> kg/ug					
BW=body weight (kg)					
ATc=averaging time for carcinogens (days)					
$ELCR = LADD \times SFo$					
SFo=oral cancer slope factor (kg-day/mg)					
LADD=lifetime average daily dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>
IRS (mg/day)	50	480	50	480	50
FI	0.5	1	0.5	1	0.5
EF (day/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
Atc (days)	25550	25550	25550	25550	25550
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09
<b>Noncarcinogenic Risk</b>					
$ADD = EPC \times FI \times IRS \times EF \times ED \times CF / (BW \times ATn)$					
EPC=exposure point concentration (ug/kg)					
FI=fraction ingested from contaminated source					
IRS=soil ingestion rate (mg/day)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
BW=body weight (kg)					
ATn=averaging time for noncarcinogens (days)					
$HQ = ADD / RfDo$					
ADD-average daily dose (mg/kg-day)					
RfDo=injection reference dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>
IRS (mg/day)	50	480	50	480	50
FI	0.5	1	0.5	1	0.5
EF (day/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
ATn (days)	9125	40	9125	9125	9125
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09

**Table A-3.  
SOIL INGESTION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE: ALBURN**

Carcinogenic Risk										
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	LADD	ELOR	LADD	ELOR	LADD	ELOR	LADD	ELOR	LADD	ELOR
COPO										
Arsenic	2.89E-07	4.24E-07	1.90E-07	1.99E-07	1.41E-08	2.12E-08	1.09E-08	1.82E-08	1.19E-07	1.70E-07
Beryllium	2.72E-08	0.00E+00	1.99E-08	0.00E+00	1.89E-07	0.00E+00	1.04E-07	0.00E+00	1.09E-08	0.00E+00
Benzene	1.42E-08	7.99E-08	6.99E-07	9.89E-08	7.89E-08	9.99E-07	6.67E-08	9.09E-07	6.80E-07	3.19E-08
Benz(a)anthracene	9.90E-08	9.80E-08	4.10E-08	2.99E-08	4.49E-07	9.89E-07	9.42E-07	2.49E-07	6.69E-08	2.90E-08
Benz(a)fluoranthene	1.92E-07	7.49E-08	4.70E-08	9.49E-08	6.10E-07	3.70E-07	9.92E-07	2.89E-07	4.09E-08	2.99E-08
Benz(a)pyrene	7.74E-08	6.89E-07	8.87E-08	2.90E-07	9.87E-07	2.99E-08	2.97E-07	2.17E-08	9.10E-08	2.89E-07
Dibenz(a,h)anthracene	2.94E-08	1.99E-07	1.22E-08	9.89E-08	1.92E-07	9.94E-07	1.01E-07	7.40E-07	1.09E-08	7.71E-08
Indeno(1,2,3-cd)perylene	6.12E-08	9.74E-08	2.99E-08	1.72E-08	2.99E-07	1.97E-07	1.97E-07	1.44E-07	2.09E-08	1.80E-08
Benzo(b)fluoranthene	1.84E-08	1.99E-08	7.10E-08	7.81E-08	7.70E-08	9.47E-08	6.81E-08	6.90E-08	6.19E-08	6.79E-08
Methylene chloride	9.87E-07	7.17E-08	4.41E-07	8.91E-08	4.79E-08	9.89E-08	9.67E-08	2.79E-08	9.99E-07	2.97E-08
Tetrachloroethane	9.92E-07	6.19E-08	4.87E-07	2.99E-08	4.99E-08	2.99E-07	9.81E-08	1.99E-07	2.97E-07	2.09E-08
Trichloroethene	1.49E-08	1.90E-08	9.79E-07	7.99E-08	7.99E-08	9.99E-08	6.00E-08	6.19E-08	6.84E-07	4.49E-08
Vinyl Chloride	9.99E-07	9.99E-07	4.99E-07	9.99E-07	4.44E-08	2.99E-08	3.41E-08	2.49E-08	2.89E-07	2.89E-07
Total PCBs	9.99E-08	9.77E-08	1.89E-08	8.12E-08	1.99E-07	9.99E-07	1.90E-07	2.90E-07	1.89E-08	2.71E-08
Noncarcinogenic Risk										
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Antimony	7.79E-07	1.94E-08	9.19E-08	2.04E-01	9.99E-08	9.99E-08	2.99E-08	7.44E-08	9.10E-07	7.79E-04
Arsenic	7.92E-07	2.94E-08	9.99E-08	2.77E-01	9.99E-08	1.92E-08	9.04E-08	1.01E-08	9.17E-07	1.09E-08
Barium	1.89E-08	2.99E-04	1.97E-08	2.99E-08	9.99E-08	1.94E-08	7.81E-08	1.99E-08	7.81E-08	1.07E-04
Beryllium	7.81E-08	9.90E-08	9.00E-08	4.00E-03	9.90E-07	1.90E-04	2.92E-07	1.49E-04	9.04E-08	1.92E-06
Cadmium	9.99E-07	7.19E-04	9.79E-08	7.99E-08	1.79E-08	9.89E-08	1.97E-08	2.79E-08	1.49E-07	2.99E-04
Chromium	1.99E-08	9.99E-08	1.84E-08	9.99E-04	9.99E-08	4.99E-08	4.91E-08	9.87E-08	6.11E-08	9.41E-08
Manganese	1.91E-04	4.19E-08	2.01E-08	4.99E-01	9.84E-04	2.07E-08	7.99E-04	1.99E-08	7.99E-08	1.99E-03
Carbon disulfide	4.09E-08	4.09E-08	4.99E-04	4.99E-08	2.09E-08	2.09E-04	1.69E-08	1.69E-04	1.62E-08	1.62E-06
Chlorobenzene	2.09E-08	1.09E-04	2.19E-04	1.07E-08	1.02E-08	9.09E-04	7.90E-08	9.09E-04	9.12E-07	4.09E-06
Ethylbenzene	2.81E-04	2.81E-08	2.49E-08	2.49E-01	1.19E-08	1.19E-08	9.87E-04	9.87E-08	9.44E-08	9.44E-04
Heptachlor	1.94E-10	9.99E-07	2.04E-08	4.09E-08	9.71E-10	1.94E-08	7.49E-10	1.49E-08	7.77E-11	1.69E-07
Methylene chloride	2.99E-08	4.49E-08	2.92E-04	4.99E-08	1.94E-08	2.92E-04	1.09E-08	1.71E-04	1.07E-08	1.79E-08
Tetrachloroethane	2.79E-08	2.79E-04	2.92E-04	2.92E-08	1.99E-08	1.99E-08	1.07E-08	1.07E-08	1.11E-08	1.11E-04
Trichloroethene	4.09E-08	9.81E-04	4.99E-04	7.19E-08	2.04E-08	3.40E-08	1.67E-08	2.81E-08	1.99E-08	2.72E-04
Toluene	9.17E-08	4.09E-04	9.99E-08	4.99E-08	4.09E-04	2.04E-08	3.14E-04	1.87E-08	3.27E-08	1.99E-04
Vinyl Chloride	2.49E-08	9.99E-04	2.81E-04	9.71E-08	1.84E-08	4.14E-08	9.84E-08	9.19E-08	9.84E-07	9.81E-04
Xylenes	1.22E-08	6.12E-04	1.99E-01	9.49E-08	9.12E-08	9.09E-08	4.70E-08	2.99E-08	4.99E-04	2.49E-04
Summary										
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
ELOR for this pathway	2.84E-08		1.92E-08		1.12E-08		9.99E-08		9.99E-07	
HI for this pathway	9.90E-08		9.72E-01		4.19E-08		9.19E-08		9.92E-08	
Notes:										
ELOR: Excess lifetime cancer risks										
HI: Hazard Index										
COPO: Contaminants of potential concern										
LADD: Lifetime average daily dose										
ADD: Average daily dose										
HQ: Hazard quotient										
Bold shaded area indicated ELOR or HI exceedance for the receptor										

**Table A-4.**  
**SOIL DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE: ALBURN**

<b>Carcinogenic Risk</b>					
	<b>LADD=EPCsoilxSAxAFxABSxEFxEDxCF/(BWxATc)</b>				
	EPC=exposure point concentration (ug/kg)				
	SA=body surface area (cm <sup>2</sup> /day)				
	AF=soil adherence factor (mg/cm <sup>2</sup> )				
	ABS=dermal adsorption factor (unitless)				
	EF=exposure frequency (days/year)				
	ED=exposure duration (years)				
	CF=conversion factor (10 <sup>-9</sup> kg/ug)				
	BW=body weight (kg)				
	ATc=averaging time for carcinogens (days)				
	ELCR=LADDxSFd				
	SFd=dermal cancer slope factor (kg-day/mg)				
	LADD=lifetime average daily dose (mg/kg-day)				
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> /day)	3300	3300	3300	3300	3300
AF(mg/cm <sup>2</sup> )	0.2	0.2	0.2	0.2	0.2
ABS	<b>Chemical Specific</b>				
Inorganics	0.01	0.01	0.01	0.01	0.01
Bis(2-ethylhexyl)phthalate	0.4	0.4	0.4	0.4	0.4
Tetrachloroethene	0.03	0.03	0.03	0.03	0.03
Trichloroethene	0.03	0.03	0.03	0.03	0.03
Vinyl chloride	0.03	0.03	0.03	0.03	0.03
EF (day/year) for Soil	50	10	20	30	250
EF (day/year) for Sediment	5			5	5
ET (hour/day)	5	8	8	8	8
ED (years)	25	25	25	1	25
BW (kg)	70	70	70	70	70
Atc (days) - for Soil	25550	25550	25550	25550	25550
Atc (days) - for Sediment	25550			25550	25550
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09

**Table A-4.  
SOIL DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE: ALBURN**

<b>Noncarcinogenic Risk</b>					
<b>ADD=EPCxSAxAFxABSxEFxEDxCF/(BWxATn)-Soil and Sediment</b>					
EPC=exposure point concentration (ug/kg)					
SA=body surface area (cm <sup>2</sup> /day)					
AF=soil adherence factor (mg/cm <sup>2</sup> )					
ABS=dermal adsorption factor					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
CF=conversion factor 10 <sup>-9</sup> kg/mg					
BW=body weight (kg)					
ATn =averaging time for noncarcinogens (days)					
HQ=ADD/RfD <sub>o</sub>					
ADD=average daily dose (mg/kg-day)					
RfD <sub>o</sub> =dermal reference dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> /day)	3300	3300	3300	3300	3300
AF(mg/cm <sup>2</sup> )	0.2	0.2	0.2	0.2	0.2
ABS	<b>Chemical Specific</b>				
Inorganics	0.01	0.01	0.01	0.01	0.01
Bis(2-ethylhexyl)phthalate	0.4	0.4	0.4	0.4	0.4
Tetrachloroethane	0.03	0.03	0.03	0.03	0.03
Trichloroethane	0.03	0.03	0.03	0.03	0.03
Vinyl chloride	0.03	0.03	0.03	0.03	0.03
Others	0	0	0	0	0
EF (day/year) for Soil	50	10	20	30	250
EF (day/year) for Sediment	5			5	5
ET (hour/day)	5	8	8	8	8
ED (years)	25	25	25	1	25
BW (kg)	70	70	70	70	70
Atn (days) - for Soil	9125	9125	9125	40	9125
Atn (days) - for Sediment	9125			40	9125
Conversion Factor kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09

**Table A-5.  
WATER DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE: ALBURN**

<b>Carcinogenic Risk</b>					
<b>LADD=EPCxSAxPCxETxEFxEDxCF/(BWxATc)</b>					
EPC=exposure point concentration (ug/L)					
SA = skin surface area (cm <sup>2</sup> )					
PC = Permeability Constant (cm/hr)					
EF=exposure frequency (days/year)					
ET = exposure time (hour/day)					
ED = exposure duration (years)					
CF = conversion factor 10 <sup>-6</sup> (L-mg/cm <sup>2</sup> -ug)					
BW = body weight (kg)					
ATc = averaging time for carcinogens (days)					
ELCR=LADDxSFd					
SFd=dermal cancer slope factor (kg-day/mg)					
LADD=lifetime average daily dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> )	3300	3300	3300	3300	3300
PC(cm/hr)	<b>Chemical Specific</b>				
Inorganic	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
Benzo(a)pyrene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Benzo(a)anthracene	8.00E-01	8.00E-01	8.00E-01	8.00E-01	8.00E-01
Benzo(b)fluoranthene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Dibenzo(a,h)anthracene	2.70E+00	2.70E+00	2.70E+00	2.70E+00	2.70E+00
Indeno(1,2,3-cd)pyrene	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00
Benzo(k)fluoranthene					
Chrysene	8.10E-01	8.10E-01	8.10E-01	8.10E-01	8.10E-01
Vinyl chloride	7.30E-03	7.30E-03	7.30E-03	7.30E-03	7.30E-03
bis(2-ethylhexyl)phthalate	3.30E-02	3.30E-02	3.30E-02	3.30E-02	3.30E-02
Tetrachloroethene	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02
Trichloroethene	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02
EF (day/year) for SW & GW	5			5	5
ET (hour/day)	1	1	1	1	1
ED (years)	25			1	25
BW (kg)	70	70	70	70	70
ATc (days) - for SW & GW	25550			25550	25550
Conversion Factor (L-mg/cm <sup>2</sup> -ug)	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06

**Table A-5.  
WATER DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE: ALBURN**

<b>Noncarcinogenic Risk</b>					
<b>ADD=EPCxSAxPCxETxEFxEDxCF/(BWxATn)</b>					
EPC=exposure point concentration (ug/L)					
SA = Skin surface area (cm <sup>2</sup> )					
PC=Permeability Constant (cm/hr)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
CF=conversion factor 10 <sup>-6</sup> (L-mg/cm <sup>2</sup> -ug)					
CF=conversion factor 10 <sup>-6</sup> (L-mg/cm <sup>2</sup> -ug)					
BW=body weight (kg)					
ATn =averaging time for noncarcinogens (days)					
HO=ADD/RfD <sub>o</sub>					
ADD=average daily dose (mg/kg-day)					
RfD <sub>o</sub> =dermal reference dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> )	3300	3300	3300	3300	3300
PC (cm/hr)	<b>Chemical Specific</b>				
Inorganic	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
Benzo(a)pyrene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Benzo(a)anthracene	8.00E-01	8.00E-01	8.00E-01	8.00E-01	8.00E-01
Benzo(b)fluoranthene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Dibenzo(a,h)anthracene	2.70E+00	2.70E+00	2.70E+00	2.70E+00	2.70E+00
Indeno(1,2,3-cd)pyrene	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00
Benzo(k)fluoranthene					
Chrysene	8.10E-01	8.10E-01	8.10E-01	8.10E-01	8.10E-01
Vinyl chloride	7.30E-03	7.30E-03	7.30E-03	7.30E-03	7.30E-03
bis(2-ethylhexyl)phthalate	3.30E-02	3.30E-02	3.30E-02	3.30E-02	3.30E-02
Tetrachloroethane	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02
Trichloroethane	1.80E-02	1.80E-02	1.80E-02	1.80E-02	1.80E-02
EF (day/year) for SW & GW	5			5	5
ET (hour/day)	1	8	8	1	1
ED (years)	25			1	25
BW (kg)	70	70	70	70	70
Atn (days) - for SW & GW	9125			40	9125
Conversion Factor (L-mg/cm <sup>2</sup> -ug)	1.00E-08	1.00E-08	1.00E-08	1.00E-08	1.00E-08



**Table A-6.  
DERMAL EXPOSURE EVALUATION FOR SOIL FOR LAKE CALUMET CLUSTER SITE: ALBURN**

Carcinogenic Risk											
COPC	Dermal Adsorp. Factors (ABS)	On-site Worker		Mower		Landscape Worker		Construction Worker		Industrial/Commercial Worker	
		LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR
Arsenic	3.00E-02	2.24E-07	3.36E-07	4.48E-08	6.72E-08	8.96E-08	1.34E-07	5.38E-09	8.06E-09	1.12E-06	1.68E-06
Beryllium	1.00E-02	7.17E-09	0.00E+00	1.43E-09	0.00E+00	2.87E-09	0.00E+00	1.72E-10	0.00E+00	3.59E-08	0.00E+00
Benzene	3.00E-02	1.15E-08	6.32E-08	2.30E-07	1.26E-08	4.60E-07	2.53E-08	2.76E-08	1.62E-09	5.75E-06	3.16E-07
Bis(2-Chloroethyl) Ether	1.00E-02	4.07E-09	4.47E-09	6.13E-10	8.94E-10	1.63E-09	1.79E-09	9.78E-11	1.07E-10	2.03E-08	2.24E-08
Methylene chloride	3.00E-02	7.58E-07	5.68E-08	1.52E-07	1.14E-09	3.03E-07	2.27E-09	1.82E-08	1.36E-10	3.79E-06	2.84E-08
Tetrachloroethene	3.00E-02	7.85E-07	4.08E-08	1.57E-07	8.17E-09	3.14E-07	1.63E-08	1.89E-08	9.80E-10	3.93E-06	2.04E-07
Trichloroethene	3.00E-02	1.18E-08	1.27E-08	2.31E-07	2.54E-09	4.62E-07	5.08E-09	2.77E-08	3.05E-10	5.78E-06	6.35E-08
Vinyl Chloride	3.00E-02	7.03E-07	5.05E-07	1.41E-07	1.01E-07	2.81E-07	2.02E-07	1.69E-08	1.21E-08	3.52E-06	2.53E-06
Total PCBs	1.40E-01	1.25E-07	2.50E-07	2.50E-08	5.01E-08	5.01E-08	1.00E-07	3.00E-09	6.01E-09	6.26E-07	1.25E-06
Noncarcinogenic Risk											
COPC	Dermal Adsorp. Factors (ABS)	On-site Worker		Mower		Landscape Worker		Construction Worker		Industrial/Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Antimony	1.00E-02	2.05E-07	5.12E-04	4.09E-08	1.02E-04	8.19E-08	2.05E-04	1.12E-06	2.80E-03	1.02E-06	2.56E-03
Arsenic	3.00E-02	6.27E-07	2.09E-03	1.25E-07	4.18E-04	2.51E-07	8.36E-04	3.49E-06	1.14E-02	3.14E-06	1.05E-02
Barium	1.00E-02	4.98E-06	7.08E-05	9.92E-07	1.42E-05	1.98E-06	2.83E-05	2.71E-05	3.88E-04	2.48E-05	3.54E-04
Beryllium	1.00E-02	2.01E-08	1.00E-05	4.02E-09	2.01E-06	8.03E-09	4.02E-06	1.10E-07	5.50E-05	1.00E-07	5.02E-05
Cadmium	1.00E-02	9.44E-08	1.89E-04	1.89E-08	3.78E-05	3.78E-08	7.55E-05	5.17E-07	1.03E-03	4.72E-07	9.44E-04
Chromium	1.00E-02	3.37E-06	2.25E-08	8.76E-07	4.50E-07	1.35E-06	8.00E-07	1.85E-05	1.23E-05	1.69E-05	1.12E-05
Manganese	1.00E-02	5.04E-05	1.10E-03	1.01E-05	2.19E-04	2.02E-05	4.39E-04	2.78E-04	6.00E-03	2.82E-04	5.48E-03
Carbon disulfide	3.00E-02	3.21E-06	3.21E-05	6.42E-07	6.42E-06	1.28E-06	1.28E-05	1.78E-05	1.78E-04	1.61E-05	1.61E-04
Chlorobenzene	3.00E-02	1.61E-06	8.04E-05	3.22E-07	1.61E-05	6.43E-07	3.22E-05	8.80E-08	4.40E-04	8.04E-06	4.02E-04
Ethylbenzene	3.00E-02	1.83E-04	1.83E-03	3.66E-05	3.66E-04	7.32E-05	7.32E-04	1.00E-03	1.00E-02	9.15E-04	9.15E-03
Heptachlor	1.00E-01	5.13E-10	1.03E-08	1.03E-10	2.05E-07	2.05E-10	4.10E-07	2.81E-09	5.61E-08	2.56E-09	5.13E-08
Methylene chloride	3.00E-02	2.12E-06	3.54E-05	4.24E-07	7.07E-06	8.49E-07	1.41E-05	1.18E-05	1.94E-04	1.08E-05	1.77E-04
Tetrachloroethene	3.00E-02	2.20E-08	2.20E-04	4.40E-07	4.40E-05	8.80E-07	8.80E-05	1.20E-05	1.20E-03	1.10E-05	1.10E-03
Trichloroethene	3.00E-02	3.24E-06	5.39E-04	6.47E-07	1.08E-04	1.29E-06	2.16E-04	1.77E-05	2.85E-03	1.62E-05	2.70E-03
Toluene	3.00E-02	6.47E-05	3.23E-04	1.29E-05	6.47E-05	2.59E-05	1.29E-04	3.54E-04	1.77E-03	3.23E-04	1.62E-03
Vinyl Chloride	3.00E-02	1.97E-06	6.68E-04	3.94E-07	1.31E-04	7.87E-07	2.62E-04	1.08E-05	3.59E-03	9.84E-08	3.28E-03
Xylenes	3.00E-02	9.69E-04	4.84E-04	1.94E-04	9.69E-05	3.87E-04	1.94E-04	5.30E-03	2.65E-03	4.84E-03	2.42E-03
Summary											
		On-site Worker		Mower		Landscape Worker		Construction Worker		Industrial/Commercial Worker	
ELCR for this pathway=		1.22E-06		2.44E-07		4.88E-07		2.93E-08		1.85E-06	
HI for this pathway=		8.17E-03		1.63E-03		3.27E-03		4.47E-02		4.09E-02	
Notes:											
ELCR: Excess lifetime cancer risk											
HI: Hazard Index											
COPC: Contaminants of potential concern											
LADD: Lifetime average daily dose											
ADD: Average daily dose											
HQ: Hazard quotient											

**Table A-7.  
DERMAL EXPOSURE EVALUATION FOR SEDIMENTS FOR LAKE CALUMET CLUSTER SITE: ALBURN**

<b>Carcinogenic Risk</b>							
		<b>On-site Worker</b>		<b>Construction Worker</b>		<b>Industrial / Commercial Worker</b>	
<b>COPC</b>	<b>Dermal Adsorp. Factors</b>	<b>LADD</b>	<b>ELCR</b>	<b>LADD</b>	<b>ELCR</b>	<b>LADD</b>	<b>ELCR</b>
Arsenic	3.00E-02	1.44E-07	2.16E-07	5.76E-09	8.64E-09	1.44E-07	2.16E-07
Chrysene	0.00E+00	1.92E-08	1.40E-10	8.86E-09	6.47E-11	9.61E-08	7.02E-10
<b>Noncarcinogenic Risk</b>							
		<b>On-site Worker</b>		<b>Construction Worker</b>		<b>Industrial / Commercial Worker</b>	
<b>COPC</b>	<b>Dermal Adsorp. Factors</b>	<b>ADD</b>	<b>HQ</b>	<b>ADD</b>	<b>HQ</b>	<b>ADD</b>	<b>HQ</b>
Arsenic	3.00E-02	4.03E-07	1.34E-03	3.68E-06	1.23E-02	4.03E-07	1.34E-03
Chromium	1.00E-02	6.94E-07	4.62E-07	6.33E-06	4.22E-06	6.94E-07	4.62E-07
<b>Summary</b>							
		<b>On-site Worker</b>		<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>		
<b>ELCR for this pathway=</b>		2.16E-07		8.70E-09	2.17E-07		
<b>HI for this pathway=</b>		1.34E-03		1.23E-02	1.34E-03		

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard Index

COPC: Contaminants of potential concern

LADD: Lifetime average daily dose

ADD: Average daily dose

HQ: Hazard quotient

**Table A-8.  
DERMAL EXPOSURE EVALUATION FOR SURFACE WATER  
FOR LAKE CALUMET CLUSTER SITE: ALBURN**

Carcinogenic Risk							
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		LADD	ELCR	LADD	ELCR	LADD	ELCR
Heptachlor	1.10E-02	7.61E-10	3.43E-09	3.04E-11	1.37E-10	7.61E-10	3.43E-09

Noncarcinogenic Risk							
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ
Barium	1.00E-03	2.31E-07	3.30E-06	2.11E-06	3.01E-05	2.31E-07	3.30E-06
Manganese	1.00E-03	1.80E-08	3.92E-05	1.64E-05	3.57E-04	1.80E-08	3.92E-05

Summary				
		On-site Worker	Construction Worker	Industrial / Commercial Worker
ELCR for this pathway=		3.43E-09	1.37E-10	3.43E-09
HI for this pathway=		4.25E-05	3.88E-04	4.25E-05

**Notes:**

- ELCR: Excess lifetime cancer risks
- HI: Hazard index
- COPC: Contaminants of potential concern
- LADD: Lifetime average daily dose
- ADD: Average daily dose
- HQ: Hazard quotient

**Table A-9.  
DERMAL EXPOSURE EVALUATION FOR GROUNDWATER  
FOR LAKE CALUMET CLUSTER SITE: ALBURN**

		Carcinogenic Risk					
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		LADD	ELCR	LADD	ELCR	LADD	ELCR
Arsenic	1.00E-03	2.81E-08	4.22E-08	1.13E-09	1.69E-09	2.81E-08	4.22E-08
Beryllium	1.00E-03	1.45E-09	0.00E+00	5.81E-11	0.00E+00	1.45E-09	0.00E+00
Benzene	2.10E-02	1.16E-05	6.39E-07	4.65E-07	2.56E-08	1.16E-05	6.39E-07
Bis(2-Chloroethyl) Ether	2.10E-03	1.26E-07	1.39E-07	5.04E-09	5.54E-09	1.26E-07	1.39E-07
Methylene chloride	4.50E-03	1.76E-07	1.32E-09	7.06E-09	5.29E-11	1.76E-07	1.32E-09
N-Nitrosodiphenylamine	2.00E-02	2.77E-08	1.36E-10	1.11E-09	5.42E-12	2.77E-08	1.36E-10

		Noncarcinogenic Risk					
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ
Antimony	1.00E-03	4.26E-09	1.07E-05	3.69E-08	9.72E-05	4.26E-09	1.07E-05
Arsenic	1.00E-03	7.68E-08	2.63E-04	7.19E-07	2.40E-03	7.68E-08	2.63E-04
Barium	1.00E-03	3.00E-06	4.29E-05	2.74E-05	3.91E-04	3.00E-06	4.29E-05
Beryllium	1.00E-03	4.07E-09	2.03E-05	3.71E-08	1.66E-05	4.07E-09	2.03E-05
Cadmium	1.00E-03	1.41E-08	2.83E-05	1.29E-07	2.59E-04	1.41E-08	2.83E-05
Chromium	1.00E-03	2.27E-07	1.52E-07	2.07E-06	1.36E-06	2.27E-07	1.52E-07
Manganese	1.00E-03	2.63E-06	5.71E-05	2.40E-05	5.21E-04	2.63E-06	5.71E-05
Mercury	1.00E-03	2.32E-09		2.12E-08		2.32E-09	
Nickel	1.00E-03	1.39E-07	6.97E-06	1.27E-08	6.36E-05	1.39E-07	6.97E-06
Thallium	1.00E-03	1.68E-09	2.10E-05	1.53E-08	1.92E-04	1.68E-09	2.10E-05
Vanadium	1.00E-03	1.64E-07	2.34E-05	1.50E-08	2.14E-04	1.64E-07	2.34E-05
Zinc	1.00E-03	4.48E-06	1.49E-05	4.09E-05	1.36E-04	4.48E-06	1.49E-05
Bis(2-ethylhexyl)phthalate	3.30E-02	1.68E-06	8.42E-05	1.54E-05	7.69E-04	1.68E-06	8.42E-05
Chlorobenzene	4.10E-02	4.50E-06	2.25E-04	4.11E-05	2.05E-03	4.50E-06	2.25E-04
2,4-Dimethylphenol	1.50E-02	3.10E-06	1.55E-04	2.93E-05	1.41E-03	3.10E-06	1.55E-04
Ethylbenzene	7.40E-02	2.77E-04	2.77E-03	2.53E-03	2.53E-02	2.77E-04	2.77E-03
Methylene chloride	4.50E-03	4.94E-07	8.23E-06	4.51E-06	7.51E-05	4.94E-07	8.23E-06
Naphthalene	6.90E-02	1.87E-05	9.36E-04	1.71E-04	6.54E-03	1.87E-05	9.36E-04
Toluene	4.50E-02	1.10E-03	5.52E-03	1.01E-02	5.04E-02	1.10E-03	5.52E-03
Xylenes	6.00E-02	9.30E-04	4.65E-04	8.49E-03	4.24E-03	9.30E-04	4.65E-04

Summary			
	On-site Worker	Construction Worker	Industrial / Commercial Worker
ELCR for this pathway=	8.22E-07	3.29E-08	8.22E-07
HI for this pathway=	1.06E-02	9.71E-02	1.06E-02

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard Index

COPC: Contaminants of potential concern

LADD: Lifetime average daily dose

ADD: Average daily dose

HQ: Hazard quotient

**Table A-10.  
PARTICULATE INHALATION EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER  
SITE: ALBURN**

<b>Carcinogenic Risk</b>					
$LADD = EPCa \times ER \times IR \times EF \times ED / (BW \times ATc)$					
EPCa=exposure point concentration in air (ug/m3) = EPCxPIF					
ER=exposure rate (hrs/day)					
IR=inhalation rate (m3/hour)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
BW=body weight (kg)					
ATc=averaging time for carcinogens (days)					
PIF= Particulate Inhalation factor (kg/m3)					
ELCR=LADDxSFI					
SFI=inhalation cancer slope factor (kg-day/mg)					
LADD=lifetime average daily dose (mg/kg-day)					
Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Workers	Mower	Landscape Worker
IR (m3/hour)	1.1	2.8	1.1	1.7	1.1
ER (hr/day)	5	8	8	8	8
EF (days/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
Atc (days)	25550	25550	25550	25550	25550
Particulate Inhalation factor	8.00E-10	8.00E-09	8.00E-10	8.00E-09	8.00E-10
Conversion from ug to mg	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
<b>Noncarcinogenic Risk</b>					
$ADD = EPCa \times ER \times IR \times EF \times ED / (BW \times ATn)$					
EPCa=exposure point concentration in air (ug/m3)					
ER=exposure rate (hrs/day)					
IR=inhalation rate (m3/hr)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
BW=body weight (kg)					
ATn=averaging time for noncarcinogens (days)					
HQ=ADD/RfDI					
ADD=average daily dose (mg/kg-day)					
RfDI=inhalation reference dose (mg/kg-day)					
Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Workers	Mower	Landscape Worker
IR (m3/hour)	1.1	2.8	1.1	1.7	1.1
ER (hr/day)	5	8	8	8	8
EF (days/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
Atn (days)	9125	9125	9125	9125	40
Particulate Inhalation factor	8.00E-10	8.00E-09	8.00E-10	8.00E-10	8.00E-10

**Table A-11.  
PARTICULATE EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE: ALBURN**

Carcinogenic Risk										
COPC	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR
Arsenic	4.99E-11	0.00E+00	4.87E-11	0.00E+00	3.99E-10	0.00E+00	2.46E-10	0.00E+00	3.19E-11	0.00E+00
Beryllium	4.79E-12	0.00E+00	4.67E-12	0.00E+00	3.83E-11	0.00E+00	2.36E-11	0.00E+00	3.06E-12	0.00E+00
Benzene	2.65E-10	7.40E-12	2.60E-10	7.24E-12	2.04E-09	5.92E-11	1.96E-09	3.66E-11	1.63E-10	4.74E-12
Benzo(a)anthracene	1.67E-11	4.65E-12	1.63E-11	4.76E-12	1.25E-10	3.66E-11	7.75E-11	2.40E-11	1.00E-11	3.11E-12
Benzo(b)fluoranthene	1.80E-11	5.57E-12	1.76E-11	5.44E-12	1.44E-10	4.48E-11	6.88E-11	2.75E-11	1.15E-11	3.56E-12
Benzo(a)pyrene	1.39E-11	4.22E-11	1.33E-11	4.13E-11	1.09E-10	3.36E-10	6.74E-11	2.09E-10	8.72E-12	2.70E-11
Dibenz(a,h)anthracene	4.65E-12	1.44E-11	4.54E-12	1.41E-11	3.72E-11	1.15E-10	2.30E-11	7.19E-11	2.97E-12	9.22E-12
Indeno(1,2,3-cd)pyrene	9.01E-12	2.79E-12	8.81E-12	2.73E-12	7.21E-11	2.24E-11	4.46E-11	1.38E-11	5.77E-12	1.79E-12
Di(2-Chloroethyl) Ether	2.71E-12	3.14E-12	2.65E-12	3.07E-12	2.17E-11	2.52E-11	1.34E-11	1.55E-11	1.73E-12	2.01E-12
Methylene chloride	1.68E-10	2.79E-13	1.65E-10	2.72E-13	1.35E-09	2.22E-12	6.33E-10	1.37E-12	1.06E-10	1.78E-13
Tetrachloroethene	1.76E-10	3.49E-13	1.71E-10	3.41E-13	1.40E-09	2.79E-12	6.63E-10	1.73E-12	1.12E-10	2.23E-13
Trichloroethene	2.67E-10	1.64E-12	2.51E-10	1.51E-12	2.05E-09	1.23E-11	1.27E-09	7.62E-12	1.64E-10	9.66E-13
Vinyl Chloride	1.69E-10	2.80E-12	1.65E-10	2.44E-12	1.25E-09	2.00E-11	7.73E-10	1.24E-11	1.00E-10	1.60E-12
Total PCBs	6.99E-12	1.19E-11	6.83E-12	1.17E-11	4.77E-11	6.54E-11	2.98E-11	5.90E-11	3.81E-12	7.63E-12

Noncarcinogenic Risk										
COPC	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Antimony	1.36E-10		1.33E-10		1.09E-09		6.75E-11		1.69E-09	
Arsenic	1.39E-10		1.36E-10		1.12E-09		6.99E-11		2.03E-09	
Barium	3.31E-09	2.31E-06	3.23E-09	2.26E-06	2.64E-08	1.85E-04	1.63E-09	1.14E-06	4.83E-07	3.37E-03
Beryllium	1.34E-11	2.34E-06	1.31E-11	2.29E-06	1.07E-10	1.89E-05	6.82E-12	1.16E-06	1.96E-09	3.42E-04
Cadmium	6.29E-11		6.15E-11		5.04E-10		3.11E-11		9.19E-09	
Chromium	2.25E-09		2.20E-09		1.80E-08		1.11E-09		3.28E-07	
Manganese	3.36E-08	2.35E-03	3.28E-08	2.30E-03	2.69E-07	1.89E-02	1.66E-08	1.16E-03	4.90E-08	3.43E-01
Carbon disulfide	7.13E-10	3.57E-09	6.97E-10	3.49E-09	5.71E-09	2.85E-06	3.53E-10	1.76E-09	1.04E-07	5.21E-07
Chlorobenzene	3.57E-10	6.29E-08	3.49E-10	6.12E-08	2.89E-09	5.01E-07	1.77E-10	3.10E-08	5.22E-08	9.14E-06
Ethylbenzene	4.07E-08	1.42E-07	3.99E-08	1.39E-07	3.25E-07	1.14E-06	2.01E-08	7.03E-08	5.94E-08	2.08E-05
Heptachlor	3.42E-14		3.34E-14		2.73E-13		1.69E-14		4.99E-12	
Methylene chloride	4.71E-10	6.80E-10	4.61E-10	6.36E-10	3.77E-09	4.40E-09	2.33E-10	2.72E-10	6.66E-08	6.03E-08
Tetrachloroethene	4.69E-10		4.78E-10		3.91E-09		2.42E-10		7.14E-08	
Trichloroethene	7.19E-10		7.09E-10		5.75E-09		3.59E-10		1.05E-07	
Toluene	1.44E-08	1.29E-07	1.41E-08	1.29E-07	1.15E-07	1.01E-06	7.11E-09	6.24E-06	2.10E-06	1.84E-05
Vinyl Chloride	4.37E-10	1.51E-06	4.28E-10	1.47E-06	3.50E-09	1.21E-07	2.16E-10	7.46E-09	6.39E-06	2.20E-09
Xylenes	2.15E-07		2.10E-07		1.72E-06		1.03E-07		3.14E-05	

Summary					
	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ELCR for this pathway=	8.51E-11	8.32E-11	6.81E-10	4.21E-10	5.44E-11
HI for this pathway=	2.36E-03	2.32E-03	1.90E-02	1.17E-03	3.47E-01

<b>Notes:</b>					
ELCR: Excess lifetime cancer risks					
HI: Hazard Index					
COPC: Contaminants of potential concern					
LADD: Lifetime average daily dose					
ADD: Average daily dose					
HQ: Hazard quotient					

**Table A-12.  
GROUNDWATER VOLATILE INHALATION EXPOSURE FACTORS FOR LAKE CALUMET  
CLUSTER SITE: ALBURN**

**Carcinogenic Risk**

$$LADD = (EPC_{air} \times IR \times EF \times ED) / (BW \times ATc \times CF)$$

EPC = exposure point concentration in air (g/m<sup>3</sup>)

IR = inhalation rate (m<sup>3</sup>/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

BW = body weight (kg)

ATc = averaging time for carcinogens (day)

CF = Conversion Factor

$$ELCR = LADD \times SFI$$

SFI = Inhalation Slope Factor (kg-day/mg)

LADD = lifetime average daily dose (mg/kg-day)

Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ED (years)	25	1	25	25	25
EF (days/year)	5	5	5		
ATc (days)	25550	25550	25550		
IR (m <sup>3</sup> /day)	20	20	20	20	20
BW (kg)	70	70	70	70	70
CF (mg-g)	0.001	0.001	0.001	0.001	0.001

**Noncarcinogenic Risk**

$$ADD = EPC_{air} \times IR \times EF \times ED / (BW \times ATn)$$

EPC = exposure point concentration in air (g/m<sup>3</sup>)

IR = inhalation rate (m<sup>3</sup>/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

ATn = average time for noncarcinogens (years)

Conversion Factor = 1000

$$HQ = ADD / Rfd$$

ADD = average daily dose

Rfd = Volatile Inhalation Reference Dose (mg/kg-day)

Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ED (years)	25	1	25	25	25
EF (days/year)	5	5	5		
ATn (days)	9125	40	9125		
IR (m <sup>3</sup> /day)	20	20	20	20	20
BW (kg)	70	70	70	70	70
CF	0.001	0.001	0.001	0.001	0.001

**Table A-13.**  
**GROUNDWATER VOLATILE INHALATION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE:**  
**ALBURN**

Carcinogenic Risk							
COPC	Henry's Law Constant	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		LADD	ELCR	LADD	ELCR	LADD	ELCR
Benzene	2.28E-01	5.49E-08	1.59E-09	2.19E-09	6.38E-11	5.49E-08	1.59E-09
Methylene chloride	8.98E-02	1.83E-09	3.02E-12	7.31E-11	1.21E-13	1.83E-09	3.02E-12
Noncarcinogenic Risk							
COPC	Henry's Law Constant	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ
Chlorobenzene	1.52E-01	6.44E-09	1.13E-06	5.88E-08	1.03E-05	6.44E-09	1.13E-06
Ethylbenzene	3.23E-01	4.19E-07	1.48E-06	3.82E-06	1.34E-05	4.19E-07	1.48E-06
Methylene chloride	8.98E-02	5.12E-09	5.97E-09	4.67E-08	5.45E-06	5.12E-09	5.97E-09
Toluene	2.72E-01	2.55E-06	2.23E-05	2.32E-05	2.04E-04	2.55E-06	2.23E-05
Xylenes	2.15E-01	1.11E-06		1.01E-05		1.11E-06	
Summary							
		On-site Worker		Construction Worker		Industrial / Commercial Worker	
ELCR for this pathway=		1.59E-09		6.38E-11		1.59E-09	
HI for this pathway=		2.49E-05		2.28E-04		2.49E-05	

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard Index

COPC: Contaminants of potential concern

LADD: Lifetime average daily dose

ADD: Average daily dose

HQ: Hazard quotient



**Table A-14.**  
**SOIL VOLATILE INHALATION EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE: ALBURN**

**Carcinogenic Risk**

$$LADD = (EPC \times ER \times IR \times EF \times ED) / (VF \times BW \times ATc)$$

- EPC = Exposure Point Concentration (ug/kg)
- ER = Exposure Rate (hours/day)
- IR = Inhalation Rate (m<sup>3</sup>/hr)
- EF = Exposure Frequency (days/year)
- ED = Exposure Duration (years)
- VF = Volatilization Factor (m<sup>3</sup>/kg)
- BW = Body Weight (kg)
- ATc = Averaging Time for Carcinogens (day)

$$VF = Q/C \times ((3.14 \times D \times T)^{0.5}) / (2 \times R_0 \times D) \times CF$$

- Q/C = Inverse of the mean concentration at the center of a square source = (g/m<sup>2</sup>-s)/(kg/m<sup>3</sup>)
- D = Apparent Diffusivity (cm<sup>2</sup>/s)
- T = Exposure Interval (s)
- R<sub>0</sub> = Dry Soil Bulk Density = g/cm<sup>3</sup>
- CF = Conversion factor (10 E-4 m<sup>2</sup>/cm<sup>2</sup>)

$$D = ((O_a^{2.25} \times D_1 \times H') + (O_w^{2.25} \times D_w) / n^2) \times (1 / ((\rho_w \times K_d) + O_w + (O_a \times H')))$$

- O<sub>a</sub> = Air-Filled Soil Porosity 0.13 For Subsurface Soil
- D<sub>1</sub> = Diffusivity in Air (cm<sup>2</sup>/s) Chemical Specific
- H' = Henry's Law Constant Chemical Specific
- O<sub>w</sub> = Water-Filled Soil Porosity 0.3 For Subsurface Soil
- D<sub>w</sub> = Diffusivity in Water (cm<sup>2</sup>/s) Chemical Specific
- n = Total Soil Porosity 0.43
- ρ<sub>w</sub> = Dry Soil Bulk Density (g/cm<sup>3</sup>) 1.5
- K<sub>d</sub> = Soil Water Partition Coeff = K<sub>oc</sub> × f<sub>oc</sub>
- K<sub>oc</sub> Chemical Specific
- f<sub>oc</sub> 0.002

$$ELCR = LADD \times URF$$

- URF = Inhalation Unit Risk (m<sup>3</sup>/ug)
- LADD = lifetime average daily dose (ug/m<sup>3</sup>)

Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ED (years)	25	1	25	25	25
EF (days/year)	50	30	250	10	20
ATn (days)	9125	40	9125	9125	40
ATc (days)	25550	25550	25550	25550	25550
IR (m <sup>3</sup> /hr)	1.1	2.6	1.1	1.7	1.1
ER (hr/day)	1	8	8	8	4
BW (kg)	70	70	70	70	70

**Noncarcinogenic Risk**

$$ADD = EPC \times IR \times ER \times EF \times ED / (ATn \times VF \times BW)$$

- EPC = exposure point concentration (ug/kg)
- ER = exposure rate (hours/day)
- IR = Inhalation rate (m<sup>3</sup>/hr)
- EF = exposure frequency (days/year)
- ED = exposure duration (years)
- ATn = average time for noncarcinogens (years)
- VF = Volatilization Factor (m<sup>3</sup>/kg)
- Conversion Factor = 1000

$$HQ = ADD / Rfc$$

- ADD = average daily dose (m<sup>3</sup>/ug)
- Rfc = Volatile Inhalation Reference Dose (ug/m<sup>3</sup>)

**Table A-15.  
SOIL VOLATILE INHALATION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE: ALBURN**

	Q/Q	DI	H'	Dw	Koa	Ka	D	Y	No	VF	T <sub>soil</sub>	VF <sub>soil</sub>
	(g/m <sup>3</sup> /m/s)	(g/cm <sup>3</sup> /sec)		(g/cm <sup>3</sup> /sec)	cm <sup>2</sup> /s	cm <sup>2</sup> /s	(g/cm <sup>3</sup> /sec)	Sec	g/cm <sup>3</sup>	cm <sup>3</sup> /kg	Sec	cm <sup>3</sup> /kg
OOPC												
Tetrachloroethene	65.91	7.20E-02	7.64E-01	6.20E-02	1.65E+02	3.10E-01	3.62E-04	7.90E+02	1.50E+00	7.22E+02	3.90E+02	4.92E+02
Trichloroethene	65.91	7.90E-02	4.22E-01	9.10E-02	1.66E+02	3.22E-01	2.29E-04	7.90E+02	1.50E+00	9.24E+02	3.90E+02	6.23E+02
Vinyl Chloride	65.91	1.02E-01	1.11E+00	1.22E-02	1.89E+01	3.72E-02	1.42E-02	7.90E+02	1.50E+00	3.77E+02	3.90E+02	2.65E+02
Benzene	65.91	6.60E-02	2.22E-01	6.90E-02	6.99E+01	1.19E-01	2.42E-04	7.90E+02	1.50E+00	9.16E+02	3.90E+02	6.18E+02
Methylene chloride	65.91	1.01E-01	8.99E-02	1.17E-02	1.17E+01	2.34E-02	1.62E-04	7.90E+02	1.50E+00	1.12E+04	3.90E+02	7.66E+02
Carbon disulfide	65.91	1.04E-01	1.24E+00	1.00E-02	4.57E+01	9.14E-02	1.31E-02	7.90E+02	1.50E+00	3.94E+02	3.90E+02	2.99E+02
Chlorobenzene	65.91	7.30E-02	1.62E-01	6.70E-02	2.19E+02	4.39E-01	6.97E-02	7.90E+02	1.50E+00	1.71E+04	3.90E+02	1.15E+02
Ethylbenzene	65.91	7.60E-02	3.22E-01	7.90E-02	3.62E+02	7.29E-01	1.02E-04	7.90E+02	1.50E+00	1.40E+04	3.90E+02	9.47E+02
Toluene	65.91	8.70E-02	2.72E-01	6.90E-02	1.82E+02	3.64E-01	1.94E-04	7.90E+02	1.50E+00	1.11E+04	3.90E+02	7.32E+02
Xylenes	65.91	7.14E-02	2.16E-01	9.24E-02	3.74E+02	7.49E-01	9.48E-02	7.90E+02	1.50E+00	1.77E+04	3.90E+02	1.19E+02

OOPC	Carcinogenic Risk									
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR
Benzene	7.0E-02	5.9E-02	6.0E-02	4.2E-07	2.9E-01	2.2E-02	1.7E-02	1.4E-07	1.1E-02	9.2E-02
Methylene chloride	3.9E-02	1.9E-02	2.7E-02	1.3E-02	1.6E-01	7.1E-02	9.2E-02	4.4E-02	6.0E-02	2.6E-02
Tetrachloroethene	6.0E-02	3.4E-02	6.0E-02	4.6E-02	4.4E-01	2.5E-02	2.7E-02	1.6E-02	1.9E-02	1.0E-02
Trichloroethene	7.0E-02	1.2E-02	2.7E-02	4.7E-02	1.9E-01	2.9E-02	9.2E-02	1.6E-02	9.0E-02	1.0E-02
Vinyl Chloride	1.0E-02	4.7E-02	2.0E-02	9.2E-02	1.1E-01	6.1E-02	6.9E-02	3.1E-02	4.6E-02	2.0E-02

OOPC	Noncarcinogenic Risk									
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Tetrachloroethene	1.7E-02		2.0E+01		6.7E-01		4.1E-02		6.1E+00	
Trichloroethene	1.9E-02		3.2E+01		7.9E-01		4.6E-02		7.1E+00	
Vinyl Chloride	2.9E-02	2.9E-04	4.8E+01	4.7E-01	1.2E+00	1.1E-02	7.2E-02	7.1E-04	1.1E+01	1.0E-01
Carbon disulfide	4.5E-02	6.5E-02	7.6E+01	1.1E-01	1.6E+00	2.6E-02	1.1E-01	1.6E-04	1.7E+01	2.4E-02
Chlorobenzene	6.2E-02	2.6E-04	6.6E+00	4.2E-01	2.1E-01	1.0E-02	1.2E-02	6.5E-04	1.9E+00	9.6E-02
Ethylbenzene	6.4E-02	2.6E-02	1.2E+02	4.0E-01	2.9E+01	9.7E-02	1.6E+00	6.0E-04	2.6E+02	6.6E-02
Methylene chloride	7.8E-02		1.1E+01		2.6E-01		1.7E-02		2.6E+00	
Toluene	9.2E-01	6.1E-04	6.2E+02	1.2E+00	1.2E+01	3.2E-02	6.0E-01	2.0E-02	1.2E+02	3.0E-01
Xylenes	8.0E+00		6.0E+02		1.2E+02		7.6E+00		1.1E+02	

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ELCR for this pathway=	1.22E-07	6.16E-07	3.40E-06	2.10E-07	1.39E-07
HI for this pathway=	1.07E-03	2.17E+00	5.25E-02	3.25E-03	4.79E-01

**Table A-15.**  
**SOIL VOLATILE INHALATION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE: ALBURN**

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard Index

COPC: Contaminants of potential concern

LADD: Lifetime average daily dose

ADD: Average daily dose

HQ: Hazard quotient

Bold shaded area indicated ELCR or HI exceedances for the receptor

**Table A-16.**  
**SUMMARY OF HUMAN HEALTH RISK ASSESSMENT FOR LAKE CALUMET CLUSTER SITE: ALBURN**

**Summary of Human Risk Assessment for Soil, Sediment, Surface water and Groundwater**

	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>
<b>Total ELCR</b>	<b>5.E-06</b>	<b>2.E-06</b>	<b>3.E-05</b>	<b>1.E-05</b>	<b>2.E-06</b>
<b>Total HI</b>	<b>3.E-02</b>	<b>3.E+00</b>	<b>2.E-01</b>	<b>4.E-02</b>	<b>8.E-01</b>

**Summary of Human Risk Assessment for Soil, Sediment and Surface water**

	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>
<b>Total ELCR</b>	<b>5.E-06</b>	<b>2.E-06</b>	<b>2.E-05</b>	<b>1.E-05</b>	<b>2.E-06</b>
<b>Total HI</b>	<b>2.E-02</b>	<b>3.E+00</b>	<b>2.E-01</b>	<b>4.E-02</b>	<b>8.E-01</b>

**Summary of Human Risk Assessment for Soil**

	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>
<b>Total ELCR</b>	<b>5.E-06</b>	<b>2.E-06</b>	<b>2.E-05</b>	<b>1.E-05</b>	<b>2.E-06</b>
<b>Total HI</b>	<b>2.E-02</b>	<b>3.E+00</b>	<b>2.E-01</b>	<b>4.E-02</b>	<b>8.E-01</b>

**Table A-16.**  
**SUMMARY OF HUMAN HEALTH RISK ASSESSMENT FOR LAKE CALUMET CLUSTER SITE: ALBURN**

**Summary of Human Risk Assessment for Groundwater**

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
Total ELCR	8.E-07	3.E-08	8.E-07		
Total HI	1.E-02	1.E-01	1.E-02		

**Summary of Human Risk Assessment for Surface water**

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
Total ELCR	3.E-09	1.E-10	3.E-09		
Total HI	4.E-05	4.E-04	4.E-05		

**Summary of Human Risk Assessment for Sediment**

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
Total ELCR	2.E-07	9.E-09	2.E-07		
Total HI	1.E-03	1.E-02	1.E-03		

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard index

Bold shaded area indicated ELCR or HI exceedances for the receptor

**Table A-17.**  
**EXCEEDANCES SUMMARY OF CHEMICAL OF POTENTIAL CONCERN FOR LAKE CALUMET**  
**CLUSTER SITE: ALBURN**

**COPCs of Carcinogenic Risk In Soil**

<b>COPC</b>	<b>Receptors</b>
<b>Arsenic</b>	<b>Industrial/Commercial Worker, Mower</b>
<b>Benzene</b>	<b>Industrial/Commercial Worker</b>
<b>Benzo(a)pyrene</b>	<b>Industrial/Commercial Worker, Mower</b>
<b>Total PCBs</b>	<b>Industrial/Commercial Worker</b>
<b>Vinyl Chloride</b>	<b>Industrial/Commercial Worker, Mower</b>

**COPCs of Noncarcinogenic Risk In Soil**

<b>COPC</b>	<b>Receptors</b>
<b>Toluene</b>	<b>Construction Worker</b>

**Notes:**

**ELCR: Excess lifetime cancer risks**

**HI: Hazard Index**

**Carcinogenic exceedances: ELCR is greater than 1.00E-06**

**Noncarcinogenic exceedances: HI is greater than 1.00E+00**

**Table B-1.**  
**TOXICITY FACTORS FOR CHEMICALS OF POTENTIAL CONCERN FOR LAKE CALUMET CLUSTER SITE: USDRUM**

Carcinogenic Risk									
COPC	Ingestion Slope Factor	EPC for Soil (ug/kg)	EPC for Sediment (ug/kg)	EPC for SW (ug/L)	EPC for GW (ug/L)	EPC for GW in air (g/m)	Particulate	Dermal Slope	Volatile (URF)
	(kg-day/mg)						Inhalation Slope Factor	Factor	Inhalation Risk Factor
	(kg-day/mg)						(kg-day/mg)	(kg-day/mg)	(m <sup>3</sup> /ug)
Arsenic	1.50E+00	1.70E+04			5.20E+01			1.50E+00	0.00E+00
Beryllium		8.18E+02			5.00E+00			0.00E+00	0.00E+00
Benzene	5.50E-02	2.41E+03			7.20E+01	5.18E-09	2.90E-02	5.50E-02	8.29E-06
Benzo(a)anthracene	7.30E-01	1.15E+04			2.00E+00		3.10E-01	7.30E-01	8.86E-05
Benzo(b)fluoranthene	7.30E-01	1.33E+04			2.00E+00		3.10E-01	7.30E-01	8.88E-05
Benzo(k)fluoranthene	7.30E-02				2.00E+00		3.10E-02	7.30E-02	8.86E-06
Benzo(a)pyrene	7.30E+00	1.22E+04			2.00E+00		3.10E+00	7.30E+00	8.86E-04
Chloroform	6.10E-03	3.49E+03					8.10E-02	8.10E-03	2.31E-05
Chrysene	7.30E-03				2.00E+00		3.10E-03	7.30E-03	8.86E-07
Dibenz(a,h)anthracene	7.30E+00	9.41E+03					3.10E+00	7.30E+00	8.86E-04
1,2-Dichloroethane	9.10E-02	5.25E+03						9.10E-02	0.00E+00
4,4'-DDD	2.40E-01			3.00E-02				2.40E-01	0.00E+00
4,4'-DDE	3.40E-01			1.00E-02				3.40E-01	0.00E+00
Heptachlor	4.50E+00			2.00E-02			4.50E+00	4.50E+00	1.29E-03
Indeno(1,2,3-cd)pyrene	7.30E-01	1.19E+04			1.00E+00		3.10E-01	7.30E-01	8.86E-05
Tetrachloroethene	5.20E-02	5.49E+03					2.00E-03	5.20E-02	5.71E-07
Vinyl Chloride	7.20E-01	4.59E+03					1.60E-02	7.20E-01	4.57E-06
Total PCBs	2.00E+00	2.24E+04					2.00E+00	2.00E+00	
Noncarcinogenic Risk									
COPC	Ingestion Reference Dose	EPC for Soil (ug/kg)	EPC for Sediment (ug/kg)	EPC for SW (ug/L)	EPC for GW (ug/L)	EPC for GW in air (g/m)	Inhalation	Dermal	Volatile Inhalation Ref.
	(mg/kg-day)						Reference Dose	Reference Dose	Dose
	(mg/kg-day)						(mg/kg-day)	(mg/kg-day)	(ug/m <sup>3</sup> )
Antimony	4.00E-04	1.21E+04			1.80E+02			4.00E-04	0.00E+00
Arsenic	3.00E-04	1.70E+04			5.20E+01			3.00E-04	0.00E+00
Barium	7.00E-02			1.53E+02	2.53E+03		1.43E-04	7.00E-02	5.01E-01
Beryllium	2.00E-03	8.18E+02			5.00E+00		5.71E-06	2.00E-03	2.00E-02
Cadmium	5.00E-04				1.10E+01			5.00E-04	0.00E+00
Chromium	1.50E+00	1.48E+05			2.88E+02			1.50E+00	0.00E+00
Manganese	4.80E-02	2.11E+06		1.45E+02	8.52E+03		1.43E-05	4.80E-02	5.01E-02
Mercury					2.80E+00		8.60E-05	0.00E+00	3.01E-01
Nickel	2.00E-02				1.11E+02			2.00E-02	0.00E+00
Vanadium	2.00E-02				1.92E+02			2.00E-02	0.00E+00
Bis(2-ethylhexyl)phthalate	8.00E-01	7.81E+04						8.00E-01	0.00E+00
Chlorobenzene	2.00E-02	7.95E+03					5.71E-03	2.00E-02	2.00E+01
Chloroform	1.00E-02	3.49E+03						1.00E-02	0.00E+00
Endrin	3.00E-04			2.00E-02				3.00E-04	0.00E+00
Ethylbenzene	1.00E-01	1.19E+05					2.88E-01	1.00E-01	1.00E+03
Heptachlor	5.00E-04			2.00E-02				5.00E-04	0.00E+00
Tetrachloroethene	1.00E-02	5.49E+03						1.00E-02	0.00E+00
Toluene	2.00E-01	1.90E+04					1.14E-01	2.00E-01	3.99E+02
Vinyl Chloride	3.00E-03	4.59E+03					2.90E-02	3.00E-03	1.02E+02
Xylenes	2.00E+00	9.50E+05						2.00E+00	0.00E+00

Note:  
 COPC: Contaminants of potential concern  
 EPC: Exposure point concentration

**Table B-2.  
SOIL INGESTION EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
USDRUM**

<b>Carcinogenic Risk</b>					
$LADD = EPC \times FI \times IRS \times EF \times ED \times CF / (BW \times ATc)$					
EPC=exposure point concentration (ug/kg)					
FI=fraction ingested from contaminated source					
IRS=soil ingestion rate (mg/day)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
CF=conversion factor 10 <sup>-9</sup> kg/ug					
BW=body weight (kg)					
ATc=averaging time for carcinogens (days)					
$ELCR = LADD \times SFo$					
SFo=oral cancer slope factor (kg-day/mg)					
LADD=lifetime average daily dose (mg/kg-day)					
Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
IRS (mg/day)	50	480	50	480	50
FI	0.5	1	0.5	1	0.5
EF (day/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
Atc (days)	25550	25550	25550	25550	25550
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09
<b>Noncarcinogenic Risk</b>					
$ADD = EPC \times FI \times IRS \times EF \times ED \times CF / (BW \times ATn)$					
EPC=exposure point concentration (ug/kg)					
FI=fraction ingested from contaminated source					
IRS=soil ingestion rate (mg/day)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
BW=body weight (kg)					
ATn=averaging time for noncarcinogens (days)					
$HQ = ADD / RfDo$					
ADD=average daily dose (mg/kg-day)					
RfDo=injection reference dose (mg/kg-day)					
Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
IRS (mg/day)	50	480	50	480	50
FI	0.5	1	0.5	1	0.5
EF (day/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
ATn (days)	9125	40	9125	9125	9125
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09



**Table B-3.**  
**SOIL INGESTION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE: USDRUM**

Carcinogenic Risk										
COPC	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR
Arsenic	2.97E-07	4.45E-07	1.37E-07	2.05E-07	1.48E-06	2.22E-06	1.14E-06	1.71E-06	1.19E-07	1.78E-07
Beryllium	1.43E-08	0.00E+00	6.59E-09	0.00E+00	7.15E-08	0.00E+00	5.49E-08	0.00E+00	5.72E-09	0.00E+00
Benzene	4.21E-08	2.32E-09	1.94E-08	1.07E-09	2.11E-07	1.16E-08	1.62E-07	8.90E-09	1.69E-08	8.27E-10
Benzo(a)anthracene	2.02E-07	1.47E-07	9.29E-08	6.78E-08	1.01E-06	7.36E-07	7.74E-07	5.65E-07	8.07E-08	5.89E-08
Benzo(b)fluoranthene	2.32E-07	1.70E-07	1.07E-07	7.81E-08	1.16E-06	8.48E-07	8.92E-07	6.51E-07	9.29E-08	6.78E-08
Benzo(a)pyrene	2.14E-07	1.56E-06	9.85E-08	7.19E-07	1.07E-06	7.81E-06	8.21E-07	5.99E-06	8.55E-08	6.24E-07
Chloroform	6.10E-08	3.72E-10	2.81E-08	1.72E-10	3.05E-07	1.86E-09	2.34E-07	1.43E-09	2.44E-08	1.49E-10
Dibenz(a,h)anthracene	1.84E-07	1.20E-06	7.58E-08	5.53E-07	8.22E-07	6.00E-06	6.31E-07	4.61E-06	6.58E-08	4.80E-07
1,2-Dichloroethane	9.17E-08	8.34E-09	4.23E-08	3.85E-09	4.59E-07	4.17E-08	3.52E-07	3.20E-08	3.67E-08	3.34E-09
Indeno(1,2,3-cd)pyrene	2.07E-07	1.51E-07	9.55E-08	6.97E-08	1.04E-06	7.57E-07	7.96E-07	5.81E-07	8.29E-08	6.05E-08
Tetrachloroethene	9.60E-08	4.99E-09	4.42E-08	2.30E-09	4.80E-07	2.50E-08	3.69E-07	1.92E-08	3.84E-08	2.00E-09
Vinyl Chloride	8.03E-08	5.78E-08	3.70E-08	2.68E-08	4.01E-07	2.89E-07	3.08E-07	2.22E-07	3.21E-08	2.31E-08
Total PCBs	3.91E-07	7.81E-07	1.80E-07	3.60E-07	1.95E-06	3.91E-06	1.50E-06	3.00E-06	1.56E-07	3.12E-07
Noncarcinogenic Risk										
COPC	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Antimony	5.91E-07	1.48E-03	6.21E-05	1.55E-01	2.98E-06	7.39E-03	2.27E-06	5.67E-03	2.36E-07	5.91E-04
Arsenic	8.30E-07	2.77E-03	6.73E-05	2.91E-01	4.15E-06	1.38E-02	3.19E-06	1.06E-02	3.32E-07	1.11E-03
Beryllium	4.00E-06	2.00E-05	4.21E-06	2.10E-03	2.00E-07	1.00E-04	1.54E-07	7.69E-05	1.60E-08	8.01E-06
Chromium	7.23E-06	4.82E-06	7.60E-04	5.07E-04	3.61E-05	2.41E-05	2.78E-05	1.85E-05	2.89E-06	1.93E-06
Manganese	1.03E-04	2.25E-03	1.09E-02	2.36E-01	5.17E-04	1.12E-02	3.97E-04	8.63E-03	4.13E-05	8.99E-04
Bis(2-ethylhexyl)phthalate	3.72E-06	4.85E-06	3.91E-04	4.89E-04	1.86E-05	2.33E-05	1.43E-05	1.79E-05	1.49E-06	1.86E-06
Chlorobenzene	3.89E-07	1.94E-05	4.09E-05	2.04E-03	1.94E-06	9.72E-05	1.49E-06	7.46E-05	1.55E-07	7.77E-06
Chloroform	1.71E-07	1.71E-05	1.80E-05	1.80E-03	8.55E-07	8.55E-05	6.56E-07	6.56E-05	6.84E-08	6.84E-06
Ethylbenzene	5.81E-06	5.81E-05	6.11E-04	6.11E-03	2.90E-05	2.90E-04	2.23E-05	2.23E-04	2.32E-06	2.32E-05
Tetrachloroethene	2.69E-07	2.69E-05	2.83E-05	2.83E-03	1.34E-06	1.34E-04	1.03E-06	1.03E-04	1.08E-07	1.08E-05
Toluene	9.28E-07	4.84E-06	9.75E-05	4.87E-04	4.64E-06	2.32E-05	3.56E-06	1.78E-05	3.71E-07	1.86E-06
Vinyl Chloride	2.25E-07	7.49E-05	2.36E-05	7.87E-03	1.12E-06	3.75E-04	8.63E-07	2.88E-04	8.99E-08	3.00E-05
Xylenes	4.85E-05	2.32E-05	4.89E-03	2.44E-03	2.32E-04	1.16E-04	1.78E-04	6.92E-05	1.86E-05	9.30E-06
Summary										
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
ELCR for this pathway	3.75E-03		1.73E-06		1.87E-06		1.44E-06		1.50E-06	
HI for this pathway	6.75E-03		7.09E-01		3.37E-02		2.59E-02		2.70E-03	
Notes:										
ELCR: Excess lifetime cancer risks										
HI: Hazard index										
COPC: Contaminants of potential concern										
LADD: Lifetime average daily dose										
ADD: Average daily dose										
HQ: Hazard quotient										
Bold shaded area indicated ELCR or HI exceedances for the receptor										

**Table B-4.  
SOIL DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
USDRUM**

<b>Carcinogenic Risk</b>					
	<b>LADD=EPCxSAxAFxABSxEFxEDxCF/(BWxATc)</b>				
	EPC=exposure point concentration (ug/kg)				
	SA=body surface area (cm <sup>2</sup> /day)				
	AF=soil adherence factor (mg/cm <sup>2</sup> )				
	ABS=dermal adsorption factor (unitless)				
	EF=exposure frequency (days/year)				
	ED=exposure duration (years)				
	CF=conversion factor (10 <sup>-9</sup> kg/ug)				
	BW=body weight (kg)				
	ATc=averaging time for carcinogens (days)				
	<b>ELCR=LADDxSFd</b>				
	SFd=dermal cancer slope factor (kg-day/mg)				
	LADD=lifetime average daily dose (mg/kg-day)				
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> /day)	3300	3300	3300	3300	3300
AF (mg/cm <sup>2</sup> )	0.2	0.2	0.2	0.2	0.2
ABS	<b>Chemical Specific</b>				
Inorganics	0.01	0.01	0.01	0.01	0.01
Bis(2-ethylhexyl)phthalate	0.4	0.4	0.4	0.4	0.4
Tetrachloroethene	0.03	0.03	0.03	0.03	0.03
Trichloroethene	0.03	0.03	0.03	0.03	0.03
Vinyl chloride	0.03	0.03	0.03	0.03	0.03
Others	0	0	0	0	0
EF (day/year) for Soil	50	10	20	30	250
EF (day/year) for Sediment	5			5	5
ET (hour/day)	5	8	8	8	8
ED (years)	25	25	25	1	25
BW (kg)	70	70	70	70	70
ATc (days) - for Soil	25550	25550	25550	25550	25550
ATc (days) - for Sediment	25550			25550	25550
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09

**Table B-4.  
SOIL DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
USDRUM**

<b>Noncarcinogenic Risk</b>					
	<b>ADD=EPCxSAxAFxABSxEFxEDxCF/(BWxATn)-Soil and Sediment</b>				
	EPC=exposure point concentration (ug/kg)				
	SA=body surface area (cm <sup>2</sup> /day)				
	AF=soil adherence factor (mg/cm <sup>2</sup> )				
	ABS=dermal adsorption factor				
	EF=exposure frequency (days/year)				
	ED=exposure duration (years)				
	CF=conversion factor 10 <sup>-9</sup> kg/mg				
	BW=body weight (kg)				
	ATn =averaging time for noncarcinogens (days)				
	HQ=ADD/RfD				
	ADD-average daily dose (mg/kg-day)				
	RfD=dermal reference dose (mg/kg-day)				
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> /day)	3300	3300	3300	3300	3300
AF(mg/cm <sup>2</sup> )	0.2	0.2	0.2	0.2	0.2
<b>ABS</b>	<b>Chemical Specific</b>				
Inorganics	0.01	0.01	0.01	0.01	0.01
Bis(2-ethylhexyl)phthalate	0.4	0.4	0.4	0.4	0.4
Tetrachloroethene	0.03	0.03	0.03	0.03	0.03
Trichloroethene	0.03	0.03	0.03	0.03	0.03
Vinyl chloride	0.03	0.03	0.03	0.03	0.03
Others	0	0	0	0	0
EF (day/year) for Soil	50	10	20	30	250
EF (day/year) for Sediment	5			5	5
ET (hour/day)	5	8	8	8	8
ED (years)	25	25	25	1	25
BW (kg)	70	70	70	70	70
Atn (days) - for Soil	9125	9125	9125	9125	9125
Atn (days) - for Sediment	9125			40	9125
Conversion Factor kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09

**Table B-5.  
WATER DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
USDRUM**

<b>Carcinogenic Risk</b>					
$LADD = EPC \times SA \times PC \times ET \times EF \times ED \times CF / (BW \times ATc)$					
EPC=exposure point concentration (ug/L)					
SA = Skin surface area (cm <sup>2</sup> )					
PC=Permeability Constant (cm/hr)					
EF=exposure frequency (days/year)					
ED=exposure duration: (years)					
CF=conversion factor 10 <sup>-6</sup> (L-mg/cm <sup>2</sup> -ug)					
BW=body weight (kg)					
ATc=averaging time for carcinogens (days)					
ELCR=LADDxSFd					
SFd=dermal cancer slope factor (kg-day/mg)					
LADD=lifetime average daily dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> )	3300	3300	3300	3300	3300
PC(cm/hr)	Chemical Specific				
Inorganic	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
Benzo(a)pyrene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Benzo(a)anthracene	8.00E-01	8.00E-01	8.00E-01	8.00E-01	8.00E-01
Benzo(b)fluoranthene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Dibenzo(a,h)anthracene	2.70E+00	2.70E+00	2.70E+00	2.70E+00	2.70E+00
Indeno(1,2,3-cd)pyrene	1.80E+00	1.80E+00	1.80E+00	1.80E+00	1.80E+00
Benzo(k)fluoranthene					
Chrysene	8.10E-01	8.10E-01	8.10E-01	8.10E-01	8.10E-01
Vinyl chloride	7.30E-03	7.30E-03	7.30E-03	7.30E-03	7.30E-03
bis(2-ethylhexyl)phthalate	3.30E-02	3.30E-02	3.30E-02	3.30E-02	3.30E-02
Tetrachloroethane	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02
Trichloroethane	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02
EF (day/year) for SW & GW	5			5	5
ET (hour/day)	1	8	8	1	1
ED (years)	25			1	25
BW (kg)	70	70	70	70	70
Atc (days) - for SW & GW	25550			25550	25550
Conversion Factor (L-mg/cm <sup>2</sup> -ug)	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06

**Table B-5.  
WATER DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
USDRUM**

<b>Noncarcinogenic Risk</b>					
<b>ADD=EPCxSAxPCxETxEFxEDxCF/BWxATn</b>					
EPC=exposure point concentration (ug/L)					
SA = Skin surface area (cm <sup>2</sup> )					
PC=Permeability Constant (cm/hr)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
CF=conversion factor 10 <sup>-6</sup> (L-mg/cm <sup>2</sup> -ug)					
CF=conversion factor 10 <sup>-6</sup> (L-mg/cm <sup>2</sup> -ug)					
BW=body weight (kg)					
ATn =averaging time for noncarcinogens (days)					
HQ=ADD/RfDo					
ADD=average daily dose (mg/kg-day)					
RfDd=dermal reference dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> )	3300	3300	3300	3300	3300
PC (cm/hr)	<b>Chemical Specific</b>				
Inorganic	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
Benzo(a)pyrene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Benzo(a)anthracene	8.00E-01	8.00E-01	8.00E-01	8.00E-01	8.00E-01
Benzo(b)fluoranthene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Dibenzo(a,h)anthracene	2.70E+00	2.70E+00	2.70E+00	2.70E+00	2.70E+00
Indeno(1,2,3-cd)pyrene	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00
Benzo(k)fluoranthene					
Chrysene	8.10E-01	8.10E-01	8.10E-01	8.10E-01	8.10E-01
Vinyl chloride	7.30E-03	7.30E-03	7.30E-03	7.30E-03	7.30E-03
bis(2-ethylhexyl)phthalate	3.30E-02	3.30E-02	3.30E-02	3.30E-02	3.30E-02
Tetrachloroethene	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02
Trichloroethene	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02
EF (day/year) for SW & GW	5			5	5
ET (hour/day)	5	8	8	8	1
ED (years)	25			1	25
BW (kg)	70	70	70	70	70
Atn (days) - for SW & GW	9125			40	9125
Conversion Factor (L-mg/cm <sup>2</sup> -ug)	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06

**Table B-6.  
DERMAL EXPOSURE EVALUATION FOR SOIL FOR LAKE CALUMET CLUSTER SITE: USDRUM**

Carcinogenic Risk											
COPC	Dermal Adsorp. Factors (ABS)	On-site Worker		Mower		Landscape Worker		Construction Worker		Industrial / Commercial Worker	
		LADD	BLCR	LADD	BLCR	LADD	BLCR	LADD	BLCR	LADD	BLCR
Arsenic	3.00E-02	2.38E-07	3.82E-07	4.70E-08	7.05E-08	9.99E-08	1.41E-07	8.64E-08	6.48E-08	1.17E-08	1.78E-08
Beryllium	1.00E-02	3.77E-09	0.00E+00	7.88E-10	0.00E+00	1.81E-09	0.00E+00	9.08E-11	0.00E+00	1.89E-08	0.00E+00
Benzene	3.00E-02	3.34E-08	1.84E-09	9.98E-09	3.97E-10	1.34E-08	7.34E-10	8.01E-10	4.41E-11	1.67E-07	9.18E-08
1,2-Dichloroethane	3.00E-02	7.88E-08	6.81E-09	1.48E-08	1.32E-09	2.91E-08	2.84E-09	1.74E-08	1.89E-10	3.63E-07	3.30E-08
Chloroform	1.00E-01	1.81E-07	9.83E-10	3.22E-08	1.97E-10	6.48E-08	3.93E-10	3.97E-09	2.39E-11	6.08E-07	4.91E-08
Tetrachloroethane	3.00E-02	7.80E-08	3.98E-09	1.82E-08	7.81E-10	3.04E-08	1.88E-09	1.82E-08	9.48E-11	3.80E-07	1.88E-08
Vinyl Chloride	3.00E-02	6.98E-08	4.88E-09	1.27E-08	9.18E-09	2.84E-08	1.83E-08	1.83E-09	1.10E-08	3.18E-07	2.29E-07
Total PCBs	1.40E-01	1.44E-08	3.89E-09	2.89E-07	8.77E-07	8.77E-07	1.18E-08	3.48E-08	6.93E-08	7.22E-08	1.44E-08
Noncarcinogenic Risk											
COPC	Dermal Adsorp. Factors (ABS)	On-site Worker		Mower		Landscape Worker		Construction Worker		Industrial / Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Antimony	1.00E-02	1.86E-07	3.90E-04	3.12E-08	7.80E-08	6.24E-08	1.88E-04	3.78E-09	9.39E-08	7.80E-07	1.88E-03
Arsenic	3.00E-02	6.84E-07	2.18E-03	1.32E-07	4.38E-04	2.89E-07	8.77E-04	1.88E-08	8.29E-08	3.29E-08	1.10E-03
Beryllium	1.00E-02	1.08E-08	8.28E-08	2.11E-09	1.08E-09	4.29E-09	2.11E-09	2.84E-10	1.87E-07	5.28E-08	2.84E-08
Chromium	1.00E-02	1.81E-08	1.27E-08	3.82E-07	2.84E-07	7.69E-07	8.09E-07	4.88E-08	3.08E-08	6.84E-08	8.38E-08
Manganese	1.00E-02	2.73E-08	5.93E-04	5.48E-08	1.19E-04	1.09E-08	2.37E-04	6.88E-07	1.42E-08	1.38E-04	2.97E-03
Bis(2-ethylhexyl)phthalate	1.00E-01	9.82E-08	1.23E-05	1.89E-08	2.48E-08	3.93E-08	4.81E-08	2.98E-07	2.86E-07	4.91E-08	6.14E-08
Chlorobenzene	3.00E-02	3.08E-07	1.84E-06	6.18E-08	3.08E-08	1.23E-07	6.18E-08	7.39E-09	3.99E-07	1.54E-08	7.70E-08
Chloroform	3.00E-02	1.38E-07	1.38E-06	2.71E-08	2.71E-08	5.41E-08	5.41E-08	3.25E-09	3.25E-07	6.77E-07	6.77E-08
Ethylbenzene	3.00E-02	4.80E-08	4.80E-08	9.20E-07	9.20E-08	1.84E-08	1.84E-08	1.10E-07	1.10E-08	2.30E-08	2.30E-04
Tetrachloroethane	3.00E-02	2.13E-07	2.13E-06	4.28E-08	4.28E-08	8.52E-08	8.52E-08	5.11E-09	5.11E-07	1.08E-08	1.08E-04
Toluene	3.00E-02	7.35E-07	3.67E-06	1.47E-07	7.35E-07	2.84E-07	1.47E-08	1.78E-08	8.82E-08	3.67E-08	1.84E-05
Vinyl Chloride	3.00E-02	1.78E-07	5.93E-06	3.88E-08	1.19E-05	7.12E-08	2.37E-08	4.27E-09	1.42E-08	8.90E-07	2.87E-04
Xylenes	3.00E-02	3.68E-08	1.84E-06	7.38E-08	3.68E-08	1.47E-08	7.38E-08	8.83E-07	4.42E-07	1.84E-04	9.20E-08
Summary											
		On-site Worker		Mower		Landscape Worker		Construction Worker		Industrial / Commercial Worker	
ELCR for this pathways		3.30E-06		6.80E-07		1.22E-06		7.82E-08		1.68E-08	
HI for this pathways		3.37E-03		6.74E-04		1.36E-03		8.09E-05		1.69E-03	
<b>Notes:</b>											
ELCR: Excess lifetime cancer risks											
HI: Hazard Index											
COPC: Contaminants of potential concern											
LADD: Lifetime average daily dose											
ADD: Average daily dose											
HQ: Hazard quotient											
Bold shaded area indicated ELCR or HI exceedances for the receptor											

**Table B-7.  
DERMAL EXPOSURE EVALUATION FOR SURFACE WATER  
FOR LAKE CALUMET CLUSTER SITE: USDRUM**

Carcinogenic Risk							
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		LADD	ELCR	LADD	ELCR	LADD	ELCR
4,4'-DDD	2.80E-01	1.94E-09	4.85E-10	7.75E-11	1.86E-11	1.94E-09	4.85E-10
4,4'-DDE	2.40E-01	5.54E-10	1.88E-10	2.21E-11	7.53E-12	5.54E-10	1.88E-10
Heptachlor	1.10E-02	5.07E-11	2.28E-10	2.03E-12	9.19E-12	5.07E-11	2.28E-10

Noncarcinogenic Risk							
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ
Barium	1.00E-03	4.94E-07	7.06E-06	7.21E-06	1.03E-04	9.88E-08	1.41E-06
Manganese	1.00E-03	4.68E-07	1.02E-05	6.84E-06	1.49E-04	9.36E-08	2.04E-06
Endrin	1.80E-02	1.03E-09	3.44E-06	1.51E-08	5.03E-05	2.07E-10	6.89E-07
Heptachlor	1.10E-02	7.10E-10	1.42E-06	1.04E-08	2.07E-05	1.42E-10	2.84E-07

Summary				
		On-site Worker	Construction Worker	Industrial / Commercial Worker
ELCR for this pathway=		8.82E-10	3.53E-11	8.82E-10
HI for this pathway=		2.21E-05	3.23E-04	4.42E-06

**Notes:**

- ELCR: Excess lifetime cancer risks
- HI: Hazard Index
- COPC: Contaminants of potential concern
- LADD: Lifetime average daily dose
- ADD: Average daily dose
- HQ: Hazard quotient

**Table B-8.  
DERMAL EXPOSURE EVALUATION FOR GROUNDWATER  
FOR LAKE CALUMET CLUSTER SITE: USDRUM**

Carcinogenic Risk							
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		LADD	ELCR	LADD	ELCR	LADD	ELCR
Arsenic	1.00E-03	1.20E-08	1.80E-08	4.80E-10	7.20E-10	1.20E-08	1.80E-08
Beryllium	1.00E-03	1.15E-09	0.00E+00	4.81E-11	0.00E+00	1.15E-09	0.00E+00
Benzene	2.10E-02	3.49E-07	1.92E-08	1.39E-08	7.67E-10	3.49E-07	1.92E-08
Indeno(1,2,3-cd)pyrene	1.90E+00	4.38E-07	3.20E-07	1.75E-08	1.26E-08	4.38E-07	3.20E-07

Noncarcinogenic Risk							
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ
Antimony	1.00E-03	5.17E-07	1.29E-03	7.54E-08	1.69E-02	1.03E-07	2.58E-04
Arsenic	1.00E-03	1.68E-07	5.60E-04	2.48E-08	8.17E-03	3.36E-08	1.12E-04
Barium	1.00E-03	6.17E-08	1.17E-04	1.19E-04	1.70E-03	1.63E-08	2.33E-05
Beryllium	1.00E-03	1.61E-08	6.07E-06	2.36E-07	1.18E-04	3.23E-09	1.61E-08
Cadmium	1.00E-03	3.55E-08	7.10E-05	5.19E-07	1.04E-03	7.10E-09	1.42E-05
Chromium	1.00E-03	9.30E-07	6.20E-07	1.38E-08	9.06E-09	1.66E-07	1.24E-07
Manganese	1.00E-03	2.75E-06	5.98E-04	4.02E-04	6.73E-03	5.50E-08	1.20E-04
Mercury	1.00E-03	9.04E-09		1.32E-07		1.81E-09	
Nickel	1.00E-03	3.58E-07	1.79E-05	5.23E-08	2.62E-04	7.17E-08	3.58E-06
Vanadium	1.00E-03	6.20E-07	3.10E-05	9.06E-08	4.53E-04	1.24E-07	6.20E-06

Summary			
	On-site Worker	Construction Worker	Industrial / Commercial Worker
ELCR for this pathway=	3.57E-07	1.43E-08	3.57E-07
HI for this pathway=	2.69E-03	3.93E-02	5.39E-04

Notes:  
 ELCR: Excess lifetime cancer risks  
 HI: Hazard Index  
 COPC: Contaminants of potential concern  
 LADD: Lifetime average daily dose  
 ADD: Average daily dose  
 HQ: Hazard quotient



**Table B-9.**  
**PARTICULATE INHALATION EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER**  
**SITE: USDRUM**

<b>Carcinogenic Risk</b>					
	<b>LADD=EPCa x ER x IR x EF x ED / (BW x ATc)</b>				
	EPCa=exposure point concentration in air (ug/m3) = EPC x PIF				
	ER=exposure rate (hrs/day)				
	IR=inhalation rate (m3/hour)				
	EF=exposure frequency (days/year)				
	ED=exposure duration (years)				
	BW=body weight (kg)				
	ATc=averaging time for carcinogens (days)				
	PIF= Particulate Inhalation factor				
	ELCR=LADD x SFI				
	SFI=inhalation cancer slope factor (kg-day/mg)				
	LADD=lifetime average daily dose (mg/kg-day)				
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Workers</b>	<b>Mower</b>	<b>Landscape Worker</b>
IR (m3/hour)	1.1	2.8	1.1	1.7	1.1
ER (hr/day)	5	8	8	8	8
EF (days/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
Atc (days)	25550	25550	25550	25550	25550
Particulate Inhalation factor	8.00E-10	8.00E-09	8.00E-10	8.00E-09	8.00E-10
Conversion from ug to mg	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
<b>Noncarcinogenic Risk</b>					
	<b>ADD=EPCa x ER x IR x EF x ED / (BW x ATn)</b>				
	EPCa=exposure point concentration in air (ug/m3)				
	ER=exposure rate (hrs/day)				
	IR=inhalation rate (m3/hr)				
	EF=exposure frequency (days/year)				
	ED=exposure duration (years)				
	BW=body weight (kg)				
	ATn=averaging time for noncarcinogens (days)				
	HQ=ADD/RfDI				
	ADD=average daily dose (mg/kg-day)				
	RfDI=inhalation reference dose (mg/kg-day)				
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Workers</b>	<b>Mower</b>	<b>Landscape Worker</b>
IR (m3/hour)	1.1	2.8	1.1	1.7	1.1
ER (hr/day)	5	8	8	8	8
EF (days/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
Atn (days)	9125	9125	9125	9125	40
Particulate Inhalation factor	8.00E-10	8.00E-09	8.00E-10	8.00E-10	8.00E-10

**Table B-10.**  
**PARTICULATE EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE: USDRUM**

COPC	Carcinogenic Risk									
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR
Arsenic	8.22E-11	0.00E+00	8.10E-11	0.00E+00	4.18E-10	0.00E+00	2.58E-10	0.00E+00	3.34E-11	0.00E+00
Beryllium	2.52E-12	0.00E+00	2.46E-12	0.00E+00	2.01E-11	0.00E+00	1.84E-11	0.00E+00	1.61E-12	0.00E+00
Benzene	7.42E-12	2.15E-13	7.25E-12	2.10E-13	5.93E-11	1.72E-12	3.67E-11	1.09E-12	4.75E-12	1.38E-13
Benzo(a)anthracene	3.55E-11	1.10E-11	3.47E-11	1.08E-11	2.84E-10	8.80E-11	1.76E-10	5.44E-11	2.27E-11	7.04E-12
Benzo(b)fluoranthene	4.06E-11	1.27E-11	4.00E-11	1.24E-11	3.27E-10	1.01E-10	2.02E-10	6.27E-11	2.62E-11	8.11E-12
Benzo(a)pyrene	3.78E-11	1.17E-10	3.69E-11	1.14E-10	3.01E-10	9.33E-10	1.88E-10	5.77E-10	2.41E-11	7.47E-11
Chloroform	1.07E-11	8.70E-13	1.05E-11	8.51E-13	6.59E-11	6.98E-12	5.31E-11	4.30E-12	6.88E-12	5.57E-13
Dibenz(a,h)anthracene	2.89E-11	8.97E-11	2.83E-11	8.77E-11	2.32E-10	7.18E-10	1.43E-10	4.44E-10	1.85E-11	5.74E-11
1,2-Dichloroethane	1.61E-11	0.00E+00	1.58E-11	0.00E+00	1.29E-10	0.00E+00	7.98E-11	0.00E+00	1.03E-11	0.00E+00
Indeno(1,2,3-cd)pyrene	3.85E-11	1.13E-11	3.57E-11	1.11E-11	2.92E-10	9.05E-11	1.80E-10	5.59E-11	2.33E-11	7.24E-12
Tetrachloroethene	1.69E-11	3.38E-14	1.65E-11	3.30E-14	1.35E-10	2.70E-13	6.36E-11	1.67E-13	1.08E-11	2.16E-14
Vinyl Chloride	1.41E-11	2.28E-13	1.38E-11	2.21E-13	1.13E-10	1.51E-12	6.99E-11	1.12E-12	9.04E-12	1.45E-13
Total PCBs	6.57E-11	1.37E-10	6.72E-11	1.34E-10	5.50E-10	1.10E-09	3.40E-10	6.60E-10	4.40E-11	6.60E-11
COPC	Noncarcinogenic Risk									
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Antimony	1.04E-10		1.02E-10		8.32E-10		5.14E-11		1.52E-08	
Arsenic	1.48E-10		1.43E-10		1.17E-09		7.23E-11		2.13E-08	
Beryllium	7.04E-12	1.23E-08	6.89E-12	1.21E-08	5.64E-11	9.57E-08	3.48E-12	6.10E-07	1.03E-09	1.80E-04
Chromium	1.27E-09		1.24E-09		1.02E-08		6.29E-10		1.86E-07	
Manganese	1.82E-08	1.27E-03	1.78E-08	1.24E-03	1.46E-07	1.02E-02	9.00E-09	6.29E-04	2.66E-08	1.86E-01
Bis(2-ethoxy)phthalate	6.55E-10		6.40E-10		5.24E-09		3.24E-10		9.55E-08	
Chlorobenzene	6.84E-11	1.20E-08	6.69E-11	1.17E-08	5.47E-10	9.59E-08	3.38E-11	5.83E-09	9.99E-09	1.75E-08
Chloroform	3.01E-11		2.94E-11		2.41E-10		1.49E-11		4.39E-09	
Ethylbenzene	1.02E-09	3.58E-09	9.99E-10	3.49E-09	6.18E-09	2.86E-08	5.08E-10	1.77E-09	1.49E-07	5.22E-07
Tetrachloroethene	4.73E-11		4.62E-11		3.79E-10		2.34E-11		6.91E-09	
Toluene	1.63E-10	1.43E-09	1.60E-10	1.40E-09	1.31E-09	1.15E-08	8.07E-11	7.08E-10	2.38E-08	2.09E-07
Vinyl Chloride	3.98E-11	1.38E-09	3.87E-11	1.33E-09	3.18E-10	1.09E-08	1.98E-11	6.75E-10	5.77E-09	1.98E-07
Xylenes	8.18E-09		8.00E-09		6.54E-08		4.05E-09		1.19E-08	
Summary										
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
ELCR for this pathway=	2.43E-10		2.37E-10		1.94E-09		1.20E-09		1.55E-10	
HI for this pathway=	1.27E-03		1.24E-03		1.02E-02		6.30E-04		1.66E-01	
Notes:										
ELCR: Excess lifetime cancer risks										
HI: Hazard index										
COPC: Contaminants of potential concern										
LADD: Lifetime average daily dose										
ADD: Average daily dose										
HQ: Hazard quotient										

**Table B-11.  
GROUNDWATER VOLATILE INHALATION EXPOSURE FACTORS FOR LAKE CALUMET  
CLUSTER SITE: USDRUM**

**Carcinogenic Risk**

$$LADD = (EPC \times IR \times EF \times ED) / (BW \times ATc \times CF)$$

EPC = exposure point concentration in air (g/m<sup>3</sup>)

IR = inhalation rate (m<sup>3</sup>/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

BW = body weight (kg)

ATc = averaging time for carcinogens (day)

CF = Conversion Factor

$$ELCR = LADD \times SFI$$

SFI = Inhalation Slope Factor (kg-day/mg)

LADD = lifetime average daily dose (mg/kg-day)

Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ED (years)	25	1	25	25	25
EF (days/year)	5	5	5		
ATc (days)	25550	25550	25550		
IR (m <sup>3</sup> /day)	20	20	20	20	20
BW (kg)	70	70	70	70	70
CF (mg-g)	0.001	0.001	0.001	0.001	0.001

**Noncarcinogenic Risk**

$$ADD = EPC \times IR \times EF \times ED / (BW \times ATn)$$

EPC = exposure point concentration in air (g/m<sup>3</sup>)

IR = inhalation rate (m<sup>3</sup>/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

ATn = average time for noncarcinogens (years)

Conversion Factor = 1000

$$HQ = ADD / Rfd$$

ADD = average daily dose

Rfd = Volatile Inhalation Reference Dose (mg/kg-day)

Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ED (years)	25	1	25	25	25
EF (days/year)	5	5	5		
ATn (days)	9125	40	9125		
IR (m <sup>3</sup> /day)	20	20	20	20	20
BW (kg)	70	70	70	70	70
CF	0.001	0.001	0.001	0.001	0.001

**Table B-12.  
GROUNDWATER VOLATILE INHALATION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE:  
USDRUM**

<b>Carcinogenic Risk</b>							
<b>COPC</b>	<b>Henry's Law Constant</b>	<b>On-site Worker</b>		<b>Construction Worker</b>		<b>Industrial / Commercial Worker</b>	
		<b>LADD</b>	<b>ELCR</b>	<b>LADD</b>	<b>ELCR</b>	<b>LADD</b>	<b>ELCR</b>
<b>Benzene</b>	<b>2.28E-01</b>	<b>1.65E-09</b>	<b>4.77E-11</b>	<b>6.58E-11</b>	<b>1.91E-12</b>	<b>1.65E-09</b>	<b>4.77E-11</b>
<b>Noncarcinogenic Risk</b>							
<b>COPC</b>	<b>Henry's Law Constant</b>	<b>On-site Worker</b>		<b>Construction Worker</b>		<b>Industrial / Commercial Worker</b>	
		<b>ADD</b>	<b>HQ</b>	<b>ADD</b>	<b>HQ</b>	<b>ADD</b>	<b>HQ</b>
<b>Summary</b>							
		<b>On-site Worker</b>		<b>Construction Worker</b>		<b>Industrial / Commercial Worker</b>	
<b>ELCR for this pathway=</b>		<b>4.77E-11</b>		<b>1.91E-12</b>		<b>4.77E-11</b>	
<b>HI for this pathway=</b>		<b>0.00E+00</b>		<b>0.00E+00</b>		<b>0.00E+00</b>	

**Notes:**

- ELCR: Excess lifetime cancer risks**
- HI: Hazard index**
- COPC: Contaminants of potential concern**
- LADD: Lifetime average daily dose**
- ADD: Average daily dose**
- HQ: Hazard quotient**

**Table B-13.**  
**SOIL VOLATILE INHALATION EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE: USDRUM**

**Carcinogenic Risk**

$$LADD = (EPC \times ER \times IR \times EF \times ED) / (VF \times BW \times ATc)$$

- EPC = Exposure Point Concentration (ug/kg)
- ER = Exposure Rate (hours/day)
- IR = Inhalation Rate (m<sup>3</sup>/hr)
- EF = Exposure Frequency (days/year)
- ED = Exposure Duration (years)
- VF = Volatilization Factor (m<sup>3</sup>/kg)
- BW = Body Weight (kg)
- ATc = Averaging Time for Carcinogens (day)

$$VF = Q/C \times ((3.14 \times D \times T)^{0.5} / (2 \times R_0 \times D)) \times CF$$

- Q/C = Inverse of the mean concentration at the center of a square source = (g/m<sup>2</sup>-s)/(kg/m<sup>3</sup>)
- D = Apparent Diffusivity (cm<sup>2</sup>/s)
- T = Exposure Interval (s)
- R<sub>0</sub> = Dry Soil Bulk Density = g/cm<sup>3</sup>
- CF = Conversion factor (10 E-4 m<sup>2</sup>/cm<sup>2</sup>)

$$D = (D_a^{0.5} \times D_s \times H') + (D_w^{0.5} \times D_w / n^2) \times (1 / ((\rho_s \times K_d) + O_w + (O_s \times H')))$$

- O<sub>a</sub> = Air-Filled Soil Porosity 0.13 For Subsurface Soil
- D<sub>a</sub> = Diffusivity in Air (cm<sup>2</sup>/s) Chemical Specific
- H' = Henry's Law Constant Chemical Specific
- O<sub>w</sub> = Water-Filled Soil Porosity 0.3 For Subsurface Soil
- D<sub>w</sub> = Diffusivity in Water (cm<sup>2</sup>/s) Chemical Specific
- n = Total Soil Porosity 0.43
- ρ<sub>s</sub> = Dry Soil Bulk Density (g/cm<sup>3</sup>) 1.5
- K<sub>d</sub> = Soil Water Partition Coeff = K<sub>oc</sub> × f<sub>oc</sub>
- K<sub>oc</sub> Chemical Specific
- f<sub>oc</sub> 0.002

$$ELCR = LADD \times URF$$

- URF = Inhalation Unit Risk (m<sup>3</sup>/ug)
- LADD = lifetime average daily dose (ug/m<sup>3</sup>)

Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscaper Worker
ED (years)	25	1	25	25	25
EF (days/year)	50	30	250	10	20
ATn (days)	9125	40	9125	9125	40
ATc (days)	25550	25550	25550	25550	25550
IR (m <sup>3</sup> /hr)	1.1	2.8	1.1	1.7	1.1
ER (hr/day)	1	8	8	8	4
BW (kg)	70	70	70	70	70

**Noncarcinogenic Risk**

$$ADD = EPC \times ER \times IR \times EF \times ED / (ATn \times VF \times BW)$$

- EPC = exposure point concentration (ug/kg)
- ER = exposure rate (hours/day)
- IR = Inhalation rate (m<sup>3</sup>/hr)
- EF = exposure frequency (days/year)
- ED = exposure duration (years)
- ATn = average time for noncarcinogens (years)
- VF = Volatilization Factor (m<sup>3</sup>/kg)
- Conversion Factor = 1000

$$HC = ADD / Rfc$$

- ADD = average daily dose (m<sup>3</sup>/ug)
- Rfc = Volatile Inhalation Reference Dose (ug/m<sup>3</sup>)

**Table B-14.**  
**SOIL VOLATILE INHALATION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE: USDRUM**

COPC	QC	DI	H'	Dw	Koc	Kd	D	T	Ro	VF	T <sub>construction</sub>	VF <sub>construction</sub>
	g/eq.m/kg/cu.m)	(sq.cm/sec)		(sq.cm/sec)	cm <sup>3</sup> /g	cu.cm/g	(sq.cm/sec)	Sec	g/cu.cm	cu.m/kg	Sec	cu.m/kg
Benzene	8.58E+01	8.80E-02	2.28E-01	9.80E-08	6.89E+01	1.18E-01	2.42E-04	7.90E+08	1.80E+00	9.18E+03	3.60E+06	6.18E+02
1,2-Dichloroethane	8.58E+01	1.04E-01	4.01E-02	9.80E-08	1.74E+01	3.48E-02	7.34E-05	7.90E+08	1.80E+00	1.86E+04	3.60E+06	1.12E+03
Tetrachloroethane	8.58E+01	7.20E-02	7.54E-01	8.20E-08	1.55E+02	3.10E-01	3.82E-04	7.90E+08	1.80E+00	7.29E+03	3.60E+06	4.82E+02
Vinyl Chloride	8.58E+01	1.06E-01	1.11E+00	1.23E-08	1.88E+01	3.72E-02	1.43E-03	7.90E+08	1.80E+00	3.77E+03	3.60E+06	2.55E+02
Chlorobenzene	8.58E+01	7.30E-02	1.52E-01	8.70E-08	2.19E+02	4.38E-01	6.97E-05	7.90E+08	1.80E+00	1.71E+04	3.60E+06	1.18E+03
Ethylbenzene	8.58E+01	7.50E-02	3.23E-01	7.80E-08	3.63E+02	7.26E-01	1.03E-04	7.90E+08	1.80E+00	1.40E+04	3.60E+06	9.47E+02
Toluene	8.58E+01	8.70E-02	2.72E-01	8.60E-08	1.82E+02	3.64E-01	1.64E-04	7.90E+08	1.80E+00	1.11E+04	3.60E+06	7.52E+02
Xylenes	8.58E+01	7.14E-02	2.18E-01	9.34E-08	3.74E+02	7.48E-01	6.48E-05	7.90E+08	1.80E+00	1.77E+04	3.60E+06	1.19E+03

COPC	Carcinogenic Risk									
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR
Benzene	2.02E-04	1.68E-09	1.47E-03	1.21E-08	8.10E-03	6.71E-08	5.01E-04	4.15E-09	3.24E-04	2.68E-09
1,2-Dichloroethane	2.43E-04	0.00E+00	1.76E-03	0.00E+00	9.71E-03	0.00E+00	6.00E-04	0.00E+00	3.88E-04	0.00E+00
Tetrachloroethane	5.80E-04	3.31E-10	4.20E-03	2.40E-09	2.32E-02	1.33E-06	1.43E-03	8.19E-10	9.28E-04	5.30E-10
Vinyl Chloride	9.39E-04	4.28E-09	6.78E-03	3.10E-08	3.74E-02	1.71E-07	2.31E-03	1.06E-08	1.50E-03	6.65E-09

COPC	Noncarcinogenic Risk									
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Tetrachloroethane	1.82E-03		2.68E+00		6.49E-02		4.01E-03		5.92E-01	
Vinyl Chloride	2.82E-03	2.58E-05	4.33E+00	4.27E-02	1.05E-01	1.03E-03	6.48E-03	6.39E-05	9.57E-01	9.43E-03
Chlorobenzene	1.00E-03	5.02E-05	1.66E+00	6.28E-02	4.01E-02	2.01E-03	2.48E-03	1.24E-04	3.66E-01	1.83E-02
Ethylbenzene	1.82E-02	1.82E-05	3.01E+01	3.01E-02	7.29E-01	7.28E-04	4.51E-02	4.50E-05	6.65E+00	6.64E-03
Toluene	3.69E-03	9.19E-06	6.05E+00	1.52E-02	1.47E-01	3.67E-04	9.06E-03	2.27E-05	1.34E+00	3.35E-03
Xylenes	1.18E-01		1.91E+02		4.82E+00		2.86E-01		4.22E+01	

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ELCR for this pathway	4.61E-09	3.34E-08	1.84E-07	1.14E-08	7.38E-09
HI for this pathway	1.03E-04	1.71E-01	4.13E-03	2.56E-04	3.77E-02

**Table B-14.**  
**SOIL VOLATILE INHALATION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE: USDRUM**

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard index

COPC: Contaminants of potential concern

LADD: Lifetime average daily dose

ADD: Average daily dose

HQ: Hazard quotient

**Table B-15.**

**SUMMARY OF HUMAN HEALTH RISK ASSESSMENT FOR LAKE CALUMET CLUSTER SITE: USDRUM**

**Summary of Human Risk Assessment for Soil, Sediment, Surface water and Groundwater**

	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>
<b>Total ELCR</b>	<b>1.E-05</b>	<b>3.E-05</b>	<b>5.E-05</b>	<b>3.E-05</b>	<b>4.E-05</b>
<b>Total HI</b>	<b>1.E-02</b>	<b>9.E-01</b>	<b>7.E-02</b>	<b>3.E-02</b>	<b>2.E-01</b>

**Summary of Human Risk Assessment for Soil, Sediment and Surface water**

	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>
<b>Total ELCR</b>	<b>1.E-05</b>	<b>3.E-05</b>	<b>5.E-05</b>	<b>3.E-05</b>	<b>4.E-05</b>
<b>Total HI</b>	<b>1.E-02</b>	<b>9.E-01</b>	<b>6.E-02</b>	<b>3.E-02</b>	<b>2.E-01</b>

**Summary of Human Risk Assessment for Soil**

	<b>On-site Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>
<b>Total ELCR</b>	<b>1.E-05</b>	<b>3.E-05</b>	<b>5.E-05</b>	<b>3.E-05</b>	<b>4.E-05</b>
<b>Total HI</b>	<b>1.E-02</b>	<b>9.E-01</b>	<b>6.E-02</b>	<b>3.E-02</b>	<b>2.E-01</b>



**Table B-15.**  
**SUMMARY OF HUMAN HEALTH RISK ASSESSMENT FOR LAKE CALUMET CLUSTER SITE: USDRUM**

**Summary of Human Risk Assessment for Groundwater**

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
Total ELCR	4.E-07	1.E-08	4.E-07		
Total HI	3.E-03	4.E-02	5.E-04		

**Summary of Human Risk Assessment for Surface water**

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
Total ELCR	9.E-10	4.E-11	9.E-10		
Total HI	2.E-05	3.E-04	4.E-06		

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard Index

Bold shaded area indicated ELCR or HI exceedances for the receptor

**Table B-16.**  
**EXCEEDANCES SUMMARY OF CHEMICAL OF POTENTIAL CONCERN**  
**FOR LAKE CALUMET CLUSTER SITE: USDRUM**

**COPCs of Carcinogenic Risk In Soil**

<b>COPC</b>	<b>Receptors</b>
Arsenic	Industrial/Commercial Worker, Mower
Benzo(a)pyrene	On-site Worker, Industrial/Commercial Worker, Mower
Dibenz(a,h)anthracene	On-site Worker, Industrial/Commercial Worker, Mower
Total PCBs	On-site Worker, Industrial/Commercial Worker, Mower, Landscape worker

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard Index

Carcinogenic exceedances: ELCR is greater than 1.00E-06

Noncarcinogenic exceedances: HI is greater than 1.00E+00

Table C-1.

TOXICITY FACTORS FOR CHEMICALS OF POTENTIAL CONCERN FOR LAKE CALUMET CLUSTER SITE: UNNAMED PARCEL

Carcinogenic Risk									
COPC	Ingestion Slope	EPC for Soil	EPC for Sediment	EPC for SW	EPC for GW	EPC for GW In air	Particulate	Dermal Slope	Volatile (URF)
	Factor						Inhalation Slope	Factor	Inhalation Risk Factor
	(kg-day/mg)	(ug/kg)	(ug/kg)	(ug/L)	(ug/L)	(g/m)	(kg-day/mg)	(kg-day/mg)	(m <sup>3</sup> /ug)
Arsenic	1.50E+00	2.33E+04			7.27E+01			1.50E+00	0.00E+00
Beryllium		1.22E+03						0.00E+00	0.00E+00
Benzene	5.50E-02				5.20E+01	3.73E-09	2.90E-02	5.50E-02	8.29E-06
Benzo(a)anthracene	7.30E-01	4.54E+03			2.00E+00		3.10E-01	7.30E-01	8.86E-05
Benzo(b)fluoranthene	7.30E-01	5.73E+03			2.00E+00		3.10E-01	7.30E-01	8.86E-05
Benzo(k)fluoranthene	7.30E-02	3.91E+03			1.00E+00		3.10E-02	7.30E-02	8.86E-06
Benzo(a)pyrene	7.30E+00	4.24E+03			2.00E+00		3.10E+00	7.30E+00	8.86E-04
Chrysene	7.30E-03				2.00E+00		3.10E-03	7.30E-03	8.86E-07
Dibenz(a,h)anthracene	7.30E+00	1.50E+03			0.00E+00		3.10E+00	7.30E+00	8.86E-04
1,2-Dibromo-3-Chloropropane	1.40E+00	1.49E+03					2.40E-03	1.40E+00	8.86E-07
1,2-Dichloroethane	9.10E-02	1.16E+03						9.10E-02	0.00E+00
Indeno(1,2,3-cd)pyrene	7.30E-01	2.47E+03			6.00E-01		3.10E-01	7.30E-01	8.86E-05
alpha-BHC	6.30E+00	2.42E+01					6.30E+00	6.30E+00	1.80E-03
Heptachlor	4.50E+00	1.72E+01					4.50E+00	4.50E+00	1.29E-03
Methylene chloride	7.50E-03	1.11E+03					1.65E-03	7.50E-03	4.71E-07
Trichloroethene	1.10E-02	8.77E+02					6.00E-03	1.10E-02	1.71E-06
Total PCBs	2.00E+00	2.69E+03					2.00E+00	2.00E+00	5.71E-04
Noncarcinogenic Risk									
COPC	Ingestion	EPC for Soil	EPC for Sediment	EPC for SW	EPC for GW	EPC for GW In air	Inhalation	Dermal	Volatile Inhalation Ref.
	Reference Dose						Reference Dose	Reference Dose	
	(mg/kg-day)	(ug/kg)	(ug/kg)	(ug/L)	(ug/L)	(g/m)	(mg/kg-day)	(mg/kg-day)	(ug/m <sup>3</sup> )
Arsenic	3.00E-04	2.33E+04			7.27E+01			3.00E-04	0.00E+00
Beryllium	2.00E-03	1.22E+03					5.71E-06	2.00E-03	2.00E-02
Cadmium	5.00E-04				1.48E+02			5.00E-04	0.00E+00
Chromium	1.50E+00	2.05E+05			2.99E+02			1.50E+00	0.00E+00
Manganese	4.60E-02	1.49E+06			2.29E+03		1.43E-05	4.60E-02	5.01E-02
Mercury					9.30E+00		8.60E-05	0.00E+00	3.01E-01
Nickel	2.00E-02				2.48E+02			2.00E-02	0.00E+00
Vanadium	2.00E-02				9.77E+01			2.00E-02	0.00E+00
Zinc	3.00E-01				1.02E+04			3.00E-01	0.00E+00
Bis(2-ethylhexyl)phthalate	8.00E-01				4.20E+01			8.00E-01	0.00E+00
Chlorobenzene	2.00E-02	5.59E+03					5.71E-03	2.00E-02	2.00E+01
1,1-Dichloroethane	1.00E-01	1.10E+03					1.43E-01	1.00E-01	5.01E+02
Ethylbenzene	1.00E-01	3.47E+03					2.88E-01	1.00E-01	1.00E+03
Heptachlor	5.00E-04	1.72E+01						5.00E-04	0.00E+00
Methylene chloride	6.00E-02	1.11E+03					8.57E-01	6.00E-02	3.00E+03
Toluene	2.00E-01	7.21E+03					1.14E-01	2.00E-01	3.99E+02
Trichloroethene	1.10E-02	8.77E+02					6.00E-03	1.10E-02	2.10E+01
1,1,1-Trichloroethane	2.00E-02	7.07E+03					6.29E-01	2.00E-02	2.20E+03
Xylenes	2.00E+00	1.98E+04						2.00E+00	0.00E+00

Note:  
 COPC: Contaminants of potential concern  
 EPC: Exposure point concentration

**Table C-2.  
SOIL INGESTION EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

<b>Carcinogenic Risk</b>					
$LADD = EPC \times FI \times IRS \times EF \times ED \times CF / (BW \times ATc)$					
EPC=exposure point concentration (ug/kg)					
FI=fraction ingested from contaminated source					
IRS=soil ingestion rate (mg/day)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
CF=conversion factor 10 <sup>-6</sup> kg/ug					
BW=body weight (kg)					
ATc=averaging time for carcinogens (days)					
ELCR=LADDxSf					
Sf=oral cancer slope factor (kg-day/mg)					
LADD=lifetime average daily dose (mg/kg-day)					
Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
IRS (mg/day)	50	480	50	480	50
FI	0.5	1	0.5	1	0.5
EF (day/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
Atc (days)	25550	25550	25550	25550	25550
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09
<b>Noncarcinogenic Risk</b>					
$ADD = EPC \times FI \times IRS \times EF \times ED \times CF / (BW \times ATn)$					
EPC=exposure point concentration (ug/kg)					
FI=fraction ingested from contaminated source					
IRS=soil ingestion rate (mg/day)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
BW=body weight (kg)					
ATn=averaging time for noncarcinogens (days)					
HQ=ADD/RfDo					
ADD=average daily dose (mg/kg-day)					
RfDo=injection reference dose (mg/kg-day)					
Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
IRS (mg/day)	50	480	50	480	50
FI	0.5	1	0.5	1	0.5
EF (day/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
ATn (days)	9125	40	9125	9125	9125
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09

**Table C-3.  
SOIL INGESTION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE: UNNAMED PARCEL**

<b>Carcinogenic Risk</b>										
<b>COPC</b>	<b>On-site Worker</b>		<b>Construction Worker</b>		<b>Industrial / Commercial Worker</b>		<b>Mower</b>		<b>Landscape Worker</b>	
	<b>LADD</b>	<b>ELCR</b>	<b>LADD</b>	<b>ELCR</b>	<b>LADD</b>	<b>ELCR</b>	<b>LADD</b>	<b>ELCR</b>	<b>LADD</b>	<b>ELCR</b>
Arsenic	4.07E-07	6.11E-07	1.88E-07	2.82E-07	2.04E-08	3.06E-08	1.56E-08	2.35E-08	1.63E-07	2.44E-07
Beryllium	2.12E-08	0.00E+00	9.79E-09	0.00E+00	1.06E-07	0.00E+00	8.16E-08	0.00E+00	8.50E-09	0.00E+00
Benzo(a)anthracene	7.94E-08	5.79E-08	3.66E-08	2.67E-08	3.97E-07	2.90E-07	3.05E-07	2.23E-07	3.18E-08	2.32E-08
Benzo(b)fluoranthene	1.00E-07	7.31E-08	4.81E-08	3.37E-08	5.01E-07	3.65E-07	3.85E-07	2.81E-07	4.01E-08	2.92E-08
Benzo(k)fluoranthene	6.84E-08	4.99E-09	3.15E-08	2.30E-09	3.42E-07	2.50E-08	2.63E-07	1.92E-08	2.74E-08	2.00E-09
Benzo(a)pyrene	7.40E-08	5.40E-07	3.41E-08	2.49E-07	3.70E-07	2.70E-08	2.84E-07	2.07E-08	2.96E-08	2.16E-07
Dibenz(a,h)anthracene	2.62E-08	1.91E-07	1.21E-08	8.82E-08	1.31E-07	9.57E-07	1.01E-07	7.35E-07	1.05E-08	7.66E-08
1,2-Dibromo-3-Chloropropane	2.60E-08	3.64E-08	1.20E-08	1.68E-08	1.30E-07	1.82E-07	9.97E-08	1.40E-07	1.04E-08	1.45E-08
1,2-Dichloroethane	2.03E-08	1.85E-09	9.36E-09	8.52E-10	1.02E-07	9.24E-09	7.80E-08	7.10E-09	8.13E-09	7.39E-10
Indeno(1,2,3-cd)pyrene	4.32E-08	3.15E-08	1.99E-08	1.45E-08	2.16E-07	1.58E-07	1.66E-07	1.21E-07	1.73E-08	1.28E-08
alpha-BHC	4.23E-10	2.67E-09	1.95E-10	1.23E-09	2.12E-09	1.33E-08	1.63E-09	1.02E-08	1.69E-10	1.07E-09
Heptachlor	3.00E-10	1.35E-09	1.38E-10	6.22E-10	1.50E-09	6.74E-09	1.15E-09	5.18E-09	1.20E-10	5.40E-10
Methylene chloride	1.84E-08	1.48E-10	8.94E-09	6.71E-11	9.70E-08	7.26E-10	7.45E-08	5.59E-10	7.76E-09	5.82E-11
Trichloroethane	1.53E-08	1.69E-10	7.06E-09	7.78E-11	7.66E-08	8.43E-10	5.88E-08	6.47E-10	6.13E-09	6.74E-11
Total PCBs	4.70E-08	9.41E-08	2.17E-08	4.34E-08	2.35E-07	4.70E-07	1.81E-07	3.61E-07	1.88E-08	3.76E-08
<b>Noncarcinogenic Risk</b>										
<b>COPC</b>	<b>On-site Worker</b>		<b>Construction Worker</b>		<b>Industrial / Commercial Worker</b>		<b>Mower</b>		<b>Landscape Worker</b>	
	<b>ADD</b>	<b>HQ</b>	<b>ADD</b>	<b>HQ</b>	<b>ADD</b>	<b>HQ</b>	<b>ADD</b>	<b>HQ</b>	<b>ADD</b>	<b>HQ</b>
Arsenic	1.14E-08	3.80E-03	1.20E-04	4.00E-01	5.70E-06	1.90E-02	4.38E-06	1.48E-02	4.58E-07	1.52E-03
Beryllium	5.95E-08	2.97E-05	6.25E-06	3.13E-03	2.97E-07	1.49E-04	2.28E-07	1.14E-04	2.38E-08	1.19E-05
Chromium	1.00E-05	6.67E-08	1.05E-03	7.01E-04	5.00E-05	3.34E-05	3.84E-05	2.58E-05	4.00E-06	2.67E-06
Manganese	7.28E-05	1.58E-03	7.65E-03	1.66E-01	3.64E-04	7.91E-03	2.79E-04	6.08E-03	2.91E-05	6.33E-04
Chlorobenzene	2.73E-07	1.37E-05	2.87E-05	1.44E-03	1.37E-06	6.83E-05	1.05E-06	5.25E-05	1.09E-07	5.47E-06
1,1-Dichloroethane	5.38E-08	5.38E-07	5.66E-06	5.66E-05	2.69E-07	2.69E-06	2.07E-07	2.07E-06	2.15E-08	2.15E-07
Ethylbenzene	1.70E-07	1.70E-06	1.79E-05	1.79E-04	8.50E-07	8.50E-06	6.53E-07	6.53E-06	6.80E-08	6.80E-07
Heptachlor	8.39E-10	1.68E-06	8.82E-06	1.76E-04	4.20E-09	6.39E-06	3.22E-09	6.45E-06	3.39E-10	6.71E-07
Methylene chloride	5.43E-08	9.08E-07	5.71E-06	9.52E-05	2.72E-07	4.53E-06	2.09E-07	3.48E-06	2.17E-08	3.62E-07
Toluene	3.53E-07	1.78E-06	3.71E-05	1.85E-04	1.76E-06	8.82E-06	1.35E-06	6.77E-06	1.41E-07	7.06E-07
Trichloroethane	4.29E-08	3.90E-08	4.51E-06	4.10E-04	2.14E-07	1.95E-05	1.65E-07	1.50E-05	1.72E-08	1.56E-06
1,1,1-Trichloroethane	3.48E-07	1.73E-05	3.64E-05	1.82E-03	1.73E-06	6.65E-05	1.33E-06	6.64E-05	1.38E-07	6.92E-06
Xylenes	9.57E-07	4.78E-07	1.01E-04	5.03E-05	4.78E-06	2.39E-06	3.67E-06	1.84E-06	3.83E-07	1.91E-07
<b>Summary</b>										
	<b>On-site Worker</b>		<b>Construction Worker</b>		<b>Industrial / Commercial Worker</b>		<b>Mower</b>		<b>Landscape Worker</b>	
ELCR for this pathway	1.65E-06		7.59E-07		6.23E-06		6.32E-06		6.59E-07	
HI for this pathway	5.48E-03		5.74E-01		2.73E-02		2.10E-02		2.18E-03	
Notes:										
ELCR: Excess lifetime cancer risks										
HI: Hazard index										
COPC: Contaminants of potential concern										
LADD: Lifetime average daily dose										
ADD: Average daily dose										
HQ: Hazard quotient										
Bold shaded area indicated ELCR or HI exceedances for the receptor										

**Table C-4.  
SOIL DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

<b>Carcinogenic Risk</b>					
$LADD = EPC_{soil} \times SA \times AF \times ABS \times EF \times ED \times CF / (BW \times ATc)$					
EPC=exposure point concentration (ug/kg)					
SA=body surface area (cm <sup>2</sup> /day)					
AF=soil adherence factor (mg/cm <sup>2</sup> )					
ABS=dermal adsorption factor (unitless)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
CF=conversion factor (10 <sup>-9</sup> kg/ug)					
BW=body weight (kg)					
ATc=averaging time for carcinogens (days)					
ELCR=LADD x SFd					
SFd=dermal cancer slope factor (kg-day/mg)					
LADD=lifetime average daily dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> /day)	3300	3300	3300	3300	3300
AF (mg/cm <sup>2</sup> )	0.2	0.2	0.2	0.2	0.2
ABS	<b>Chemical Specific</b>				
Inorganics	0.01	0.01	0.01	0.01	0.01
Bis(2-ethylhexyl)phthalate	0.4	0.4	0.4	0.4	0.4
Tetrachloroethene	0.03	0.03	0.03	0.03	0.03
Trichloroethene	0.03	0.03	0.03	0.03	0.03
Vinyl chloride	0.03	0.03	0.03	0.03	0.03
Others	0	0	0	0	0
EF (day/year) for Soil	50	10	20	30	250
EF (day/year) for Sediment	5			5	5
ET (hour/day)	5	8	8	8	8
ED (years)	25	25	25	1	25
BW (kg)	70	70	70	70	70
Atc (days) - for Soil	25550	25550	25550	25550	25550
Atc (days) - for Sediment	25550			25550	25550
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09

**Table C-4.  
SOIL DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

<b>Noncarcinogenic Risk</b>					
<b>ADD=EPCxSAxAFxABSxEFxEDxCF/(BWxATn)-Soil and Sediment</b>					
EPC=exposure point concentration (ug/kg)					
SA=body surface area (cm <sup>2</sup> /day)					
AF=soil adherence factor (mg/cm <sup>2</sup> )					
ABS=dermal adsorption factor					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
CF=conversion factor 10 <sup>-9</sup> kg/mg					
BW=body weight (kg)					
ATn =averaging time for noncarcinogens (days)					
HQ=ADD/RfD <sub>o</sub>					
ADD-average daily dose (mg/kg-day)					
RfD <sub>o</sub> =dermal reference dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> /day)	3300	3300	3300	3300	3300
AF(mg/cm <sup>2</sup> )	0.2	0.2	0.2	0.2	0.2
ABS	<b>Chemical Specific</b>				
Inorganics	0.01	0.01	0.01	0.01	0.01
Bis(2-ethylhexyl)phthalate	0.4	0.4	0.4	0.4	0.4
Tetrachloroethene	0.03	0.03	0.03	0.03	0.03
Trichloroethene	0.03	0.03	0.03	0.03	0.03
Vinyl chloride	0.03	0.03	0.03	0.03	0.03
Others	0	0	0	0	0
EF (day/year) for Soil	50	10	20	30	250
EF (day/year) for Sediment	5			5	5
ET (hour/day)	5	8	8	8	8
ED (years)	25	25	25	1	25
BW (kg)	70	70	70	70	70
Atn (days) - for Soil	9125	9125	9125	9125	9125
Atn (days) - for Sediment	9125			40	9125
Conversion Factor (kg/ug)	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09

**Table C-5.  
WATER DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

Carcinogenic Risk					
	<b>LADD=EPCxSAxPCxETxEFxEDxCF/(BWxATc)</b>				
	EPC=exposure point concentration (ug/L)				
	SA = Skin surface area (cm <sup>2</sup> )				
	PC=Permeability Constant (cm/hr)				
	EF=exposure frequency (days/year)				
	ED=exposure duration (years)				
	CF=conversion factor 10 <sup>-6</sup> (L-mg/cm <sup>2</sup> -ug)				
	BW=body weight (kg)				
	ATc=averaging time for carcinogens (days)				
	ELCR=LADDx3Fd				
	SF=dermal cancer slope factor (kg-day/mg)				
	LADD=lifetime average daily dose (mg/kg-day)				
Exposure Factor	On-site Worker	Mower	Landscape Worker	Construction Worker	Industrial / Commercial Worker
SA (cm <sup>2</sup> )	3300	3300	3300	3300	3300
PC(cm/hr)	Chemical Specific				
Inorganic	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
Benzo(a)pyrene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Benzo(a)anthracene	8.00E-01	8.00E-01	8.00E-01	8.00E-01	8.00E-01
Benzo(b)fluoranthene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Dibenzo(a,h)anthracene	2.70E+00	2.70E+00	2.70E+00	2.70E+00	2.70E+00
Indeno(1,2,3-cd)pyrene	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00
Benzo(k)fluoranthene					
Chrysene	8.10E-01	8.10E-01	8.10E-01	8.10E-01	8.10E-01
Vinyl chloride	7.30E-03	7.30E-03	7.30E-03	7.30E-03	7.30E-03
bis(2-ethylhexyl)phthalate	3.30E-02	3.30E-02	3.30E-02	3.30E-02	3.30E-02
Tetrachloroethane	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02
Trichloroethane	1.80E-02	1.80E-02	1.80E-02	1.80E-02	1.80E-02
EF (day/year) for SW & GW	5			5	5
ET (hour/day)	1	1	1	1	1
ED (years)	25			1	25
BW (kg)	70	70	70	70	70
Atc (days) - for SW & GW	25550			25550	25550
Conversion Factor (L-mg/cm <sup>2</sup> -ug)	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06



**Table C-5.  
WATER DERMAL EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

<b>Noncarcinogenic Risk</b>					
<b>ADD=EPCxSAxPCxETxEFxEDxCF/(BWxATn)</b>					
EPC=exposure point concentration (ug/L)					
SA = Skin surface area (cm <sup>2</sup> )					
PC=Permeability Constant (cm/hr)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
CF=conversion factor 10 <sup>-6</sup> (L-mg/cm <sup>2</sup> -ug)					
CF=conversion factor 10 <sup>-6</sup> (L-mg/cm <sup>2</sup> -ug)					
BW=body weight (kg)					
ATn =averaging time for noncarcinogens (days)					
HQ=ADD/RfDo					
ADD-average daily dose (mg/kg-day)					
RfDd=dermal reference dose (mg/kg-day)					
<b>Exposure Factor</b>	<b>On-site Worker</b>	<b>Mower</b>	<b>Landscape Worker</b>	<b>Construction Worker</b>	<b>Industrial / Commercial Worker</b>
SA (cm <sup>2</sup> )	3300	3300	3300	3300	3300
PC (cm/hr)	<b>Chemical Specific</b>				
Inorganic	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
Benzo(a)pyrene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Benzo(a)anthracene	8.00E-01	8.00E-01	8.00E-01	8.00E-01	8.00E-01
Benzo(b)fluoranthene	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00
Dibenzo(a,h)anthracene	2.70E+00	2.70E+00	2.70E+00	2.70E+00	2.70E+00
Indeno(1,2,3-cd)pyrene	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00
Benzo(k)fluoranthene					
Chrysene	8.10E-01	8.10E-01	8.10E-01	8.10E-01	8.10E-01
Vinyl chloride	7.30E-03	7.30E-03	7.30E-03	7.30E-03	7.30E-03
bia(2-ethylhexyl)phthalate	3.30E-02	3.30E-02	3.30E-02	3.30E-02	3.30E-02
Tetrachloroethene	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02
Trichloroethene	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02
EF (day/year) for SW & GW	5			5	5
ET (hour/day)	1	1	1	1	1
ED (years)	25			1	25
BW (kg)	70	70	70	70	70
Atn (days) - for SW & GW	9125			40	9125
Conversion Factor (L-mg/cm <sup>2</sup> -ug)	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06

**Table C-6.  
DERMAL EXPOSURE EVALUATION FOR SOIL FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

Carcinogenic Risk											
COPC	Dermal Adcorp. Factors (ADD)	On-site Worker		Mower		Landscape Worker		Construction Worker		Industrial/Commercial Worker	
		LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR
Arsenic	3.00E-02	3.23E-07	4.84E-07	6.45E-08	6.68E-08	1.29E-07	1.64E-07	7.74E-09	1.18E-08	1.61E-08	2.42E-08
Beryllium	1.00E-02	6.61E-09	0.00E+00	1.12E-09	0.00E+00	2.24E-09	0.00E+00	1.38E-10	0.00E+00	2.80E-08	0.00E+00
1,2-Dibromo-3-Chloropropane	1.00E-02	6.66E-09	6.60E-09	1.37E-09	1.62E-09	2.74E-09	3.84E-09	1.85E-10	2.50E-10	3.43E-08	4.80E-08
1,2-Dichloroethane	1.00E-02	8.26E-09	4.68E-10	1.07E-09	6.76E-11	2.18E-09	1.68E-10	1.29E-10	1.17E-11	2.68E-08	2.44E-09
alpha-BHC	3.00E-02	3.35E-10	2.11E-09	6.71E-11	4.22E-10	1.34E-10	6.46E-10	6.06E-12	6.07E-11	1.66E-08	1.06E-08
Heptachlor	3.00E-02	2.37E-10	1.07E-09	4.75E-11	2.14E-10	6.50E-11	4.27E-10	6.70E-12	2.86E-11	1.19E-09	6.34E-09
Methylene chloride	1.00E-02	8.12E-09	3.84E-11	1.08E-09	7.69E-12	2.08E-09	1.64E-11	1.23E-10	6.22E-13	2.66E-08	1.92E-10
Trichloroethane	3.00E-02	1.21E-09	1.33E-10	2.43E-09	2.67E-11	4.85E-09	5.34E-11	2.91E-10	3.20E-12	6.07E-08	6.67E-10
Total PCBs	3.00E-02	3.73E-09	7.48E-08	7.48E-08	1.46E-08	1.46E-08	2.66E-08	6.84E-10	1.79E-09	1.66E-07	3.73E-07

Noncarcinogenic Risk											
COPC	Dermal Adcorp. Factors (ADD)	On-site Worker		Mower		Landscape Worker		Construction Worker		Industrial/Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Arsenic	3.00E-02	6.09E-07	3.91E-09	1.61E-07	6.02E-04	3.61E-07	1.20E-09	2.17E-08	7.23E-08	4.52E-08	1.61E-08
Beryllium	1.00E-02	1.67E-08	7.68E-08	3.14E-08	1.67E-08	6.28E-08	3.14E-08	3.77E-10	1.88E-07	7.65E-08	3.63E-08
Chromium	1.00E-02	2.84E-08	1.76E-08	5.26E-07	3.52E-07	1.08E-08	7.04E-07	6.34E-09	4.23E-08	1.32E-08	6.81E-08
Manganese	1.00E-02	1.82E-05	4.18E-04	3.84E-06	8.35E-05	7.89E-06	1.67E-04	4.61E-07	1.00E-05	6.61E-05	2.09E-03
Chlorobenzene	1.00E-02	7.22E-08	3.61E-08	1.44E-08	7.22E-07	2.89E-08	1.44E-08	1.73E-09	6.66E-08	3.61E-07	1.80E-05
1,1-Dichloroethane	1.00E-02	1.42E-08	1.42E-07	2.84E-09	2.84E-08	5.68E-09	5.68E-08	3.41E-10	3.41E-09	7.11E-08	7.11E-07
Ethylbenzene	1.00E-02	4.49E-08	4.49E-07	6.97E-09	6.97E-08	1.79E-08	1.79E-07	1.08E-09	1.08E-08	2.24E-07	2.24E-06
Heptachlor	3.00E-02	6.66E-10	1.33E-08	1.33E-10	2.66E-07	2.66E-10	5.32E-07	1.60E-11	3.19E-08	3.32E-09	6.65E-08
Methylene chloride	1.00E-02	1.43E-08	2.39E-07	2.87E-09	4.78E-08	5.74E-09	6.66E-08	3.44E-10	5.74E-09	7.17E-08	1.20E-06
Toluene	1.00E-02	6.31E-08	4.66E-07	1.66E-08	6.31E-08	3.73E-08	1.66E-07	2.24E-09	1.12E-08	4.66E-07	2.33E-06
Trichloroethane	3.00E-02	3.40E-08	3.06E-08	6.79E-09	6.18E-07	1.38E-08	1.24E-08	6.15E-10	7.41E-08	1.70E-07	1.54E-06
1,1,1-Trichloroethane	3.00E-02	2.74E-07	1.87E-06	5.48E-08	2.74E-08	1.10E-07	5.48E-08	6.67E-09	3.29E-07	1.37E-08	6.64E-06
Xylenes	1.00E-02	2.53E-07	1.29E-07	6.05E-08	2.53E-08	1.01E-07	5.05E-08	6.06E-09	3.03E-08	1.26E-08	6.32E-07

Summary						
	On-site Worker	Mower	Landscape Worker	Construction Worker	Industrial/Commercial Worker	
ELCR for this pathway	5.72E-07	1.14E-07	2.29E-07	1.37E-08	2.66E-08	
HI for this pathway	3.46E-03	6.92E-04	1.36E-03	6.31E-05	1.73E-03	
Notes:						
ELCR: Excess lifetime cancer risks						
HI: Hazard index						
COPC: Contaminants of potential concern						
LADD: Lifetime average daily dose						
ADD: Average daily dose						
HQ: Hazard quotient						

**Table C-7.  
DERMAL EXPOSURE EVALUATION FOR GROUNDWATER  
FOR LAKE CALUMET CLUSTER SITE: UNNAMED PARCEL**

Carcinogenic Risk							
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		LADD	ELCR	LADD	ELCR	LADD	ELCR
Arsenic	1.00E-03	1.68E-08	2.52E-08	6.71E-10	1.01E-09	1.68E-08	2.52E-08
Benzene	2.10E-02	2.52E-07	1.39E-08	1.01E-08	5.54E-10	2.52E-07	1.39E-08
Indeno(1,2,3-cd)pyrene	1.90E+00	2.63E-07	1.92E-07	1.05E-08	7.68E-09	2.63E-07	1.92E-07

Noncarcinogenic Risk							
COPC	Permeability Constant cm/hr	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ
Arsenic	1.00E-03	4.69E-08	1.56E-04	4.28E-07	1.43E-03	4.69E-08	1.56E-04
Cadmium	1.00E-03	9.56E-08	1.91E-04	8.72E-07	1.74E-03	9.56E-08	1.91E-04
Chromium	1.00E-03	1.93E-07	1.29E-07	1.76E-06	1.17E-06	1.93E-07	1.29E-07
Manganese	1.00E-03	1.48E-06	3.21E-05	1.35E-05	2.93E-04	1.48E-06	3.21E-05
Mercury	1.00E-03	6.01E-09		5.48E-08		6.01E-09	
Nickel	1.00E-03	1.60E-07	8.01E-06	1.46E-06	7.31E-05	1.60E-07	8.01E-06
Vanadium	1.00E-03	6.31E-08	3.15E-06	5.76E-07	2.88E-05	6.31E-08	3.15E-06
Zinc	1.00E-03	6.59E-06	2.20E-05	6.01E-05	2.00E-04	6.59E-06	2.20E-05
Bis(2-ethylhexyl)phthalate	2.30E-02	6.24E-07	7.80E-07	5.69E-06	7.12E-06	6.24E-07	7.80E-07

Summary				
		On-site Worker	Construction Worker	Industrial / Commercial Worker
ELCR for this pathway=		2.31E-07	9.24E-09	2.31E-07
HI for this pathway=		4.14E-04	3.78E-03	4.14E-04

**Notes:**

- ELCR: Excess lifetime cancer risks
- HI: Hazard Index
- COPC: Contaminants of potential concern
- LADD: Lifetime average daily dose
- ADD: Average daily dose
- HQ: Hazard quotient

**Table C-8.  
PARTICULATE INHALATION EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER  
SITE: UNNAMED PARCEL**

<b>Carcinogenic Risk</b>					
<b>LADD=EPCa x ER x IR x EF x ED / (BW x ATc)</b>					
EPCa=exposure point concentration in air (ug/m3) = EPC x PIF					
ER=exposure rate (hr/day)					
IR=inhalation rate (m3/hour)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
BW=body weight (kg)					
ATc=averaging time for carcinogens (days)					
PIF= Particulate Inhalation factor					
ELCR=LADD x SFI					
SFI=inhalation cancer slope factor (kg-day/mg)					
LADD=lifetime average daily dose (mg/kg-day)					
Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Workers	Mower	Landscape Worker
IR (m3/hour)	1.1	2.8	1.1	1.7	1.1
ER (hr/day)	5	8	8	8	8
EF (days/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
Atc (days)	25550	25550	25550	25550	25550
Particulate Inhalation factor	8.00E-10	8.00E-09	8.00E-10	8.00E-09	8.00E-10
Conversion from ug to mg	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
<b>Noncarcinogenic Risk</b>					
<b>ADD=EPCa x ER x IR x EF x ED / (BW x ATn)</b>					
EPCa=exposure point concentration in air (ug/m3)					
ER=exposure rate (hr/day)					
IR=inhalation rate (m3/hr)					
EF=exposure frequency (days/year)					
ED=exposure duration (years)					
BW=body weight (kg)					
ATn=averaging time for noncarcinogens (days)					
HQ=ADD/RfDI					
ADD=average daily dose (mg/kg-day)					
RfDI=inhalation reference dose (mg/kg-day)					
Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Workers	Mower	Landscape Worker
IR (m3/hour)	1.1	2.8	1.1	1.7	1.1
ER (hr/day)	5	8	8	8	8
EF (days/year)	50	30	250	10	20
ED (years)	25	1	25	25	25
BW (kg)	70	70	70	70	70
Atn (days)	9125	9125	9125	9125	40
Particulate Inhalation factor	8.00E-10	8.00E-09	8.00E-10	8.00E-10	8.00E-10

**Table C-9.  
PARTICULATE EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

Carcinogenic Risk										
COPC	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR
Arsenic	7.17E-11	0.00E+00	7.01E-11	0.00E+00	5.74E-10	0.00E+00	3.55E-10	0.00E+00	4.59E-11	0.00E+00
Beryllium	3.74E-12	0.00E+00	3.65E-12	0.00E+00	2.99E-11	0.00E+00	1.85E-11	0.00E+00	2.39E-12	0.00E+00
Benzo(a)anthracene	1.40E-11	4.33E-12	1.37E-11	4.23E-12	1.12E-10	3.46E-11	6.91E-11	2.14E-11	6.94E-12	2.77E-12
Benzo(b)fluoranthene	1.78E-11	5.46E-12	1.72E-11	5.34E-12	1.41E-10	4.37E-11	8.72E-11	2.70E-11	1.13E-11	3.50E-12
Benzo(k)fluoranthene	1.20E-11	3.73E-13	1.18E-11	3.65E-13	9.63E-11	2.99E-12	5.95E-11	1.85E-12	7.71E-12	2.39E-13
Benzo(a)pyrene	1.30E-11	4.04E-11	1.27E-11	3.95E-11	1.04E-10	3.23E-10	6.44E-11	2.00E-10	8.34E-12	2.58E-11
Dibenz(a,h)anthracene	4.62E-12	1.43E-11	4.51E-12	1.40E-11	3.69E-11	1.14E-10	2.28E-11	7.08E-11	2.95E-12	9.16E-12
1,2-Dibromo-3-Chloropropane	4.57E-12	1.10E-14	4.47E-12	1.07E-14	3.66E-11	8.78E-14	2.26E-11	5.42E-14	2.93E-12	7.02E-15
1,2-Dichloroethane	3.58E-12	0.00E+00	3.49E-12	0.00E+00	2.88E-11	0.00E+00	1.77E-11	0.00E+00	2.29E-12	0.00E+00
Indeno(1,2,3-cd)pyrene	7.61E-12	2.36E-12	7.43E-12	2.30E-12	6.08E-11	1.89E-11	3.76E-11	1.17E-11	4.87E-12	1.51E-12
alpha-BHC	7.45E-14	4.69E-13	7.28E-14	4.59E-13	5.96E-13	3.76E-12	3.69E-13	2.32E-12	4.77E-14	3.00E-13
Heptachlor	5.28E-14	2.37E-13	5.16E-14	2.32E-13	4.22E-13	1.90E-12	2.61E-13	1.17E-12	3.38E-14	1.52E-13
Methylene chloride	3.42E-12	5.64E-15	3.34E-12	5.51E-15	2.73E-11	4.51E-14	1.69E-11	2.79E-14	2.19E-12	3.61E-15
Trichloroethene	2.70E-12	1.62E-14	2.64E-12	1.58E-14	2.16E-11	1.29E-13	1.33E-11	8.00E-14	1.73E-12	1.04E-14
Total PCBs	8.28E-12	1.68E-11	8.09E-12	1.62E-11	6.62E-11	1.32E-10	4.09E-11	8.19E-11	5.30E-12	1.06E-11
Noncarcinogenic Risk										
COPC	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Arsenic	2.01E-10		1.96E-10		1.61E-09		9.93E-11		2.93E-08	
Beryllium	1.05E-11	1.63E-06	1.02E-11	1.79E-06	8.37E-11	1.47E-05	5.18E-12	9.07E-07	1.53E-09	2.68E-04
Chromium	1.76E-09		1.72E-09		1.41E-08		8.71E-10		2.57E-07	
Manganese	1.28E-08	8.96E-04	1.25E-08	8.78E-04	1.02E-07	7.17E-03	6.33E-09	4.43E-04	1.87E-06	1.31E-01
Chlorobenzene	4.81E-11	8.42E-09	4.70E-11	8.23E-09	3.85E-10	6.74E-08	2.38E-11	4.17E-09	7.02E-09	1.23E-06
1,1-Dichloroethane	9.47E-12	6.63E-11	9.26E-12	6.48E-11	7.58E-11	5.30E-10	4.69E-12	3.28E-11	1.38E-09	9.67E-09
Ethylbenzene	2.99E-11	1.05E-10	2.92E-11	1.02E-10	2.39E-10	8.37E-10	1.48E-11	5.17E-11	4.37E-09	1.53E-08
Heptachlor	1.48E-13		1.44E-13		1.18E-12		7.31E-14		2.16E-11	
Methylene chloride	9.56E-12	1.12E-11	9.35E-12	1.09E-11	7.65E-11	8.93E-11	4.73E-12	5.52E-12	1.40E-09	1.63E-09
Toluene	6.21E-11	5.45E-10	6.07E-11	5.32E-10	4.97E-10	4.36E-09	3.07E-11	2.69E-10	9.06E-09	7.95E-08
Trichloroethene	7.55E-12	1.26E-09	7.38E-12	1.23E-09	6.04E-11	1.01E-08	3.73E-12	6.22E-10	1.10E-09	1.84E-07
1,1,1-Trichloroethane	6.09E-11	9.68E-11	5.95E-11	9.46E-11	4.87E-10	7.74E-10	3.01E-11	4.79E-11	8.89E-09	1.41E-08
Xylenes	1.68E-10		1.65E-10		1.35E-09		8.33E-11		2.46E-08	
Summary										
	On-site Worker		Construction Worker		Industrial / Commercial Worker		Mower		Landscape Worker	
ELCR for this pathway=	8.45E-11		8.26E-11		6.78E-10		4.18E-10		5.41E-11	
HI for this pathway=	8.98E-04		8.77E-04		7.18E-03		4.44E-04		1.31E-01	
Notes:										
ELCR: Excess lifetime cancer risks										
HI: Hazard index										
COPC: Contaminants of potential concern										
LADD: Lifetime average daily dose										
ADD: Average daily dose										
HQ: Hazard quotient										

**Table C-10.  
GROUNDWATER VOLATILE INHALATION EXPOSURE FACTORS FOR LAKE CALUMET  
CLUSTER SITE: UNNAMED PARCEL**

**Carcinogenic Risk**

$$LADD = (EPC \times IR \times EF \times ED) / (BW \times ATc \times CF)$$

EPC = exposure point concentration in air (g/m<sup>3</sup>)

IR = inhalation rate (m<sup>3</sup>/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

BW = body weight (kg)

ATc = averaging time for carcinogens (day)

CF = Conversion Factor

$$ELCR = LADD \times SFI$$

SFI = Inhalation Slope Factor (kg-day/mg)

LADD = lifetime average daily dose (mg/kg-day)

Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ED (years)	25	1	25	25	25
EF (days/year)	5	5	5		
ATc (days)	25550	25550	25550		
IR (m <sup>3</sup> /day)	20	20	20	20	20
BW (kg)	70	70	70	70	70
CF (mg-g)	0.001	0.001	0.001	0.001	0.001

**Noncarcinogenic Risk**

$$ADD = EPC \times IR \times EF \times ED / (BW \times ATn)$$

EPC = exposure point concentration in air (g/m<sup>3</sup>)

IR = inhalation rate (m<sup>3</sup>/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

ATn = average time for noncarcinogens (years)

Conversion Factor = 1000

$$HQ = ADD / Rfd$$

ADD = average daily dose

Rfd = Volatile Inhalation Reference Dose (mg/kg-day)

Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ED (years)	25	1	25	25	25
EF (days/year)	5	5	5		
ATn (days)	9125	40	9125		
IR (m <sup>3</sup> /day)	20	20	20	20	20
BW (kg)	70	70	70	70	70
CF	0.001	0.001	0.001	0.001	0.001

**Table C-11.  
GROUNDWATER VOLATILE INHALATION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

Carcinogenic Risk							
COPC	Henry's Law Constant	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		LADD	ELCR	LADD	ELCR	LADD	ELCR
Benzene	2.28E-01	1.19E-09	3.45E-11	4.76E-11	1.38E-12	1.19E-09	3.45E-11
Noncarcinogenic Risk							
COPC	Henry's Law Constant	On-site Worker		Construction Worker		Industrial / Commercial Worker	
		ADD	HQ	ADD	HQ	ADD	HQ
Summary							
		On-site Worker		Construction Worker		Industrial / Commercial Worker	
ELCR for this pathway=		3.45E-11		1.38E-12		3.45E-11	
HI for this pathway=		0.00E+00		0.00E+00		0.00E+00	

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard Index

COPC: Contaminants of potential concern

LADD: Lifetime average daily dose

ADD: Average daily dose

HQ: Hazard quotient

**Table C-12.  
SOIL VOLATILE INHALATION EXPOSURE FACTORS FOR LAKE CALUMET CLUSTER SITE: UNNAMED  
PARCEL**

**Carcinogenic Risk**

$$LADD = (EPC \times ER \times IR \times EF \times ED) / (VF \times BW \times ATc)$$

- EPC = Exposure Point Concentration (ug/kg)
- ER = Exposure Rate (hours/day)
- IR = Inhalation Rate (m<sup>3</sup>/hr)
- EF = Exposure Frequency (days/year)
- ED = Exposure Duration (years)
- VF = Volatilization Factor (m<sup>3</sup>/kg)
- BW = Body Weight (kg)
- ATc = Averaging Time for Carcinogens (day)

$$VF = QIC \times (2.14 \times 10^{-11})^{0.5} \times (2 \times R_0 \times D)^{-0.5} \times CF$$

- QIC = Inverse of the mean concentration at the center of a square source = (g/m<sup>3</sup>-s)/(g/m<sup>3</sup>)
- D = Apparent Diffusivity (cm<sup>2</sup>/s)
- T = Exposure Interval (s)
- R<sub>0</sub> = Dry Soil Bulk Density = g/cm<sup>3</sup>
- CF = Conversion factor (10 E-4 m<sup>2</sup>/cm<sup>2</sup>)

$$D = (Q_a^{1.5} \times D_a \times H) + (Q_w^{1.5} \times D_w \times n^2) \times (1 / (K_{oc} \times L_w + Q_w + (Q_a \times H)))$$

- Q<sub>a</sub> = Air-Filled Soil Porosity 0.13 For Subsurface Soil
- D<sub>a</sub> = Diffusivity in Air (cm<sup>2</sup>/s) Chemical Specific
- H = Henry's Law Constant Chemical Specific
- Q<sub>w</sub> = Water-Filled Soil Porosity 0.3 For Subsurface Soil
- D<sub>w</sub> = Diffusivity in Water (cm<sup>2</sup>/s) Chemical Specific
- n = Total Soil Porosity 0.43
- ρ<sub>s</sub> = Dry Soil Bulk Density (g/cm<sup>3</sup>) 1.5
- K<sub>oc</sub> = Soil Water Partition Coeff = K<sub>oc</sub> x L<sub>w</sub>
- K<sub>oc</sub> Chemical Specific
- L<sub>w</sub> 0.002

$$ELCR = LADD \times URF$$

- URF = Inhalation Unit Risk (m<sup>3</sup>/ug)
- LADD = Lifetime average daily dose (ug/m<sup>3</sup>)

Exposure Factor	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
ED (years)	25	1	25	25	25
EF (days/year)	30	30	250	10	20
ATc (days)	9125	40	9125	9125	40
ATc (days)	25500	25500	25500	25500	25500
IR (m <sup>3</sup> /hr)	1.1	2.8	1.1	1.7	1.1
ER (hr/day)	1	8	8	8	4
BW (kg)	62	70	70	70	70

**Noncarcinogenic Risk**

$$ADD = EPC \times ER \times IR \times EF \times ED / (ATn \times VF \times BW)$$

- EPC = exposure point concentration (ug/kg)
- ER = exposure rate (hours/day)
- IR = Inhalation rate (m<sup>3</sup>/hr)
- EF = exposure frequency (days/year)
- ED = exposure duration (years)
- ATn = average time for noncarcinogens (years)
- VF = Volatilization Factor (m<sup>3</sup>/kg)
- Conversion Factor = 1000

$$HQ = ADD / Rfc$$

- ADD = average daily dose (m<sup>3</sup>/kg)
- Rfc = Volatile Inhalation Reference Dose (ug/m<sup>3</sup>)



**Table C-13.**  
**SOIL VOLATILE INHALATION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE:**  
**UNNAMED PARCEL**

COPC	Q/C	DI	H'	Dw	Koc	Kd	D	T	Ro	VF	T <sub>Construction</sub>	VF <sub>Construction</sub>
	g/sq.m/kg/cu.m)	(sq.cm/sec)		(sq.cm/sec)	cm <sup>3</sup> /g	cu.cm/g	(sq.cm/sec)	Sec	g/ cu.cm	cu.m/kg	Sec	cu.m/kg
1,2-Dibromo-3-Chloropropane	85.81	2.12E-02	9.68E-04	7.02E-06	1.29E+02	2.58E-01	1.18E-06	7.90E+08	1.50E+00	1.31E+05	3.60E+06	8.84E+03
1,2-Dichloroethane	85.81	1.04E-01	4.01E-02	9.90E-06	1.74E+01	3.48E-02	7.34E-05	7.90E+08	1.50E+00	1.66E+04	3.60E+06	1.12E+03
Indeno(1,2,3-cd)pyrene	85.81	1.90E-02	6.56E-05	5.68E-06	3.47E+06	6.94E+03	5.41E-11	7.90E+08	1.50E+00	1.94E+07	3.60E+06	1.31E+06
alpha-BHC	85.81	1.42E-02	4.35E-04	7.34E-06	1.23E+03	2.46E+00	1.90E-07	7.90E+08	1.50E+00	3.27E+05	3.60E+06	2.21E+04
Heptachlor	85.81	1.10E-02	6.07E+01	5.69E-06	1.41E+06	2.82E+03	9.55E-07	7.90E+08	1.50E+00	1.46E+05	3.60E+06	9.84E+03
Methylene chloride	85.81	1.01E-01	8.98E-02	1.17E-05	1.17E+01	2.34E-02	1.82E-04	7.90E+08	1.50E+00	1.12E+04	3.60E+06	7.56E+02
Trichloroethene	85.81	7.90E-02	4.22E-01	9.10E-06	1.66E+02	3.32E-01	2.38E-04	7.90E+08	1.50E+00	9.24E+03	3.60E+06	6.23E+02
Chlorobenzene	85.81	7.30E-02	1.52E-01	8.70E-06	2.19E+02	4.38E-01	6.97E-05	7.90E+08	1.50E+00	1.71E+04	3.60E+06	1.15E+03
1,1-Dichloroethane	85.81	7.42E-02	2.30E-02	1.05E-05	3.16E+01	6.32E-02	2.86E-05	7.90E+08	1.50E+00	2.66E+04	3.60E+06	1.80E+03
Ethylbenzene	85.81	7.50E-02	3.23E-01	7.80E-06	3.63E+02	7.26E-01	1.03E-04	7.90E+08	1.50E+00	1.40E+04	3.60E+06	9.47E+02
Heptachlor	85.81	1.10E-02	6.07E+01	5.69E-06	1.41E+06	2.82E+03	9.55E-07	7.90E+08	1.50E+00	1.46E+05	3.60E+06	9.84E+03
Methylene chloride	85.81	1.01E-01	8.98E-02	1.17E-05	1.17E+01	2.34E-02	1.62E-04	7.90E+08	1.50E+00	1.12E+04	3.60E+06	7.56E+02
Toluene	85.81	8.70E-02	2.72E-01	8.60E-06	1.82E+02	3.84E-01	1.84E-04	7.90E+08	1.50E+00	1.11E+04	3.60E+06	7.52E+02
Trichloroethene	85.81	7.90E-02	4.22E-01	9.10E-06	1.66E+02	3.32E-01	2.38E-04	7.90E+08	1.50E+00	9.24E+03	3.60E+06	6.23E+02
1,1,1-Trichloroethane	85.81	7.80E-02	7.05E-01	8.80E-06	1.10E+02	2.20E-01	4.63E-04	7.90E+08	1.50E+00	6.62E+03	3.60E+06	4.47E+02
Xylenes	85.81	7.14E-02	2.15E-01	9.34E-06	3.74E+02	7.48E-01	6.48E-05	7.90E+08	1.50E+00	1.77E+04	3.60E+06	1.19E+03

COPC	Carcinogenic Risk									
	On-site Worker		Construction		Industrial /		Mower		Landscape Worker	
	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR	LADD	ELCR
1,2-Dibromo-3-Chloropropane	1.2E-05	8.1E-12	6.3E-05	4.3E-11	3.5E-04	2.4E-10	2.2E-05	1.5E-11	1.4E-05	9.6E-12
1,2-Dichloroethane	7.2E-05	0.0E+00	3.9E-04	0.0E+00	2.2E-03	0.0E+00	1.3E-04	0.0E+00	8.6E-05	0.0E+00
Indeno(1,2,3-cd)pyrene	1.3E-07	1.2E-11	7.1E-07	6.3E-11	3.9E-06	3.5E-10	2.4E-07	2.1E-11	1.6E-07	1.4E-11
alpha-BHC	7.7E-08	1.4E-10	4.1E-07	7.4E-10	2.3E-06	4.1E-09	1.4E-07	2.5E-10	9.1E-08	1.6E-10
Heptachlor	1.2E-07	1.6E-10	6.6E-07	8.4E-10	3.6E-06	4.7E-09	2.2E-07	2.9E-10	1.4E-07	1.9E-10
Methylene chloride	1.0E-04	4.8E-11	5.5E-04	2.6E-10	3.1E-03	1.4E-09	1.9E-04	8.9E-11	1.2E-04	5.8E-11
Trichloroethene	9.8E-05	1.7E-10	5.3E-04	9.1E-10	2.9E-03	5.0E-09	1.8E-04	3.1E-10	1.2E-04	2.0E-10

COPC	Noncarcinogenic Risk									
	On-site Worker		Construction		Industrial /		Mower		Landscape Worker	
	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
Chlorobenzene	9.5E-04	4.7E-05	1.2E+00	5.8E-02	2.8E-02	1.4E-03	1.7E-03	8.7E-05	2.6E-01	1.3E-02
1,1-Dichloroethane	1.2E-04	2.4E-07	1.5E-01	2.9E-04	3.6E-03	7.1E-06	2.2E-04	4.4E-07	3.2E-02	6.5E-05
Ethylbenzene	7.2E-04	7.2E-07	8.8E-01	8.8E-04	2.1E-02	2.1E-05	1.3E-03	1.3E-06	1.9E-01	1.9E-04
Heptachlor	3.4E-07		4.2E-04		1.0E-05		6.3E-07		9.2E-05	
Methylene chloride	2.9E-04	9.6E-06	3.5E-01	1.2E-04	8.5E-03	2.8E-06	5.3E-04	1.8E-07	7.8E-02	2.6E-05
Toluene	1.9E-03	4.7E-06	2.3E+00	5.8E-03	5.6E-02	1.4E-04	3.4E-03	8.6E-06	5.1E-01	1.3E-03
Trichloroethene	2.8E-04	1.3E-05	3.4E-01	1.6E-02	8.2E-03	3.9E-04	5.1E-04	2.4E-05	7.5E-02	3.6E-03
1,1,1-Trichloroethane	3.1E-03	1.4E-06	3.8E+00	1.7E-03	9.2E-02	4.2E-05	5.7E-03	2.6E-06	8.4E-01	3.8E-04
Xylenes	3.2E-03		3.9E+00		9.5E-02		5.9E-03		8.7E-01	

**Table C-13.  
SOIL VOLATILE INHALATION EXPOSURE EVALUATION FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

	Summary				
	On-site Worker	Construction	Industrial /	Mower	Landscape Worker
ELCR for this pathway=	6.31E-10	2.66E-09	1.66E-09	6.78E-10	6.31E-10
HI for this pathway=	6.31E-08	6.66E-08	1.66E-09	6.78E-08	1.44E-08

Notes:  
 ELCR: Excess lifetime cancer risks  
 HI: Hazard Index  
 COPC: Contaminants of potential concern  
 LADD: Lifetime average daily dose  
 ADD: Average daily dose  
 HQ: Hazard quotient

**Table C-14.  
SUMMARY OF HUMAN HEALTH RISK ASSESSMENT FOR LAKE CALUMET CLUSTER SITE:  
UNNAMED PARCEL**

**Summary of Human Risk Assessment for Soil, Sediment, Surface water and Groundwater**

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
Total ELCR	3.E-06	1.E-06	2.E-05	1.E-05	1.E-06
Total HI	1.E-02	6.E-01	5.E-02	2.E-02	1.E-01

**Summary of Human Risk Assessment for Soil, Sediment and Surface water**

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
Total ELCR	3.E-06	1.E-06	2.E-05	1.E-05	1.E-06
Total HI	1.E-02	6.E-01	5.E-02	2.E-02	1.E-01

**Summary of Human Risk Assessment for Soil**

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
Total ELCR	3.E-06	1.E-06	2.E-05	1.E-05	1.E-06
Total HI	1.E-02	6.E-01	5.E-02	2.E-02	1.E-01

**Summary of Human Risk Assessment for Groundwater**

	On-site Worker	Construction Worker	Industrial / Commercial Worker	Mower	Landscape Worker
Total ELCR	2.E-07	9.E-09	2.E-07		
Total HI	4.E-04	4.E-03	4.E-04		

**Table C-14.**  
**SUMMARY OF HUMAN HEALTH RISK ASSESSMENT FOR LAKE CALUMET CLUSTER SITE:**  
**UNNAMED PARCEL**

**Notes:**

**ELCR: Excess lifetime cancer risks**

**HI: Hazard index**

**Bold shaded area indicated ELCR or HI exceedances for the receptor**

**Table C-15.**  
**EXCEEDANCES SUMMARY OF CHEMICAL OF POTENTIAL CONCERN**  
**FOR LAKE CALUMET CLUSTER SITE: UNNAMED PARCEL**

**COPCs of Carcinogenic Risk in Soil**

<b>COPC</b>	<b>Receptors</b>
Arsenic	Industrial/Commercial Worker, Mower
Benzo(a)pyrene	Industrial/Commercial Worker, Mower

**Notes:**

ELCR: Excess lifetime cancer risks

HI: Hazard index

Carcinogenic exceedances: ELCR is greater than 1.00E-06

Noncarcinogenic exceedances: HI is greater than 1.00E+00