FINAL

BASELINE RISK ASSESSMENT

DES MOINES TCE SITE

OU4

Site: Des Moines TCE
ID # IAD980687922
Break: 2.4
Other: OU4
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Black & Veatch Waste Science, Inc.

Kansas City, Missouri

30221200
Superfund

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Baseline Risk Assessment

1.0 Introduction

BLACK & VEATCH Waste Science, Inc. (BVWS) was tasked to provide a baseline risk assessment utilizing data from a number of previous investigations at Operable Unit No. 4 (OU4) of the Des Moines TCE Site located in Des Moines, Iowa. A previous risk assessment was performed by Eckenfelder, Inc. on OU2 of the same site, and the data and findings of that report are not re-evaluated in this report. There was also an addendum to that OU2 risk assessment performed by BVWS, dated November 23, 1993, which evaluated future residential exposures at OU2. This risk assessment report is structured in compliance with the Risk Assessment Guidance for Superfund (RAGS) manual (USEPA, 1989a) and in a manner similar to the OU2 risk assessment in that many of the same assumptions have been used.

Risk assessment is a scientific procedure intended to estimate the probability of adverse health effects from exposures to toxic substances. The results of the risk assessment are not absolute statements of every possible human health effect. Accordingly, remedial and risk management decisions should not be exclusively based upon the baseline risk assessment results, but should consider these results in conjunction with assessment uncertainties, available technologies, public perceptions, and economic feasibilities. Traditionally, Superfund baseline risk assessments have focused on contaminants and exposure pathways directly related to the site. These assessments do not address risks from other sources of chemical exposure (e.g., dietary exposures) or risks from other contaminants that are not associated with the site under evaluation.

Risk assessment is a multi-step process comprising the following tasks:

- Data evaluation.
- Toxicity assessment.
- Exposure assessment.
- Risk characterization.
- Uncertainty analysis.

The baseline risk assessment also includes an environmental assessment. A wildlife toxicity assessment has been completed and accompanies this report. The nature of the environmental assessment, whether exhaustive or cursory, depends upon various site conditions.

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The general format for risk assessment and definition of terms is consistent with those provided by United States Environmental Protection Agency (USEPA) Risk Assessment Guidance for Superfund Volume I (Parts A, B, and C) and Volume II (1989a). Additional guidance comes from the Office of Solid Waste and Emergency Response (OSWER) directive 9285.6-03 "Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors" (USEPA, 1991a).

Data evaluation includes the selection of chemicals of potential concern (COPC) that will be evaluated in the risk assessment, based on issues such as data quality, frequency of detection, presence in background samples, and presence in laboratory blanks.

The toxicity assessment involves determining the adverse health effects associated with chemical exposures, the relationship between magnitude of exposure and adverse effects, and the related uncertainties involved.

Exposure assessment involves characterizing the contaminated media on site, identifying and evaluating environmental transport and fate pathways, identifying the populations potentially exposed to the COPCs, and estimating the magnitudes, frequencies, and durations of exposures.

Risk characterization is the estimation of health risks associated with the COPCs based on information from the toxicity and exposure assessments. Although risk characterization is conducted for all COPCs, the discussion focuses on those contaminants that contribute most of the total risk, as indicated by the results of the risk calculations.

Uncertainty analysis is a qualitative and, where possible, quantitative description of the assumptions and limitations inherent in each step of the risk assessment.

The environmental assessment normally involves an inventory of onsite plant and animal communities, an explanation of how these communities might be exposed to onsite contamination, a description of the toxicological and physiological impacts of this contamination upon individual species, and a qualitative evaluation of some of the potential risks posed to onsite flora and fauna by the contaminants.

Although these steps are presented sequentially, the risk assessment process is highly iterative. Information developed in each step of the risk assessment is useful in subsequent steps and provides feedback to preceding steps. For example, concentration data from the exposure assessment may be used during the data evaluation to select COPCs. Toxicity profiles developed in the toxicity assessment

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may provide important qualitative information for use in the risk characterization or in the uncertainty analysis.

1.1 Objectives of the Risk Assessment

The revision of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) states that the purpose of the remedial process is to implement procedures that reduce, control, or eliminate risk to human health and the environment. The main objective of the human health evaluation process is to provide the information necessary to assist in the decision-making process at potential remedial sites. The following are specific objectives of the human health evaluation process:

- Provide analysis of preliminary risks (risks that could exist onsite in the absence of remediation or institutional controls) and help determine what actions are necessary;
- Provide a basis for determining the levels of chemicals that can remain onsite and not adversely impact public health;
- Provide a basis for comparing potential health impacts of various remedial alternatives; and
- Provide a consistent process for evaluating and documenting the site-specific threats to public health.

The revision of the NCP also calls for the selection of remedial actions that are protective of environmental organisms and ecosystems. In addition, numerous federal and state laws and regulations concerning environmental protection are potentially "Applicable or Relevant and Appropriate Requirements" (ARARs).

This risk assessment provides an evaluation of potential risk to human health and the environment from exposure to the contaminants at OU4 on the Des Moines TCE Site in Des Moines, Iowa. The assessment results will attempt to document the magnitude and cause of risk at the site. In addition, the results will aid in the determination of necessary response actions and in the establishment and subsequent modification of remediation goals. A flow chart of the risk assessment process is presented in Figure 1-1.

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2.0 Approach and Theoretical Considerations

This subsection presents a general discussion of the methods used and theoretical considerations involved in each step of the risk assessment. The results of each step of the risk assessment for OU4 are presented in Sections 3.0 through 6.0.

2.1 Data Evaluation

The process of determining the COPCs for OU4 includes an evaluation of the analytical data, an analysis of the sources of contamination and areas that the sources impact, and a review of site characteristics. A focused risk assessment has already been performed to evaluate the South Pond, the area around the South Pond, the East ditch, and stockpiled soils at OU4 (hereafter referred to as the South Pond Area). These areas and the data associated with them that were used in the focused risk assessment memorandum are not further evaluated in this risk assessment.

The media-specific analytes that were not eliminated because of data quality considerations were identified as COPCs and carried to the next step in the process, the toxicity assessment.

2.2 Toxicity Assessment

In developing risk assessment methods, USEPA recognized that fundamental differences exist between the carcinogenic (associated with cancer) and noncarcinogenic dose-response variables used to estimate risks. Because of these differences, human health risk assessment is conducted separately for the carcinogenic and noncarcinogenic effects of contaminants.

The reference dose (RfD) is defined as an estimate of a daily dose for the human population, including sensitive subgroups, that could be experienced over a lifetime without appreciable adverse noncarcinogenic health effects (USEPA, 1989a). Examples of noncarcinogenic effects include liver damage, decreased fertility, birth defects, and damage to the central nervous system. The RfD is expressed in units of milligrams of contaminant per kilogram of body weight per day (mg/kg/day).

The RfD is usually established from the relationship between the dose of a non-carcinogen and the frequency of adverse health effects observed in experimental animals or humans, with the assumption that there is a threshold for the initiation of noncarcinogenic effects (Dourson and Stara, 1983). The assumption of a threshold is based on the concept that the body has certain protective mechanisms that must be overcome before the adverse effect is manifested.

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The threshold of observed noncarcinogenic effects (No Observed Adverse Effect Level, NOAEL, which is used to derive the RfD) is divided by an uncertainty factor to account for any of the following potential sources of uncertainty in the available toxicological database: presence of sensitive subpopulations (e.g., elderly, children, infirm), extrapolation from animal studies to humans, lack of chronic exposure data, lack of a dose at which no adverse effects were observed, or inadequate toxicological database. Each source of uncertainty is usually assigned a factor of 10. These are then multiplied together to yield the uncertainty factor. The NOAEL is then divided by the uncertainty factor to generate the RfD.

The uncertainty associated with the RfD can span several orders of magnitude. For this reason, the RfD should not be viewed as a strict scientific demarcation between a toxic dose and a nontoxic dose (USEPA, 1989a). Uncertainty factors are reported along with the RfD; a higher uncertainty factor indicates a larger degree of uncertainty about the value of the RfD and suggests that the RfD is more likely to change when additional data become available.

USEPA classifies the data regarding carcinogenicity according to the weight-of-evidence system described in Section 4.0 of this report. A carcinogenic slope factor (SF), which is expressed in units of the inverse of milligrams of contaminant per kilogram of body weight per day $(mg/kg/day)^{-1}$, is usually calculated for chemicals in Classes A, B1, and B2, and sometimes also for Class C (defined in detail in Section 4.0). The SF is used to estimate an upper bound of the excess probability (above the background probability) that an individual will develop cancer at some point in the individual's life, due to exposure to a potential carcinogen (USEPA, 1989a).

Toxicity data were obtained from USEPA's 1994 Integrated Risk Information System (IRIS) database (USEPA, 1994a). When data were not currently available in IRIS, supplemental sources of information, such as values from the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1994b) or interim values provided by USEPA, were used.

2.3 Exposure Assessment

USEPA (1989a) specifies three distinct steps for the exposure assessment process: (1) characterizing the exposure setting, (2) identifying exposure pathways, and (3) quantifying exposure. The exposure setting is characterized by describing site physical features as well as identifying potentially exposed populations. Potentially

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exposed populations include those individuals potentially exposed under current or future land use.

Exposure pathways generally consist of four elements: (1) a source and mechanism of contaminant release, (2) a retention or transport medium, (3) a point of potential human contact with the contaminated medium (i.e., the exposure point), and (4) an exposure route (i.e., ingestion, inhalation, and dermal contact) at the contact point. If all four elements of an exposure pathway are present, the pathway is considered "complete." Points of potential human contact and exposure routes are evaluated under both current and future land-use scenarios. Exposure routes represent the means of contact between the potentially exposed population and a medium such as soil. This would include human contact via ingestion and dermal absorption.

Quantifying the magnitude, frequency, and duration of exposure for the populations and exposure pathways is the last step in the exposure assessment. This step involves two stages: estimating exposure point concentrations, and estimating pathway-specific intakes. The exposure point concentration is the 95-percent upper confidence limit (UCL) on the arithmetic mean unless the data set comprises less than 10 data points, in which case the highest detected concentration is used (USEPA, 1989b). These concentrations and intakes are then combined to estimate the reasonable maximum exposure (RME) for a specific pathway.

The basic equation used to calculate human intake of a chemical contaminant is:

$$DI = (C)(HIF)$$

where:

DI = Daily Intake (mg of contaminant per kg of body weight per day).

C = Concentration of the contaminant in mg/kg (ppm).

HIF = Human Intake Factor (kg of medium per kg body weight per day).

Each intake variable in the above equation has a range of values. For risk assessments conducted under RAGS, the intake variable values for a given pathway are selected so that the combination of all intake variables results in an estimate of the RME for that pathway. The RME is defined as the maximum exposure that is reasonably expected to occur at or near a site.

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2.4 Risk Characterization

The information generated by the toxicity assessment is combined with information from the site-specific exposure assessment to quantify the carcinogenic and noncarcinogenic effects associated with the COPCs.

Carcinogenic and noncarcinogenic effects are calculated for each pathway of exposure and each COPC. Carcinogenic and noncarcinogenic values, respectively, are added for all chemicals in an exposure pathway (e.g., incidental ingestion of soil). The totals for all exposure pathways in a given population (e.g., current onsite resident) are added to give an estimate of the population risks. Risk assessments generally do not add risks across populations (e.g., a person living and working onsite) due to the lack of information on specific individuals.

2.4.1 Methodology for Noncarcinogenic Effects. Values for noncarcinogenic effects are expressed as a ratio of the estimated intake dose to the reference dose. The ratio, called the hazard quotient (HQ), indicates numerically whether or not the RfD (i.e., threshold) is exceeded. The HQ is not a mathematical prediction of the incidence or severity of effects, but rather a simple numerical index to identify potential exposure problems (USEPA, 1989a). An HQ greater than 1.0 suggests that exposure to a substance exceeds a level of concern (i.e., the RfD) for the chemical. The HQ is calculated as follows:

$$HQ = DI/RfD$$

where:

HQ = Hazard Quotient (unitless).
DI = Daily Intake (mg/kg day).
RfD = Reference Dose (mg/kg day).

Individual HQ values for all chemicals of potential concern are combined to calculate the noncarcinogenic hazard index (HI), which assumes simple summation of effects of all COPCs at the site.

$$\begin{aligned} HI &= HQ_1 + HQ_2 + \ldots HQ_j \text{ or} \\ &= (DI_1/RfD_1) + (DI_2/RfD_2) + \ldots + (DI_j/RfD_j) \end{aligned}$$

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where:

HQ_j = Hazard Quotient of the jth constituent.
DI_j = Daily Intake of the jth constituent.
RfD_j = Reference dose for the jth constituent.

An HI greater than 1.0 suggests that exposure to all chemicals collectively exceeds a generalized level of concern. The level of concern increases as the HI approaches and exceeds a value of 1. However, the level of concern does not increase linearly because individual RfD values do not have equal accuracy or precision and are not based on the same severity of toxic effects. Furthermore, RfD values provide no information on the shape of the dose-response curve in or above the region of concern (i.e., near the RfD). The level of concern for toxic effects may increase more quickly for some chemicals than for others. Therefore, the HI should be regarded as a general indicator of the degree of concern.

The initial HI is considered a screening value because it may combine noncarcinogenic effects for various chemicals with different toxicological endpoints (e.g., liver damage versus kidney damage). When the initial HI calculated for a particular population is greater than 1.0, noncarcinogenic effects can be evaluated in greater detail.

2.4.2 Methodology for Carcinogenic Effects. Values associated with carcinogenic effects are expressed as the excess probability (above the background probability) that an individual will develop cancer over a lifetime exposure. This presupposes that there is no threshold for carcinogens and that even minute concentrations will result in some cancers. The carcinogenic potency estimate for a chemical or SF is generally conservative (i.e., predicts higher cancer potency) because the SF is often an upper 95th percent confidence limit of the slope of the dose-response curve. This slope factor will usually only hold true for low doses because the dose-response curve is approximately linear only in the low dose region. The excess probability of developing cancer or risk is calculated for a exposure pathway by multiplying the average daily intake over a lifetime (DI) and the SF for the chemical as follows:

$$\text{Risk} = (DI)(SF)$$

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where:

DI = Daily Intake (mg/kg day)
SF = Slope Factor (kg day/mg)

Only lifetime average daily intakes are used in conjunction with slope factors to obtain excess lifetime cancer risk estimates because slope factors are formulated on the basis of average lifetime exposures. Lifetime average daily intake is obtained by adding the intake of each age group considered in an exposure scenario and averaging it over a lifetime of 70 years.

2.4.3 Evaluation of Carcinogenic Effects. The observed national background cancer risk (no exposure to site contaminants) is approximately 2.5×10^{-1} (1 in 4). In the NCP, USEPA set an added cancer risk (above background) of 10^{-6} as the point of departure for determining remediation goals for Superfund sites [40 CFR 300.430(e)(2)]. Accordingly, remediation cleanup levels should correspond to risks in the range of 10^{-6} to 10^{-4}, with a preference for cleanup levels associated with an added cancer risk of 10^{-6}. The acceptable risk and actual cleanup levels are considered a risk management decision and are determined on a case-by-case basis.

In a recent memo, USEPA (1991b) stated that a site with carcinogenic risk less than 10^{-4} generally should be considered a no-action site, unless any of the following criteria apply to the site:

- Hazard quotient greater than 1.0
- Adverse environmental impacts
- Exceedance of maximum contaminant levels (MCL) or non zero MCL goals for drinking water
- Significant uncertainties associated with the results of the risk assessment.

Once the need for remediation is determined, the preference remains for cleanup levels to correspond to risks at the low end of the target risk range (i.e., close to 10^{-6}) (USEPA, 1991b).

USEPA (1989a) recommends that actions at a Superfund site be selected on the basis of the RME estimated to occur under both current and future land-use conditions. The rationale for this approach is that average estimates are lower than the exposures that may be experienced by much of the population. However, discussion of the results of the risk assessment will focus on risks associated with the RME case and the other viable exposure routes and populations.

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As with the case for noncarcinogenic effects, carcinogenic effects are combined for all chemicals in an exposure pathway (total pathway risk) and the risks from various exposure pathways within a populations are summed (total population risk). The total pathway risk approximates the true risk due to simultaneous exposures to a mixture of multiple carcinogens. It is assumed that the intakes of individual substances are small and that all act independently (i.e., without synergism or antagonism). Because mixtures of carcinogens are most likely not truly additive, the total cancer risk estimate may become artificially more conservative as risks from a number of different carcinogens are combined. Thus, the total carcinogenic risk may be overestimated.

2.5 Uncertainty Analysis

The uncertainty analysis provides a general evaluation of the uncertainties that enter the risk assessment at each step of the process. This is necessary because each step in the process contains required assumptions which may have an effect upon the risk estimate (i.e., either overestimation or underestimation of risk). For each identified source of uncertainty, the direction and magnitude of the potential effect on the risk estimate and the steps taken to mitigate the uncertainty are noted. In many cases, the only possible steps to mitigate uncertainties are the use of best scientific judgment and the best available data.

2.6 Environmental Assessment

The NCP calls for identification and mitigation of the environmental impacts of hazardous waste sites and for the selection of remedial actions that are "protective of environmental organisms and ecosystems." The Environmental Assessment, a qualitative and/or quantitative appraisal of the actual or potential effects of a hazardous waste site on surrounding flora and fauna (excluding humans and domesticated species), is performed to fulfill this requirement. It is important to note that small, chemically induced changes within the food web of an ecological community can have a dramatic effect on larger species within the community eventually including human beings.

The environmental assessment is intended to reduce the uncertainty associated with understanding the environmental effects of a site and its remediation, and to give specific boundaries to that uncertainty. The outputs of the environmental assessment are semi-quantitative predictions of future onsite ecological effects or

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assessments of ecological risk as stated in the USEPA's "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference" (USEPA, 1989c).

A wildlife toxicity assessment has been conducted based on the conditions and setting primarily in the South Pond area. The wildlife toxicity assessment accompanies this report. The conclusions of the wildlife toxicity assessment are presented in Section 8.0.

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3.0 Data Evaluation Results

The entire set of sampling data for soil used in the risk assessment is presented in Appendix A. Chemicals of potential concern (COPC) were selected independently for each medium (e.g., surface soil) at OU4. The analytes were screened by qualifiers or "flags" placed next to the reported concentrations during data validation. Data results from all sampling events are presented in Appendix A, which includes data qualifiers.

Analytes that were analyzed for but not detected above the sample quantitation limit (SQL) were flagged with a "U" or an "ND." In Appendix A the number to the left of the "U" or "ND" is the SQL. Analytes flagged with a "U" or "ND" will be incorporated into the risk assessment if a compound has been detected at other sampling locations. The SQL is then divided by 2 and this value is used in the risk calculations. This is the standard approach to dealing with nondetects when a compound has been detected at other sampling locations.

Positively detected analytes that were reported below the sample quantitation limit were flagged with a "J." This qualifier indicates uncertainty in the reported concentration but not in the identity of the analyte. All data assigned with the "J" qualifier were retained for the next step of the screening process.

Analytes flagged with an "R" were rejected because of questionable laboratory performance (e.g., deviation from analytical protocols). The "R" flagged data were eliminated from the remainder of the risk assessment. "B" flagged organic data were detected in either a laboratory or field blank, but were retained in the data set. "B" flagged inorganic data were below the contract required detection limit (CRDL) but greater than or equal to the instrument detection limit (IDL).

The objectives of this evaluation process are to identify a set of chemicals that are likely to be site-related and to guarantee that reported concentrations are of acceptable quality for use in the quantitative risk assessment. Chemicals remaining in the quantitative risk assessment are referred to as COPCs. In the evaluation, the data validation processes for the risk assessment were reviewed, and the appropriateness of the data for the risk assessment was determined.

During the initial evaluation, the data collected for OU4 was categorized as to whether the sample locations were within the South Pond Area, in which case they were dealt with in the Focused OU4 Risk Assessment. If the data was not evaluated in the Focused OU4 Risk Assessment, they were included as data points for this OU4 Risk Assessment. The data were divided by depth in order to estimate exposure

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point concentrations, utilizing surface soils (0' to 2') for current exposure scenarios and surface plus deep soils (down to 12') for future exposures. The data was also split to include data under the existing asphalt cap in one set and the data that represents currently exposed soils in another set.

The following steps eliminated potential COPCs from further consideration for the baseline risk assessment:

- Data qualifiers resulting in rejected data eliminated contaminants from further consideration.
- Contaminants that were only detected once at a level near the SQL were eliminated from further consideration, except for exposed soils data, because only three samples exist, all detected contaminants were retained.
- Contaminants were eliminated if they were nondetected at all of the sampling locations.
- Chemicals identified as common laboratory contaminants were eliminated if the associated concentrations of contaminants were less than 10 times the lab blank value (USEPA, 1992).

Appendix A presents the capped data for the OU4 risk assessment, including calculations of exposure point concentrations for the chemicals of potential concern. Appendix B presents the exposed soil data, including calculations of exposure point concentrations for the chemicals of potential concern.

Though there would normally be two data sets for each major area or operable unit (one for current and one for future), in this case there is only one data set for each. There is only a future set for the capped data, because the cap prevents current exposure, thus eliminating risk in the present. There is only one data set for the exposed soil because all samples are surface samples, therefore no future deep soil data is present that would change the exposure point concentrations in the future case. Appendices A and B present these two data sets, for capped and exposed soils, respectively.

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Table 3-1
Applicability of Investigation Data
to OU4 Risk Assessment
Des Moines TCE Site
OU4 Risk Assessment

Investigation	Media (sample numbers)	Affected by which Response Action?	Applicable to Evaluation of Risks?	Rationale
OU2 RI Related Activities (1989 to 1991)	Deep Soil (DB-17 and DB-32 through DB-56, DB-59, DB-60, and DB-63)	Surface Cap	Yes	Although these sampling locations are currently covered by an asphalt cap, soil contamination is still present at these locations and may come into contact with future populations.
	Sediment (SS-1 and SS-2)	South Pond	Yes	The sediment, from which the SS-1 and SS-2 sediment samples were obtained, will be excavated and consolidated in the South Pond during the South Pond response action and may come into contact with future populations.
	Sediment (SS-3 through SS-5)	South Pond	Yes	This data is still considered applicable because these sediment sample locations will only be covered during the South Pond area response action and may come into contact with future populations.
Building Engineering Evaluation (1991)	Shallow Soil (SB-47 through SB-55)	Surface Cap	Yes	Although these sampling locations are curently covered by an asphalt cap, soil contamination is still present at these locations and may come into contact with future populations.
	Sediment (SP-A, C, E, I, and J)	South Pond	Yes	The sediment, from which the sediment samples were obtained, will be excavated and consolidated in the South Pond during the South Pond response action and may come into contact with future populations.
	Sediment (SP-B and SP-D)	None	Yes	These sampling locations will be addressed as "exposed soil" locations given that they will not be affected by the South Pond area response action.
	Sediment (SP-F, G, and H)	South Pond	Yes	This data is still considered applicable because these sediment sample locations will only be covered during the South Pond area response action and may come into contact with future populations.
Supplemental Building Investigation (December 1992)	Shallow Soil (SB-1 through SB-5)	Surface Cap	Yes	Samples are located west of Building 1 and were not included in previous risk assessments.
Building Site Assessment (May 1993)	Surface Soil (EE-037 through EE-042, EE-057 through EE-059)	Surface Cap	Yes	Although these locations are currently covered by an asphalt cap, soil contamination is still present at these locations and may come into contact with future populations.

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Table 3-1 (continued)
Applicability of Investigation Data
to OU4 Risk Assessment
Des Moines TCE Site
OU4 Risk Assessment

Investigation	Media (sample numbers)	Affected by which Response Action?	Applicable to Evaluation of Risks?	Rationale
Building Flood Assessment (July 1993)	Sediment (EE-105)	Building	Yes	Samples are located west of Building 1 and were not included in previous risk assessments.
Shallow Subsurface Investigation (January 1994)	Shallow Soil (OG-1 through OG-5 and OG-12 through OG-35)	Surface Cap	Yes	Although these locations are currently covered by an asphalt cap, shallow soil contamination is still present at these locations and may come into contact with future populations.
	Shallow Soil (OG-6 and OG-9 through OG-11)	South Pond	Yes	This data is still considered applicable because these shallow soil sample locations will only be covered during the South Pond area response action and may come into contact with future populations.
	Shallow Soil (OG-7 and OG-8)	South Pond	Yes	The shallow soil, from which the OG-7 and OG-8 samples were obtained, will be excavated and consolidated in the South Pond during the South Pond response action and may come into contact with future populations.
Habitat Evaluation (February 1994)	Sediment (BV-1 and BV-2)	South Pond	Yes	This data is still considered applicable because these sediment sample locations will only be covered during the South Pond area response action and may come into contact with future populations.
Drainage Channel Characterization (April 1994)	Surface Soil (BM/1-10 through BM/101-110)	South Pond	Yes	The surface soil, from which these samples were obtained, will be excavated and consolidated in the South Pond during the South Pond area response action and may come into contact with future populations.
	Surface Soil (BM/111-120)	None	Yes	This surface soil sampling location will be addressed as an "exposed soil" location given that it will not be affected by the South Pond area response action and may come into future populations.
Soil Pile Sampling (August 1994)	Surface Soil (OG-107 through OG-1011)	South Pond	Yes	The stockpiled soil, from which these samples were obtained, will be excavated and consolidated in the South Pond during the South Pond area response action.

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3.1 Background

A comparison of inorganic concentrations present in background versus those onsite was not performed due to the inadequacy of background soil data. Background soil data locations were not of sufficient quantity to adequately assess the background condition. This is normally done in order to assess whether inorganic levels onsite are due to anthropogenic activity or are simply characteristic of regional levels. Past site activities have generally involved at least two processes that result in inorganics contamination, therefore, the inorganics were all retained with respect to background. These processes included a grey iron foundry and steel wheel manufacture. The risks generated for inorganics reveal that further evaluation of inorganics is unnecessary for inorganics, which have associated risks below levels of concern. Because inorganic risks fall below levels of concern, further evaluation in the context of additional discussion of those risks is deemed irrelevant, and inorganics are not considered to be of concern for OU4.

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4.0 Toxicity Assessment Results

The purpose of the toxicity assessment is to weigh available evidence about the potential for adverse effects to exposed populations by the chemicals of potential concern and to provide an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood or severity of adverse effects.

Health hazards for chemicals exhibiting non-carcinogenic effects were evaluated using RfDs developed by the USEPA RfD work group or obtained from health effects assessments (HEA). The RfD is an estimate of the daily exposure to the human population that is not likely to be harmful over a lifetime. RfDs are expressed in units of mg/kg/day and include exposure to sensitive subpopulations within the derivation. The RfDs are usually derived from human studies involving work place exposures or from animal studies. RfDs are adjusted using uncertainty factors to account for unknown interpolations from the available studies and data. The RfD is a reference point for comparison of chemical intakes.

Health risks for chemicals exhibiting carcinogenic effects were evaluated using SFs developed by USEPA's carcinogen assessment group. SFs estimate the upper-bound excess lifetime cancer risk associated with lifetime exposure to potential human carcinogens. Excess cancer risk is calculated based on the average daily intake over a lifetime and the cancer SF. The SF is an estimate of a chemical's slope of the chronic dose-response curve at low doses. Because it is generally not possible to measure this slope directly, it is calculated from the chronic dose-response data at high dose levels. These calculations assume linearity of the dose-response curve at low doses and that the carcinogen has no threshold. Although these assumptions can be debated, this approach is currently the most appropriate means for estimating cancer risks in exposed humans.

The USEPA has developed a weight-of-evidence classification system for potential carcinogens. In this system, chemicals are classified as either Group A, B1, B2, C, D, or E. Group A chemicals are classified as human carcinogens with sufficient evidence from epidemiologic studies to support a causal association between human exposure and cancer. Group B1 and B2 chemicals are classified as probable human carcinogens. Group B1 applies to chemicals with limited evidence of carcinogenicity in humans from epidemiologic studies, and Group B2 applies to chemicals with inadequate evidence of carcinogenicity in humans but sufficient evidence of carcinogenicity in animals. Group C applies to chemicals with limited evidence of carcinogenicity in animals. Group D is not classified because of

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inadequate evidence of carcinogenicity in animals, and Group E applies to chemicals that show no evidence of carcinogenicity in humans where there is at least two adequate animal tests or both epidemiologic and animal studies.

The dermal exposures at OU4 require adjusted RfDs and SFs because the USEPA has not developed dermal RfDs or SFs. These critical toxicity values were derived based on available oral RfDs and SFs. This derivation requires conversion of the RfDs and SFs to absorbed dose rather than the administered dose because dermal intakes are calculated as absorbed doses. Approximate values for adjusted RfDs and SFs used in the dermal contact scenarios were derived by simple extrapolation from oral RfDs and SFs. For RfDs, the oral RfD value was multiplied by the oral absorption fraction. For SFs, the oral SF was divided by the oral absorption fraction. This absorption fraction was obtained from the chemical-specific Agency for Toxic Substances and Disease Registry (ATSDR) Toxicity Profile. If no chemical specific absorption fraction existed for a contaminant, then a conservative five percent absorption was assumed (USEPA, 1989a).

Appendix C presents oral and adjusted dermal RfDs and SFs for the COPCs in soil at OU4.

Neither carcinogenic nor noncarcinogenic toxicity values were available for lead in the IRIS data base. However, USEPA provides recommended acceptable levels for lead (USEPA, 1993), which are presented in Appendix H. These acceptable levels are 500 to 1,000 ppm for soil (500 for residential and 1,000 for industrial). Onsite lead levels in soil exceed both of these concentrations.

USEPA provides a chronic oral RfD value for cadmium based on the ingestion of water and a separate chronic oral RfD value based on the ingestion of food. To reflect this distinction, this assessment used the RfD value for food ingestion to calculate a hazard index for soil ingestion.

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5.0 Exposure Assessment Results

This section presents the results of the exposure assessment for OU4. The purpose of the exposure assessment is to identify potential receptors and quantify their potential exposure to the chemicals of potential concern.

5.1 Characterization of Exposure Setting

The exposure setting consists of two components: the physical features of the sites and the potentially exposed populations. The physical features and site background are presented in this section. Additional detail on site background and the site setting can be found in the OU2 RI and the OU4 RI reports.

5.1.1 Site Background. The OU2 and OU4 area has been used for a variety of industrial uses, including a grey iron foundry (built in 1910), a steel wheels manufacturing plant, chemical and herbicide distribution, and pesticide formulation processes. During various activities completed at the site over the years, DICO or related companies have modified drainage patterns and site features through the construction of several buildings and regrading efforts. The buildings were constructed as various industrial activities were initiated at the site. In addition, drainage features across the site have changed significantly over time due to the construction of a flood control levee; the installation of a storm water bypass to the Raccoon River that redirects storm water from a large area to the north of DICO; and the enclosure of the main drainage channel through the DICO property.

Some of the activities conducted within OU2 and OU4 involved bulk chemical storage and distribution. As reported in the OU2 RI (ECK, 1993a), an entity called DiChem, Inc. formerly located in Buildings 1 through 5 of OU4, purchased bulk quantities of various solvents for repackaging and distribution to commercial clients in the 1950s and 1960s. These solvents included perchloroethylene (PCE), TCE, toluene, xylene, and 1,1,1-TCA. These solvents were stored in large aboveground containers and then packaged in 55-gallon drums for distribution. A drum cleaning area was located to the west of the DICO Production Building. The drum fill area was located immediately north of Building 1. DiChem also distributed hydrochloric, phosphoric, and sulfuric acids at the site from the 1940s through the mid to late 1970s.

Other activities conducted almost exclusively within the OU4 area involved pesticide and herbicide formulation. Buildings 1 through 5 and the Maintenance

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Building were used by DiChem for the formulation of technical grade pesticides and herbicides. The primary formulation activities were conducted within Buildings 2 and 3 while Buildings 4 and 5 were primarily used for chemical storage, delivery, and product storage. These activities reportedly occurred from the mid-1950s through the early 1970s. Raw materials were provided by several companies who contracted with DiChem to perform the formulation processes. Successors to these companies, known as the DiChem Customer Group, who have been notified as to their potential liability at the site include Amoco Corporation, Chevron Chemical Company, Miles Inc., Monsanto Company, and Shell Oil Company. The pesticide formulation equipment was removed from the buildings in the late 1970s.

From the late 1970s, until the summer of 1993, the OU4 buildings were generally used for painting and warehousing of steel wheels and brake assemblies.

In July 1993, the OU2 and OU4 portions of the site were flooded by up to 6 feet of water. The flood waters inundated the site, after apparently backing up to the site inside the existing levee system along the Raccoon River. As flood water receded from the site, several inches of sediment materials were deposited in the DICO buildings. DICO personnel flushed some of the sediment from the buildings following subsidence of the flood waters to retrieve inventory contained in Buildings 1 and 2. However, the majority of the sediment and inventory remained in the buildings until they were addressed during a building response action subsequently conducted at the site.

In the fall of 1993, Titan Wheel International Inc. (Titan) purchased the Dyneer Corporation, DICO's corporate parent. Subsequently, Titan has taken an active role in continuing the OU1 remedy and addressing the concerns related to the OU2 and OU4 portions of the site.

Fourteen separate site investigation activities have been conducted within the OU4 area of the site. This series of separate, but interrelated site investigations was conducted concurrent with and subsequent to USEPA's approval of the OU2 RI report in February 1993. The site investigations completed within OU4 are can be summarized as follows (more detailed descriptions can be found in the OU4 RI report):

- OU2 RI related activities were conducted between 1989 and 1993. A portion of the OU2 RI data is now referred to as OU4 data because a portion of the OU2 sampling locations are included within the OU4 boundaries of the site.

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- A building engineering evaluation of dust/residues and insulation materials in Buildings 1 through 5 and the Maintenance Building was conducted during 1991.
- A supplemental site investigation of Buildings 1 through 3 was also conducted during December 1992.
- Archived dust samples from the building engineering evaluation were analyzed in March 1993.
- A building site assessment of Buildings 1 through 5 and the Maintenance Building was conducted in May 1993.
- A building flood assessment was conducted in July 1993 to assess the effects of the May-June flooding on Buildings 1 and 2.
- Additional shallow subsurface soil (0-6 inches) investigation sampling was performed within the OU4 area in January 1994.
- An ecological habitat evaluation of the South Pond Area was conducted in February 1994.
- A drainage channel investigation was performed in April 1994.
- Building inventory post-washing sampling and analysis within Building 2 was conducted from May through August 1994.
- Confirmatory air monitoring of Buildings 4 and 5 was performed during July 1994.
- Stockpiled soils, remaining after the installation of underground utilities east of Buildings 4 and 5, were sampled and analyzed in August 1994.
- The aldrin tank excavation was performed in September and October 1994. Soil samples were collected in the excavation area at various stages of the response action.
- Confirmatory air monitoring of Buildings 1 through 5 and the Maintenance Building was performed during November 1994.

Portions of the data obtained during these site investigations are no longer applicable for the purposes of evaluating the nature and extent of contamination within the OU4 portion of the site, and thus are not relevant to this risk assessment. These are further discussed in the OU4 RI report.

Three response actions are in various stages of completion at the site as the RI/FS process proceeds for OU2 and OU4. Brief descriptions of the response actions are as follows (more detailed descriptions can be found in the OU4 RI report):

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- In March 1994, USEPA signed an action memorandum and issued a Unilateral Administrative Order (UAO) to DICO to clean and encapsulate various interior portions of DICO Buildings 1 through 5 and the Maintenance Building.
- In June 1994, USEPA signed an action memorandum and issued a UAO to DICO. This order required either excavation and offsite disposal of contaminated soils or the placement of a asphalt cap over a large portion of OU2 to mitigate human health risk to industrial receptors due to detected concentrations of pesticides and herbicides. DICO chose to place an asphalt cap over a larger portion of both OU2 and OU4 areas at the site.
- Later this year (1995), a response action is anticipated to begin in the South Pond area of OU4. It is anticipated that the South Pond area response action will mitigate the threat presented by the contamination detected within the South Pond, the drainage ditch that receives discharges from the South Pond, and soil piles stockpiled directly east of Buildings 4 and 5. This response action will consist of complete excavation and consolidation of contaminated soils in the South Pond which will be capped with clean fill and revegetated. Surface drainage pathways will also be re-routed around the South Pond as part of this response action. USEPA plans to negotiate an Administrative Order on Consent (AOC) with a group of PRPs to complete the required response action.

5.1.2 Physical Features. The topography of both the OU2 and OU4 portions of the site can be attributed to fill material used to bring the property above the former elevation of the Raccoon River flood plain. In general, the DICO property is level; however, the northern portion of the site slopes slightly to the east-northeast away from the Raccoon River and the southern portion of the site slopes to the south-southeast. The levee system to the south and west of the developed portion of the site is approximately 10 feet higher in elevation than the level area on which the DICO facility is located. Topography in the southwest portion of the site (Frank DePuydt woods) slopes slightly to the southeast and is approximately 10 feet lower than the elevation of the DICO facility (20 feet below the top of the levee).

The primary drainageways at the site are the Ingersoll Run (which previously existed as an open ditch and now exists as an underground culvert) that allows storm water runoff to flow from north to south through the middle of the site, a ditch

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adjacent and parallel to the eastern DICO property line, and a ditch parallel to the former railroad spur. Site-specific surface water drainage at the site has been affected by the placement of the response action asphalt cap over most of OU2 and OU4, excluding the South Pond area. The presence of the asphalt cap significantly reduces infiltration of precipitation. Precipitation which lands on asphalt capped areas moves as overland flow (sheet flow) across the site and enters the primary drainageways. Storm water runoff flows through the primary drainageways to the southeast area of OU4 and leaves OU4 flowing to the east and south.

As part of the planned South Pond response action, an extension to the Ingersoll Run will be constructed to divert storm water runoff around the South Pond area.

The site is located within the 100-year floodplain of the Raccoon River. Based on the Federal Emergency Management Agency's (FEMA) flood insurance map, the levee system protects the developed portion of the site from a 100-year flood event. The Frank DePuydt woods, outside the levee, is located within the 100-year flood plain where the base flood elevation is 802 feet above mean sea level (MSL).

In 1993 the DICO facility was flooded due to a record high crest of the Raccoon River, described as approximately a 400-year flood event. Since the 1993 flood event, flood gates were constructed to provide protection against a 400 to 500-year flood. Several pump stations have also been installed to help alleviate flood potential associated with combined sewer overflow conditions during significant rainfall or high water. These pump stations are designed to handle a 10 year rainfall event.

The City of Des Moines Planning Department (Planning Department) was contacted by USEPA and BVWS in November 1994 to determine the current and anticipated future land use and zoning plans for the site and surrounding area.

The present zoning (as of 1990) for the site (the entire DICO property) is currently designated as a "heavy industrial district", and the southern portion of OU4, the Frank DePuydt woods beyond the levee system, is designated as "floodplain".

The Planning Department considers that the DICO property is involved in "warehousing and distribution". The southern portion of the site, containing the South Pond, and a section of Frank DePuydt woods, is considered by the Planning Department to be vacant.

A "Riverpoint Urban Renewal Plan" has been developed for the purpose of promoting new growth along the Raccoon River in downtown Des Moines. This renewal plan was prepared because the area is considered to be relatively stagnant, with under-utilized land and a high percentage of substandard buildings. The

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Riverpoint Urban Renewal Area covers approximately 1,125 acres in an area directly south of the Des Moines downtown core. The renewal area is generally bounded by the Raccoon River and Scott Street to the south; Ingersoll Avenue and the Norfolk Southern Rail Line to the north; East 14th Street to the east; and Fleur Drive to the west. The western extension of the Riverpoint Plan, encompasses the DICO property and the site. Information presented in the Riverpoint Urban Renewal Plan is summarized in the OU2 RI report.

As part of the 15th Amendment to the Des Moines 2000 Land Use Plan, the City Plan and Zoning Commission held a public hearing to consider amending the plan by revising the classification of land in the vicinity of SW 15th Street north of the Raccoon River. The amendment to revise the land classification from High Density Residential to Industrial was approved by the city council on January 16, 1995.

5.2 Potentially Exposed Populations

Potentially exposed populations include either current or future groups that could possibly come in contact with contaminants at the site. This can typically range from a maintenance-type worker with very low exposure potential to future residents who spend the majority of their time onsite.

5.2.1 Current Populations Onsite. There are no human populations that may currently be exposed to contaminants at OU4 that are under the cap. For exposure to soils that are not under the cap, people recreating on the site could come in contact with exposed soils, but no workers regularly contact this area. For the purpose of this BRA, exposed soils refers to only those areas which have not been or are not anticipated to be affected by a response action. These areas of exposed soils include three samples (SP-B, SP-D, and SS111-120) located east of the east ditch and near the south end of the Dico property. For current populations, exposure to exposed soil will be evaluated for current recreational populations.

5.2.2 Future Populations Onsite. In order to adequately assess potential future risks, it was assumed that OU4 will be developed in one of two ways. Either the site will remain industrial and the cap will be maintained, or it will become residential and the cap will be removed. For onsite soil beneath the cap, future residential and future industrial scenarios will be evaluated assuming the cap is not present. The

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same is true for exposed soils. Accordingly, future onsite populations that could potentially be exposed include onsite workers and onsite residents.

5.3 Identification of Exposure Pathways

This section identifies the exposure pathways that will be quantitatively evaluated in the OU4 risk assessment.

5.3.1 Current Land-Use Conditions. The potential exposure pathways for OU4 under current land-use conditions include only pathways typical of soil exposure. The cap prevents current exposure to nearly all of OU4. For current land use, incidental ingestion of exposed soil and dermal contact with exposed soil are quantitatively evaluated.

5.3.2 Future Land-Use Conditions. The potential exposure pathways for OU4 under future land-use conditions also include pathways typical of soil exposure. For the capped data, future workers and residents will be evaluated utilizing incidental ingestion and dermal contact. Exposed soils will be evaluated with the same future populations and the same future pathways, incidental ingestion and dermal contact.

5.4 Summary of Exposure Pathways

Based on the preceding evaluation process, the following pathways have been retained for subsequent quantitative evaluation:

- Current exposure of recreators to contaminants in soil (0-2') through ingestion and dermal contact for exposed soils.
- Future exposure of onsite workers to contaminants in soil (0-12') through ingestion and dermal contact for capped soils.
- Future exposure of onsite residents to contaminants in soil (0-12') through ingestion and dermal contact for capped soils.
- Future exposure of onsite workers to contaminants in soil (0-2') through ingestion and dermal contact for exposed soils.
- Future exposure of onsite residents to contaminants in soil (0-2') through ingestion and dermal contact for exposed soils.

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5.5 *Quantitation of Exposure*

Quantitative characterization of carcinogenic and noncarcinogenic effects requires estimates of exposure levels for each contaminant. The intake of a chemical is estimated from six basic factors: exposure frequency, exposure duration, contact rate, chemical concentration, body weight, and averaging time. In this assessment, intake is normalized for time and body weight, and is expressed in milligrams of chemical per kilogram of body weight per day (mg/kg/day).

Intake is described by the following general equation:

$$\text{Intake} = (C \times CR \times EF \times ED)/(BW \times AT)$$

where:

Intake	=	Amount of chemical at the exchange boundary (mg/kg/day).
C	=	Exposure point concentration (units are media dependent).
CR	=	Contact rate (units are media dependent).
EF	=	Exposure frequency (days).
ED	=	Exposure duration (years).
BW	=	Body weight (kg).
AT	=	Averaging time over which exposure is averaged (days).

The above intake parameters vary depending on the route of exposure. This subsection describes the way the exposure concentrations and the human intake factors are derived.

5.5.1 Exposure Concentration. One possible estimate of the exposure point concentration term (C) in the intake equation would be to use the arithmetic average of the concentration that is contacted over the exposure period. However, in order to be adequately conservative and account for the uncertainty of any estimate of exposure concentrations, the 95th percent upper one-sided confidence limit (95th UCL) on the arithmetic mean of the average was used for this variable. The 95th UCL was used to evaluate a RME case. Standard statistical methods (t-test) are used to calculate the upper confidence limit on the arithmetic mean, and where this value exceeds the maximum observed concentration, the maximum concentration is used as the exposure-point concentration. This generally occurs only when the data set consists of less than 10 sampling points. Contaminant concentrations reported as

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"not detected," or below the SQL at only some locations in a data set were not eliminated from the risk assessment. Instead, the concentrations of these contaminants were estimated using one-half the SQL and these values, along with detections, were used to calculate the exposure-point concentrations (USEPA, 1989a). Contaminants that were reported as "not detected" for all sampling points in a data set were eliminated from the risk assessment, as were data sets with only one low level (near the detection limit) detection.

For the current exposure scenarios at OU4, only surface soils (0-2') were included in the calculation of exposure-point concentrations.

For the future exposure scenarios at the facility, surface and subsurface soils (0-12') were grouped together for the calculation of exposure-point concentrations.

Exposure-point concentrations were estimated for the chemicals of potential concern that were detected in the following media and are presented on the tables in Appendices D and E. The data was broken down as follows:

Current Exposure:

- Exposed onsite soils (0 to 2 feet deep).

Future Exposure:

- Capped onsite soils (0 to 12 feet deep).

Appendices D and E present statistical data including the 95th UCL on the arithmetic mean, the maximum detected value, and the number of samples (N). Where the 95th UCL exceeds the maximum detected value, the maximum detected value is used as the exposure concentration. The final column on these two tables presents either the 95th percent UCL or the maximum, whichever is less, and this column is used as the exposure-point concentration for the computations of hazard quotient (noncarcinogenic effect) and risk (carcinogenic effect).

The estimates of future soil exposure concentrations presented here assume that concentrations will remain constant over the duration of exposure (up to 30 years). This is a conservative assumption because nearly all chemicals, especially volatiles, are subject to a variety of fate processes (except inorganic chemicals which are highly persistent). For onsite soils for the future scenarios, a 0 to 12 foot depth range was selected based on the fact that normal commercial excavation is within this range and data for these depths was available, making the risk assessment protective of human health. If future construction or excavating were to occur and foundations were

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excavated in the area, the soil from below could then be brought up to the surface, resulting in exposure to these deeper soils.

5.5.2 Human Intake Factors. HIFs are site-specific terms that quantify the degree of contact between humans and environmental media at the exposure points. The USEPA has developed several guidance documents that provide information for deriving HIFs. The RAGS manual summarizes much of the information for these other sources, and was used as the primary source for information to derive the HIFs. Additional guidance includes the Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03 (USEPA, 1991a) issued March 25, 1991, and the Interim Guidance for Dermal Exposure Assessment (USEPA, 1991c).

The OSWER directive 9285.6-03 was used for most exposure assumptions (i.e., ingestion rate, exposure duration, body weight, skin surface areas available for contact, adherence factor, etc.) in this risk assessment except where noted under the non-standard assumptions section.

These assumptions are used in the risk tables to calculate exposures and carcinogenic and noncarcinogenic effects. All the exposure assumptions and equations necessary to calculate the HIF for a particular exposure pathway is listed as a footnote to each risk tables in Appendix G.

5.5.3 Exposure Assumptions.

5.5.3.1 Current Land Use and Zoning.

Recreational Scenarios. For recreational populations, incidental ingestion and dermal contact for an adult and child combination scenario was evaluated using the following exposure assumptions:

<u>Incidental Ingestion</u>
Incidental Ingestion of Soil (Child and Adult combined):

Ingestion Rate, Child (IRC)	200 mg/day (OSWER 9285.6-03)
Ingestion Rate, Adult (IRA)	100 mg/day (OSWER 9285.6-03)
Fraction from Source	0.166 unitless (2 hrs/12 hr day)
Exposure Duration, Child (EDC)	6 years (OSWER 9285.6-03)
Exposure Duration, Adult (EDA)	24 years (OSWER 9285.6-03)
Exposure Frequency, Child (EFC)	52 days/yr (2 days/wk, 26 wks/yr)
Exposure Frequency, Adult (EFA	26 days/yr (1 day/wk, 26 wks/yr)
Body Weight, Child (BWC)	15 kg (OSWER 9285.6-03)

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Body Weight, Adult (BWA)	70 kg (OSWER 9285.6-03)
Averaging Time, Noncarcinogens (ATN)	30 years (OSWER 9285.6-03)
Averaging Time, Carcinogens (ATC)	70 years (OSWER 9285.6-03)
Conversion Factor (CF)	0.000001 kg/mg

Dermal Contact

Dermal Contact with Soil (Child and Adult combined):

Surface Area, Child (SAC)	2500 cm^2 (USEPA, 1991c)
Surface Area, Adult (SAA)	5000 cm^2 (USEPA, 1991c)
Fraction from Source	0.166 unitless (2 hrs/12 hr day)
Exposure Duration, Child (EDC)	6 years (OSWER 9285.6-03)
Exposure Duration, Adult (EDA	24 years (OSWER 9285.6-03)
Exposure Frequency, Child (EFC)	52 days/yr (2 days/wk, 26 wks/yr)
Exposure Frequency, Adult (EFA)	26 days/yr (1 day/wk, 26 wks/yr)
Body Weight, Child (BWC)	15 kg (OSWER 9285.6-03)
Body Weight, Adult (BWA)	70 kg (OSWER 9285.6-03)
Averaging Time, Noncarcinogens (ATN)	30 years (OSWER 9285.6-03)
Averaging Time, Carcinogens (ATC)	70 years (OSWER 9285.6-03)
Adherence Factor (AF)	1.00 mg/cm^2 (OHEA-E-367)
Conversion Factor (CF)	0.000001 kg/mg
Absorption Factor (ABS)	Contaminant specific (CAPCOA values)

5.5.3.2 Future Land Use and Zoning.

Residential Scenarios. For future residential populations, incidental ingestion and dermal contact for a combined child and adult scenario was evaluated using the following exposure assumptions:

Incidental Ingestion

Incidental Ingestion of Soil (Child and Adult combined):

Ingestion Rate, Child (IRC)	200 mg/day (OSWER 9285.6-03)
Ingestion Rate, Adult (IRA)	100 mg/day (OSWER 9285.6-03)
Exposure Duration, Child (EDC)	6 years (OSWER 9285.6-03)
Exposure Duration, Adult (EDA)	24 years (OSWER 9285.6-03)
Exposure Frequency, Child (EFC)	350 days/yr (OSWER 9285.6-03)
Exposure Frequency, Adult (EFA)	350 days/yr (OSWER 9285.6-03)
Body Weight, Child (BWC)	15 kg (OSWER 9285.6-03)
Body Weight, Adult (BWA)	70 kg (OSWER 9285.6-03)
Averaging Time, Noncarcinogens (ATN)	30 years (OSWER 9285.6-03)

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Averaging Time, Carcinogens (ATC)	70 years (OSWER 9285.6-03)
Conversion Factor (CF)	0.000001 kg/mg

Dermal Contact

Dermal Contact with Soil (Child and Adult combined):

Surface Area, Child (SAC)	2500 cm^2 (OHEA-E-367)
Surface Area, Adult (SAA)	5000 cm^2 (OHEA-E-367)
Exposure Duration, Child (EDC)	6 years (OSWER 9285.6-03)
Exposure Duration, Adult (EDA)	24 years (OSWER 9285.6-03)
Exposure Frequency, Child (EFC)	350 days/yr (OSWER 9285.6-03)
Exposure Frequency, Adult (EFA)	350 days/yr (OSWER 9285.6-03)
Body Weight, Child (BWC)	15 kg (OSWER 9285.6-03)
Body Weight, Adult (BWA)	70 kg (OSWER 9285.6-03)
Averaging Time, Noncarcinogens (ATN)	30 years (OSWER 9285.6-03)
Averaging Time, Carcinogens (ATC)	70 years (OSWER 9285.6-03)
Adherence Factor (AF)	1.00 mg/cm^2 (OHEA-E-367)
Conversion Factor (CF)	0.000001 kg/mg
Absorption Factor (ABS)	Contaminant specific (CAPCOA values)

Occupational (General Worker) Scenarios. For occupational (general worker) populations, incidental ingestion and dermal contact for an adult scenario was evaluated using the following exposure assumptions:

Incidental Ingestion

Incidental Ingestion of Soil (Adult):

Ingestion Rate, Adult (IR)	50 mg/day (OSWER 9285.6-03)
Exposure Duration, Adult (ED)	25 years (OSWER 9285.6-03)
Exposure Frequency, Adult (EF)	48 days/yr (Eckenfelder RI)
Body Weight, Adult (BW)	70 kg (OSWER 9285.6-03)
Averaging Time, Noncarcinogens (ATN)	25 years (OSWER 9285.6-03)
Averaging Time, Carcinogens (ATC)	70 years (OSWER 9285.6-03)
Conversion Factor (CF)	0.000001 kg/mg

Dermal Contact

Dermal Contact with Soil (Adult):

Surface Area, Adult (SA)	3120 cm^2 (USEPA, 1991c)
Exposure Duration, Adult (ED)	25 years (OSWER 9285.6-03)
Exposure Frequency, Adult (EF)	48 days/yr (Eckenfelder RI)

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Body Weight, Adult (BW)	70 kg (OSWER 9285.6-03)
Averaging Time, Noncarcinogens (ATN)	25 years (OSWER 9285.6-03)
Averaging Time, Carcinogens (ATC)	70 years (OSWER 9285.6-03)
Adherence Factor (AF)	1.00 mg/cm^2 (USEPA, 1991c)
Conversion Factor (CF)	0.000001 kg/mg
Absorption Factor (ABS)	contarninant specific (CAPCOA values)

5.5.4 Site-Specific Exposure Assumptions. The site-specific or non-default exposure assumptions used at OU4 are generally taken from the Exposure Factors Handbook (USEPA, 1989d) or are factors that were agreed upon in the Eckenfelder OU2 Risk Assessment. All other assumptions conform to the OSWER Directives that apply to risk assessments. For the soil exposures at this site these site-specific or non-default assumptions include the following:

- Skin surface area for dermal exposures for the adult resident is 5,000 square centimeters for the RME case which and for the child is 2,500 square centimeters. These values come from OHEA-E-367.
- The absorption factors for the dermal route are 0.1 for organics, 0.1 for copper, lead, manganese, selenium, and zinc, 0.2 for cadmium, and 0.01 for the remaining inorganics. These values are from CAPCOA.
- For workers, an exposure duration of 48 days/year was chosen, which represents one day/week exposure for 48 weeks/year. This was agreed upon for the OU2 risk assessment.
- Dermal surface area for the worker is 3,120 square centimeters, which represents the 90th percentile value for hands and arms from the exposure factors handbook.
- There is little guidance on the application of a recreational scenario, and the values chosen are intended to reflect potential exposures at this site. The current recreator is assumed to experience 1/12 of the daily exposure from the site, representing 2 hours/day and a 12-hour day.
- The adult recreator is assumed to spend 26 days/year at the site, while the child is assumed to spend 52 days/year at the site. These are based on 1 day/week and 2 days/week, respectively, for the summer months.

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6.0 Risk Characterization Results

The final step in the risk assessment process is risk characterization. Risk characterization involves reviewing the results from the exposure assessment and the toxicity assessment in order to present a calculated or estimated risk for each exposure at the site. The risks are then combined across appropriate exposure pathways.

The risks calculations, for the compounds carried through the process, are presented in Appendix D for the capped soils (Tables 1-6) and exposed soils (Tables 7-15), and can be summarized as follows:

6.1 Current Scenarios

6.1.1 Exposed Soil Recreator (Current Child/Adult) Risks.

Noncarcinogenic Risk:

Incidental Ingestion surface soil 0 to 2 ft	0.000081 (Table 13)
Dermal Contact surface soil 0 to 2 ft	0.0029 (Table 14)
Incidental Ingestion combined with Dermal Contact	0.003

Carcinogenic Risk:

Incidental Ingestion surface soil 0 to 2 ft	1.7×10^{-8} (Table 13)
Dermal Contact surface soil 0 to 2 ft	6.4×10^{-7} (Table 14)
Incidental Ingestion combined with Dermal Contact	7×10^{-7}

6.2 Future Scenarios

6.2.1 Capped Area Residential (Child and Adult) Risks

Noncarcinogenic Risk:

Incidental Ingestion surface soil 0 to 12 ft	3.6 (Table 1)
Dermal Contact surface soil 0 to 12 ft	140 (Table 2)
Incidental Ingestion combined with Dermal Contact	144

Carcinogenic Risk:

Incidental Ingestion surface soil 0 to 12 ft	7.5×10^{-4} (Table 1)
Dermal Contact site surface soil 0 to 12 ft	3.0×10^{-2} (Table 2)
Incidental Ingestion combined with Dermal Contact	3×10^{-2}

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6.2.2 Capped Area Worker Risks

Noncarcinogenic Risk:

Incidental Ingestion surface soil 0 to 12 ft	0.093	(Table 4)
Dermal Contact surface soil 0 to 12 ft	9.6	(Table 5)
Incidental Ingestion combined with Dermal Contact	9.7	

Carcinogenic Risk:

Incidental Ingestion surface soil 0 to 12 ft	$1.6x10^{-5}$	(Table 4)
Dermal Contact surface soil 0 to 12 ft	$1.7x10^{-3}$	(Table 5)
Incidental Ingestion combined with Dermal Contact	$1.7x10^{-3}$	

6.2.3 Exposed Soils Area Residential Risks

Noncarcinogenic Risk:

Incidental Ingestion surface soil 0 to 12 ft	0.0039	(Table 7)
Dermal Contact surface soil 0 to 12 ft	0.17	(Table 8)
Incidental Ingestion combined with Dermal Contact	0.2	

Carcinogenic Risk:

Incidental Ingestion surface soil 0 to 12 ft	$8.2x10^{-7}$	(Table 7)
Dermal Contact surface soil 0 to 12 ft	$3.8x10^{-5}$	(Table 8)
Incidental Ingestion combined with Dermal Contact	$4x10^{-5}$	

6.2.4 Exposed Soils Area Worker Risks

Noncarcinogenic Risk:

Incidental Ingestion surface soil 0 to 12 ft	0.000099	(Table 10)
Dermal Contact surface soil 0 to 12 ft	0.012	(Table 11)
Incidental Ingestion combined with Dermal Contact	0.01	

Carcinogenic Risk:

Incidental Ingestion surface soil 0 to 12 ft	$1.8x10^{-8}$	(Table 10)
Dermal Contact site surface soil 0 to1 2 ft	$2.1x10^{-6}$	(Table 11)
Incidental Ingestion combined with Dermal Contact	$2x10^{-6}$	

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6.3 Evaluation of Risks

6.3.1 Evaluating Noncarcinogenic Effects. The values for adverse noncarcinogenic effects from chemical exposure are expressed as a HQ. The HQ is the ratio of the DI a human receives to the RfD, the estimated dose below which it is unlikely for even sensitive populations to experience adverse health effects.

All HQ values for chemicals within each exposure pathway are summed to yield the hazard index (HI). If the value of the HI is less than 1.0, it indicates that the hazard of noncarcinogenic injury is low. If the HI is greater than 1.0, it indicates some degree of concern for noncarcinogenic effects. Using the HQ equation, the DI values as calculated using the equations in Subsection 2.4 (presented in detail in the Tables in Appendix D) and the RfD values in Tables in Appendix C, a hazard quotient for each of the exposure scenarios considered in this risk assessment were calculated for each chemical of potential concern associated with each pathway and exposure point. Only chronic HIs are derived, as the subchronic effects within a given exposure scenario will always be equal to or less than the chronic effects for that scenario. The entire calculation process for the exposure pathways at OU4 is presented in Appendix D. These tables present the exposure assessment results as well as the quantitation of carcinogenic and noncarcinogenic effects.

The tables in Appendix D present the exposure assumptions and formulas used to generate the HIFs and both noncarcinogenic and carcinogenic effects. The HIF is generated from the formula and assumptions presented at the bottom of each table. The formula used to derive "Intake" is also presented at the bottom of each table. The RfDs, SFs, and permeability constants are given in the tables in Appendix C. The respective carcinogenic and noncarcinogenic values from each chemical are summed to yield the final pathway carcinogenic risk and noncarcinogenic effect hazard.

6.3.2 Evaluating Carcinogenic Risks. The risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer during a lifetime from that exposure. The risk value is calculated from the multiplication of the DI and the SF. OSWER directive 9355.0-30 states that cumulative site risks of less than 1×10^{-4} indicate that remedial action is generally unnecessary unless onsite levels of a contaminant exceed chemical specific standards

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(e.g., MCLs, MCLGs, etc.) or there are "imminent and substantial" adverse environmental impacts (USEPA, 1991b).

Using the equation from Section 2.4 and employing the DI values calculated for lifetime exposure (Appendix D) along with the SF values (Appendix C), cancer risks were calculated for lifetime exposures that may occur at OU4. A summary of the carcinogenic risk results is presented in Section 6.2. It is important to note that the carcinogenic risk estimates presented in Section 6.2 represent the summation of the individual risks associated with each of the chemicals of potential concern for which adequate cancer information is available.

For comparison purposes, pathways with risks that exceed 1×10^{-5} are discussed in detail, while pathways with lower risks are deemed to be less significant. This level is simply the midpoint of the acceptable risk range (1×10^{-4} to 1×10^{-6}) as defined by USEPA in OSWER directive 9355.0-30 (USEPA, 1991b), and represents a reasonable point at which more discussion is appropriate. In addition, any pathway or population for which remedial action is generally warranted (i.e., risks equal to or greater than 1×10^{-4}) are noted.

6.3.3 Summary of Capped Soil Risks. There are no current risks to contaminated soil that is under the cap because the cap has essentially eliminated a complete exposure pathway. If the exposure pathway is incomplete, the potentially exposed population is not in contact with contaminants in the media of concern, therefore quantifiable risks do not exist.

Future residents (Appendix D Tables 1 and 2) could come in contact with contaminated soils if the cap were disturbed or allowed to deteriorate, resulting in a completion of the soil exposure pathways (incidental ingestion and dermal contact). The future residential scenario is the RME for this site, and yields the most restrictive cleanup levels (i.e. lowest) for the contaminants of concern, though it is somewhat less likely to occur than the future occupational (worker) scenario. The zoning for this area was recently changed to maintain the industrial land use setting. Noncarcinogenic risks to the future resident are well over the 1.0 level that is the level where increased concern is triggered. Both incidental ingestion (HI = 3.6) and dermal contact (HI = 140) are above the level of concern, indicating the presence of increased concern for future residents in the event of residential development. The largest single risk driving contaminant is aldrin with an HI of 2.2 for incidental ingestion. Aldrin also yields an HI of 105 for dermal contact. Additional

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noncarcinogenic risk driving contaminants include the two congeners of chlordane, heptachlor epoxide, and dieldrin, which all have HQ's above 1.0, and 4',4'-DDT, MCPP, aluminum, and manganese with HQ's slightly below 1.0. Carcinogenic risks also yield results that are well in excess of the acceptable risk range, defined as risk that fall between $1x10^{-4}$ to $1x10^{-6}$. The incidental ingestion pathway yields a risk total of $8x10^{-4}$ while the dermal contact pathway yields a risk total of $3x10^{-2}$. These values indicate a concern for carcinogens for the future residential population. Risk driving carcinogens include aldrin, dieldrin, and chlordane, which all exceed the $1x10^{-4}$ risk level. Additionally, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, heptachlor, heptachlor epoxide, 2,3,7,8-TCDD (dioxin), arsenic and beryllium all exceed the $1x10^{-6}$ risk level, but fall within the acceptable risk range (between $1x10^{-4}$ and $1x10^{-6}$).

Future workers (Appendix D Tables 4 and 5) represent the most likely future population if any development occurs on the site. They could come in contact with contaminated soils if the cap were disturbed or allowed to deteriorate, resulting in a completion of the soil exposure pathways (incidental ingestion and dermal contact). Future worker noncarcinogenic risks exceed the 1.0 level of concern for noncarcinogens. The incidental ingestion scenario hazard index is well below 1.0 (HI = 0.093), but the dermal contact hazard index exceeds 1.0 (HI = 9.6). Primary risk drivers are aldrin, dieldrin, and chlordane. No other contaminants yield an HQ that approaches 1.0. Carcinogenic risk for the future worker exceeds the acceptable risk range, with incidental ingestion yielding a risk of $1.6x10^{-5}$ and the dermal contact pathway yielding a risk of $1.7x10^{-3}$. The risk drivers include aldrin and dieldrin, which exceed $1x10^{-4}$, and chlordane, 4,4'-DDD, 4,4'DDE, 4,4'-DDT, heptachlor, heptachlor epoxide, 2,3,7,8-TCDD (dioxin), and beryllium, which all exceed $1x10^{-6}$ but fall within the acceptable risk range.

6.3.4 Summary of Exposed Soil Risks. The current risks to contaminated soil that is exposed include recreational populations that may come in contact with soils that are currently exposed. The current recreational population (Appendix D Tables 13 and 14) shows noncarcinogenic risk that is well below a level of concern (1.0) for both incidental ingestion (HI = 0.000081) and for dermal contact (HI = 0.0029), indicating little reason for concern for noncarcinogenic hazards for current populations. Carcinogenic risks are well below the acceptable risk range for both pathways (incidental ingestion and dermal contact), and no risks exceed $1x10^{-6}$ for current recreational populations. Incidental ingestion yielded a total risk of $1.7x10^{-8}$

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while dermal contact yielded a total risk level of 6.4×10^{-7}, indicating little concern for current recreational population's exposure to exposed soils.

Future residents (Appendix D Tables 7 and 8) could come in contact with contaminated soils. The future residential scenario is the RME for this site, and yields the most restrictive cleanup levels (i.e. lowest) for the contaminants of concern, though it is somewhat less likely to occur than the future occupational (worker) scenario. Noncarcinogenic risks to the future resident are below the 1.0 level that is the level where increased concern is triggered. Both incidental ingestion (HI = 0.0039) and dermal contact (HI = 0.17) are below the level of concern, indicating little concern for future residents in the event of residential development as far as exposed soils are concerned. Carcinogenic risks yield results that are below the acceptable risk range (defined as risk that fall between 1×10^{-4} to 1×10^{-6}) for incidental ingestion (8.2×10^{-7}), and are within the acceptable risk range for dermal contact (3.8×10^{-5}). These values indicate little concern for carcinogens for the future residential population for exposed soil.

Future workers (Appendix D Tables 10 and 11) represent the most likely future population if any development occurs on the site. They could come in contact with contaminated soils if future development occurred at the site. Future worker noncarcinogenic risks do not exceed the 1.0 level of concern for noncarcinogens. The incidental ingestion scenario hazard index is well below 1.0 (HI = 0.000099), and the dermal contact hazard index is also well below 1.0 (HI = 0.012). Carcinogenic risk for the future worker is within the acceptable risk range, with incidental ingestion yielding a risk of 1.8×10^{-8} (below the acceptable risk range) and the dermal contact pathway yielding a risk of 2.1×10^{-6} (within the acceptable risk range). The risk drivers are aldrin and dieldrin.

6.3.5 Cleanup Levels. In Appendix D, each pair of exposure pathway tables is followed by a table of cleanup levels based on those scenarios. In this way cleanup levels are presented for each population of concern for all current and future scenarios in the risk assessment. It is important to note that these are contaminant specific cleanup levels, and do not represent the final word in targeting a potential cleanup. For example, aldrin and dieldrin have nearly identical SFs and RfDs, and are essentially identical in their endpoints in the human anatomical system. If the target risk level (for example only) was set at 1×10^{-4} and the worker scenario was deemed the RME (again for example only), Table 6 shows a cleanup level of 1.4 for

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aldrin and 1.5 for dieldrin. If these were both cleaned up to 1.5, the resultant total risk (from both contaminants) for the future worker would be $2x10^{-4}$, which is above our theoretical target of $1x10^{-4}$. The effect of this is to take compounds that have similar endpoints and estimate levels of these compounds that can remain and still yield a concentrations that meet a cleanup goal. In this example, the two compounds would both need to be cleaned up to 0.75 mg/kg, resulting in a summed risk of $1x10^{-4}$ ($5x10^{-5}$ + $5x10^{-5}$). This theory should be expanded to include all the primary risk drivers, which in the case of the OU4 risk assessment would include aldrin, dieldrin, and the two chlordanes at a minimum. Since levels present rarely yield the same exact risk values, interpretation of site specific data is important to determining if cleanup goals are indeed being protective. In the case where there is one contaminant that significantly exceeds all others as far as the risks generated are concerned, and where treatment of the media of concern is identical for the contaminants (e.g. all with the same treatment), it makes sense to assume that if the one large risk driver is treated, all the others are also treated and the result of additivity is negligible. In the case, however, where there are several risk drivers, and these fall under differing treatment options (e.g. volatiles and pesticides), the final remedy must be selected to reduce the various groups of contaminants and take into account chemical additivity. For OU4, nearly all significant risks are from pesticides, and additivity of individual compounds within a class (e.g. pesticides) is important, whereas additivity across compound class boundaries (e.g. pesticides + volatiles) is less critical..

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7.0 Uncertainty Analysis

Uncertainties associated with risk can be assessed through a variety of means. Monte Carlo statistical analysis offers a sophisticated quantitative approach for estimating the range of uncertainty around a risk estimate. Studies using Monte Carlo analysis have demonstrated that the typical range of uncertainty for a carcinogenic risk estimate is 1 to 2 orders of magnitude (USEPA, 1989a). Using Monte Carlo analysis, researchers have found that the probability distribution of a carcinogenic risk estimate is skewed to the left (i.e., toward larger risks), with the expected value (i.e., the most commonly generated value) approaching the 90th percentile for the distribution (Burmaster and von Stackelburg, 1988). The expected value was significantly larger than the estimate derived using average values for all input parameters.

7.1 Data Evaluation Uncertainty

The practice of estimating concentrations for nondetected contaminants is probably the single largest contributor of uncertainty in data evaluation. Current guidance mandates that the sample quantitation limit be used as a proxy concentration for nondetects (USEPA, 1989a). However, the actual concentration of these contaminants may be much lower or even zero. Since the actual concentration cannot be determined, the conservative assumption that the contaminant is present at one-half the quantitation limit is used. As a result of this conservative assumption, the actual or real EPCs and thus risks may be equal to or of varying magnitudes lower than the estimated EPCs and risks.

7.2 Toxicity Assessment Uncertainty

The prediction of human health consequences likely to occur following exposure to a given dose of a chemical is imprecise because of the many uncertainties in toxicological information available on dose-response relationships. The quantity of toxicity information for the chemicals evaluated is typically limited, with correspondingly varying degrees of uncertainty associated with the calculated toxicity values.

Sources of uncertainty associated with toxicity values that may result in an incorrect risk estimation include the following:

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- Using dose-response information from effects observed at high doses to predict the adverse health effects that may occur from exposure to the low levels expected from human contact with the agent in the environment.
- Using dose-response information from short-term exposure studies to predict the effects of long-term exposures, and vice versa.
- Using dose-response information from animal studies to predict effects in humans (i.e., variability in species sensitivity).
- Using dose-response information from homogeneous animal populations to predict the effects likely to be observed in a general population consisting of individuals with a wide range of sensitivities.

Only two carcinogens analyzed for in the human health evaluation for OU4, arsenic and vinyl chloride, are classified as Group A, known human carcinogen. For these contaminants, there is little uncertainty regarding their carcinogenicity in humans.

Most of the remainder of the carcinogens, including all the pesticides, identified at OU4 are classified as Group B2, probable human carcinogens, based on no evidence in humans but sufficient evidence in animals. There are a number of uncertainties regarding evidence of carcinogenicity based on animal tests. One is the use of maximum tolerated doses that cause cellular damage, which, quite apart from chemical carcinogenicity, increases the rate of cell growth during repair processes. High rates of cell growth tend to increase the potential for carcinogenic effects as a result of the exposure. Therefore, the cause of carcinogenicity (whether physical or chemical) is uncertain. Another source of uncertainty is the assumption that all chemicals that are carcinogenic in animals are also carcinogenic in humans. Therefore, for chemicals classified as Group B2, lack of evidence of carcinogenicity in humans produces considerable uncertainty in the carcinogenic risk estimates.

Uncertainty factors based on extrapolations in the toxicological data for most of the RfD values are in the range of 100 to 1,000. This indicates considerable uncertainty regarding the actual value of the RfD. These high uncertainty factors allow for uncertainties in laboratory animal to human dose extrapolation, interindividual sensitivity, subchronic to chronic extrapolation, and lowest observed adverse effect level (LOAEL) to no observed adverse effect level (NOAEL) extrapolation. On the other hand, the uncertainty factors for the oral RfDs for arsenic and barium are less than 10. This indicates very little uncertainty regarding the actual values for these RfDs.

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The assumption that response is linear with respect to dose and that there is no threshold for induction of cancer are important sources of uncertainty. Current theories suggest that carcinogens may act by several different mechanisms, which could result in more than one type of dose-response curve. In addition, there is increasing evidence that at least some carcinogens do have a carcinogenic threshold, indicating that there may be a level below which there is no carcinogenic effect. Currently, however, data are inadequate to support more detailed assumptions regarding dose-response. The uncertainties associated with carcinogenic SFs make the greatest contribution to the total uncertainty of a carcinogenic risk estimate.

Risks associated with dermal contact with soils were evaluated only for a limited number of contaminants. Because most metals are not absorbed easily through the skin, the dermal route is not expected to contribute substantially to total risks for metals. However, there is a great deal of uncertainty regarding the absorption rates of most chemicals used for both the dermal and the oral routes of exposure.

The use of chronic RfDs in evaluating exposure will slightly overestimate risks. Because subchronic RfDs are usually higher than chronic RfDs (i.e., to produce the effects of concern), a lower concentration of a chemical is needed to produce a chronic effect than to produce a subchronic/acute effect over the same time frame.

7.3 Exposure Assessment Uncertainty

The generation of estimated average daily exposure levels to chemical contaminants at OU4 included a number of uncertainties. These uncertainties are generally inherent in risk assessments associated with remedial investigations, particularly because of the type and amount of data that can be collected in the short sampling episodes. The most important uncertainties are summarized as follows:

- Although current exposure levels are based on measured concentrations in the media of concern, these values are uncertain due to limited sampling and analytical variation. To account for this, the 95th UCL of the mean concentration values and the average values were used in dose calculations. This is likely to result in an overestimation of the actual average dose.
- Contaminant concentrations in all media for future use was assumed to be the same as current contaminant concentrations, with no adjustment due to dilution, biodegradation, or volatilization, which likely results in an overestimation of those concentrations in the future.

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- The background soil assessment for OU4 is basically nonexistent, therefore, further background sampling would be required to adequately represent regional inorganic concentrations in order to determine if the concentrations onsite are above background levels or not. Because metals are not particularly important in the context of the OU4 risk assessment, this results in little impact to the conclusions of the risk assessment.
- Few site-specific data were available on worker activity patterns, so standard default values (USEPA, 1991a) combined with a reasonable approach for duration and frequency of time at the site and degree of contact with the soil were used.
- Dermal uptake of chemicals from soil, especially inorganics that are not well-absorbed dermally, is difficult to estimate because the value depends on both chemical-specific characteristics of contaminants and the soil at the site, affecting the extent of elemental fixation, desorption, and adsorption to soil particles. The absorption values employed to estimate dermal uptake, particularly when no chemical specific values are available, are highly uncertain, leading to an overestimation of dose.

Most of the assumptions in the exposure assessment involved use of default values recommended by USEPA for standardized risk assessments (USEPA, 1991a). Uncertainties regarding the use of default exposure assumptions stem from the natural variabilities among individuals of parameters such as body weight or soil ingestion rate, as well as from insufficient data on the distribution of these parameters.

Contaminant concentrations in soil were assumed to remain constant throughout the duration of exposure. This assumption is reasonable for the inorganic contaminants. However, for organic contaminants with significant removal processes (e.g., volatilization, microbial degradation), this assumption may result in overestimation of risk in future populations.

7.4 Risk Characterization Uncertainty

The factors that contribute uncertainty to the estimates of exposure concentrations, daily intakes, and toxicity information also contribute uncertainty to the estimates of carcinogenic and noncarcinogenic effects. These factors include the following:

- Chemicals not included.

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- Exposure pathways not considered.
- Derivation of exposure point concentrations.
- Intake uncertainty.
- Toxicological dose-response and toxicity values.

When values for carcinogenic and noncarcinogenic effects are summed across chemicals, it is assumed that the chemical-specific carcinogenic and noncarcinogenic effects are independent and additive. Actually, these effects may interact to produce a less-than-additive effect (antagonism) or a more-than-additive effect (synergism). Unfortunately, data on chemical interactions are lacking for most chemical mixtures. In the absence of mixture-specific toxicity data, the assumption of additivity is a standard conservative approach. This may result in overestimation or underestimation of the carcinogenic and noncarcinogenic effect.

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8.0 Conclusions

It is important to understand the limitations of this risk assessment. It is part of a larger picture for the Des Moines TCE Site, which has included a risk assessment for OU2, a Risk Assessment Addendum to the OU2 risk assessment, Risk calculations regarding the buildings, and a Focused Risk Assessment addressing risks in the South Pond Area. The results of those previous studies are not reiterated here. The conclusions of this risk assessment are based on risks for areas, the area of OU4 that has been capped and the area of OU4 that has not been capped (excluding the South Pond Area, which has already been addressed in the Focused Risk Assessment).

8.1 Conclusions Regarding Capped Soils

In conclusion, current risks to contaminated soil under the present cap have been eliminated because the cap eliminates any complete current exposure pathway. If the exposure pathway is incomplete, the potentially exposed population is not in contact with contaminants in the media of concern, therefore quantifiable risks do not exist. Therefore, current risks associated with soils under the cap are not of concern.

Future residential risks are well over levels of concern, both for noncarcinogens and for carcinogens. For future residents both incidental ingestion and dermal contact are above the level of concern, indicating the presence of increased concern for future residents in the event of residential development. Carcinogenic risks are also well in excess of the acceptable risk range, defined as risk that fall between $1x10^{-4}$ to $1x10^{-6}$. Again the incidental ingestion pathway and dermal contact pathway yield risks above the acceptable risk range. These values indicate a concern for carcinogens for the future residential population. Therefore, the soils under the cap exhibit risks that are of great concern for the future residential population. In conclusion, future residential development can not occur without remedial action to reduce the contaminant levels present under the cap.

Future workers could also come in contact with contaminated soils if the cap were disturbed or allowed to deteriorate, resulting in a completion of the soil exposure pathways. Future worker noncarcinogenic risks exceed the 1.0 level of concern for noncarcinogens. In this case, only the dermal contact hazard index exceeds 1.0. Carcinogenic risk for the future worker exceeds the acceptable risk range, with incidental ingestion within the risk range and the dermal contact pathway above the risk range. This indicates that there is concern for the future worker if the

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integrity of the cap is not maintained. In conclusion, the cap must be maintained to prevent concern for risks to future workers on the property.

8.2 Conclusions Regarding Exposed Soils

The current risks to contaminated soil that is exposed include recreational populations that may come in contact with soils that are currently exposed. The current recreational population shows noncarcinogenic risk that is well below a level of concern (1.0) for both incidental ingestion and for dermal contact, indicating little reason for concern for noncarcinogenic hazards for current populations. Carcinogenic risks are well below the acceptable risk range for both pathways (incidental ingestion and dermal contact), and no risks exceed $1x10^{-6}$ for current recreational populations. This indicates a low level of concern for current recreational population's exposure to exposed soils.

Future residents could come in contact with contaminated soils. Noncarcinogenic risks to the future resident are below the 1.0 level that is the level where increased concern is triggered. Both incidental ingestion and dermal contact are below the level of concern, indicating little concern for future residents in the event of residential development as far as exposed soils are concerned. Carcinogenic risks yield results that are below the acceptable risk range (defined as risk that fall between $1x10^{-4}$ to $1x10^{-6}$) for incidental ingestion, and are within the acceptable risk range for dermal contact. These values indicate that the contaminants present in exposed soils are low enough to be of little concern, thus remedial action involving exposed soils is not necessary.

Future workers represent the most likely future population if any development occurs on the site. They could come in contact with contaminated soils if future development occurred at the site. Future worker noncarcinogenic risks do not exceed the 1.0 level of concern for noncarcinogens. Carcinogenic risk for the future worker is within the acceptable risk range, with incidental ingestion yielding a risk of $1.8x10^{-8}$ (below the acceptable risk range) and the dermal contact pathway yielding a risk of $2.1x10^{-6}$ (within the acceptable risk range). These values indicate a low level of concern for the risks associated with future workers, and support no further action on exposed soils.

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8.3 Conclusions Regarding the Wildlife Toxicity Assessment

The conclusions of the Wildlife Toxicity Assessment suggest that there may be significant ecological risks associated with portions of the site. The risks are significant enough that remedial action may be required to be protective of the environment, however, remedial actions in the wetland area and the South Pond would physically alter or eliminate the habitat it is intended to remediate. To leave the area as it is will continue to allow aldrin and dieldrin, which are both bioaccumulative, to persist in the food chain and would not be protective of water species and wildlife. In conclusion, available remedial options should reduce or eliminate the exposure threat to contaminated sediments in the wetland area including the South Pond. Remedial options and their impacts are further discussed in the Wildlife Toxicity Assessment.

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APPENDIX A

CAPPED SOIL DATA
WITH EXPOSURE POINT CONCENTRATION CALCULATIONS
FOR CURRENT AND FUTURE EXPOSURES

Capped OU 1 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Surface Soil OG-1	Surface Soil OG-2	Surface Soil OG-3	Surface Soil OG-4	Surface Soil OG-5	Surface Soil OG-6	Surface Soil OG-7	Surface Soil OG-8	Surface Soil OG-9	Surface Soil OG-10
Analyte (all in PPM)										
Volatiles										
1,1,1-Trichloroethene										
1,2-Dichloroethene										
2-Butanone										
Acetone										
Carbon Disulfide										
Ethylbenzene										
Methylene Chloride										
Tetrachloroethene										
Toluene										
Trichloroethene										
Vinyl Chloride										
Xylenes										
Semi-volatile organics										
2,4,6-Trichlorophenol										
2,4-Dichlorophenol										
2-Methylnaphthalene										
Benzo(g,h,i)perylene										
Benzo(k)fluoranthene										
Benzoic Acid										
Chrysene										
Di-nbutylphthalate										
Dibenzofuran										
Fluoranthene										
Fluorene										
Indeno(1,2,3-cd)pyrene										
Naphthene										
Acenaphthene										
Anthracene										
Benzo(a)anthracene										
Benzo(a)pyrene										
Benzo(b)fluoranthene										
Phenanthrene										
Pyrene										
Pesticides										
delta-BHC	0.65	0.95	1.05	0.013	0.065	0.075	0.00145	0.0011	0.26	0.0395
4,4'-DDD	0.16	0.24	0.76	0.0068	0.087	0.18	0.0057	0.0013	0.33	0.25
4,4'-DDE	1.3	1.9	2.1	0.0265	0.125	0.15	0.0053	0.00225	0.2	0.11
4,4'-DDT	0.46	1.9	2.1	0.021	0.125	0.15	0.0059	0.00225	0.67	0.28
Aldrin	0.31	0.16	1.2	0.011	0.2	0.052	0.0015	0.00057	0.032	0.014
alpha-Chlordane	0.87	2	8.5	0.04	0.81	1.8	0.007	0.00091	0.56	0.28
gamma-Chlordane	0.7	1.9	7.2	0.042	1	1.8	0.00145	0.0011	0.46	0.2
Dieldrin	19	26	16	0.16	2.1	2.1	0.035	0.0031	3.1	1.4
Endosulfan sulfate	1.3	1.9	2.1	0.0265	0.125	0.15	0.0016	0.0017	0.5	0.08
Endosulfan II	1.3	1.9	2.1	0.0265	0.15	0.15	0.0029	0.00225	0.5	0.08
Endrin ketone	1.3	1.9	1.6	0.02	0.086	0.19	0.0048	0.00245	0.21	0.14
Heptachlor	0.65	0.95	1.05	0.013	0.073	0.075	0.00145	0.0011	0.26	0.0395
Heptachlor epoxide	0.65	0.95	1.05	0.013	0.065	0.075	0.00145	0.0011	0.26	0.0395
Methoxychlor	6.5	9.5	10.5	0.13	0.65	0.75	0.0145	0.011	2.6	0.395
MCPP (Mecoprop)	0.0155	0.0225	0.042	0.016	0.015	0.018	0.0175	0.0135	0.0155	0.024
2,4,5-T	0.000015	0.000025	0.00004	0.000015	0.000015	0.00002	0.0000175	0.0000135	0.0000155	0.000024
2,4-D	0.000155	0.000225	0.00042	0.00016	0.00015	0.00018	0.000175	0.000135	0.000155	0.00024
Dioxins										
2,3,7,8-TCDD	0.000034	0.000055	0.000075	0.000028	0.0001	0.00007	0.000042	0.000012	0.000105	0.000065
Inorganics										
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Chromium										
Cobalt										
Copper										
Cyanide										
Lead										
Magnesium										
Manganese										
Mercury										
Nickel										
Selenium										
Vanadium										
Zinc										

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Surface Soil OG-11	Surface Soil OG-13	Surface Soil OG-14	Surface Soil OG-15	Surface Soil OG-16	Surface Soil OG-17	Surface Soil OG-18	Surface Soil OG-19	Surface Soil OG-20	Surface Soil OG-21
Analyte (all in PPM)										
Volatiles										
1,1,1-Trichloroethane										
1,2-Dichloroethene										
2-Butanone										
Acetone										
Carbon Disulfide										
Ethylbenzene										
Methylene Chloride										
Tetrachloroethene										
Toluene										
Trichloroethene										
Vinyl Chloride										
Xylenes										
Semi-volatile organics										
2,4,6-Trichlorophenol										
2,4-Dichlorophenol										
2-Methylnaphthalene										
Benzo(g,h,i)perylene										
Benzo(k)fluoranthene										
Benzoic Acid										
Chrysene										
Di-nbutylphthalate										
Dibenzofuran										
Fluoranthene										
Fluorene										
Indeno(1,2,3-cd)pyrene										
Naphthene										
Acenaphthene										
Anthracene										
Benzo(a)anthracene										
Benzo(a)pyrene										
Benzo(b)fluoranthene										
Phenanthrene										
Pyrene										
Pesticides										
delta-BHC	1.1	0.011	0.0032	0.0011	0.0011	0.013	0.00105	0.0013	0.12	0.18
4,4'-DDD	0.48	0.0014	0.014	0.0035	0.0035	0.0255	0.0026	0.0088	0.24	0.19
4,4'-DDE	2.25	0.00225	0.0065	0.0022	0.0022	0.0255	0.00215	0.028	0.24	0.245
4,4'-DDT	0.28	0.00225	0.033	0.0027	0.0046	0.088	0.00215	0.017	0.66	0.22
Aldrin	3.6	0.00086	0.0045	0.00068	0.00094	0.028	0.0019	0.0044	0.51	0.51
alpha-Chlordane	3.4	0.00082	0.012	0.0012	0.0018	0.019	0.0025	0.0084	2.7	3.2
gamma-Chlordane	3.2	0.002	0.018	0.001	0.0019	0.018	0.0022	0.0089	3.9	4.1
Dieldrin	59	0.0035	0.18	0.0028	0.003	0.14	0.017	0.028	0.74	1.2
Endosulfan sulfate	2.25	0.0047	0.0074	0.0034	0.0045	0.0255	0.0048	0.021	0.64	0.32
Endosulfan II	2.25	0.00225	0.013	0.0022	0.0022	0.088	0.00215	0.0026	0.24	0.245
Endrin ketone	0.91	0.00225	0.0065	0.0022	0.0022	0.0255	0.00215	0.0026	0.24	2.6
Heptachlor	1.1	0.0011	0.0044	0.0011	0.0011	0.0057	0.00105	0.00071	0.71	0.8
Heptachlor epoxide	1.1	0.0008	0.0011	0.0011	0.0011	0.0094	0.00105	0.0013	0.12	0.12
Methoxychlor	11	0.011	0.032	0.011	0.011	0.13	0.0105	0.013	2	1.1
MCPP (Mecoprop)	0.027	0.0135	0.0385	0.013	0.0135	0.0155	0.013	0.0155	0.06	0.06
2,4,5-T	0.000027	0.000015	0.00004	0.000015	0.000015	0.0000155	0.000013	0.000015	0.00048	0.00043
2,4-D	0.00027	0.000135	0.000385	0.00013	0.000135	0.000155	0.00013	0.000155	0.0008	0.0006
Dioxins										
2,3,7,8-TCDD	0.00014	0.000011	0.00001	0.0000175	0.0000115	0.0000175	0.0000125	0.000012	0.00077	0.00068
Inorganics										
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Chromium										
Cobalt										
Copper										
Cyanide										
Lead										
Magnesium										
Manganese										
Mercury										
Nickel										
Selenium										
Vanadium										
Zinc										

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Capped OU4 Data
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OU4 Risk Assessment

Location Depth	Surface Soil OG-22	Surface Soil OG-23	Surface Soil OG-24	Surface Soil OG-25	Surface Soil OG-26	Surface Soil OG-27	Surface Soil OG-28	Surface Soil OG-29	Surface Soil OG-30	Surface Soil OG-31
Analyte (all in PPM)										
Volatiles										
1,1,1-Trichloroethane										
1,2-Dichloroethene										
2-Butanone										
Acetone										
Carbon Disulfide										
Ethylbenzene										
Methylene Chloride										
Tetrachloroethene										
Toluene										
Trichloroethene										
Vinyl Chloride										
Xylenes										
Semi-volatile organics										
2,4,6-Trichlorophenol										
2,4-Dichlorophenol										
2-Methylnaphthalene										
Benzo(g,h,i)perylene										
Benzo(k)fluoranthene										
Benzoic Acid										
Chrysene										
Di-nbutylphthalate										
Dibenzofuran										
Fluoranthene										
Fluorene										
Indeno(1,2,3-cd)pyrene										
Naphthene										
Acenaphthene										
Anthracene										
Benzo(a)anthracene										
Benzo(a)pyrene										
Benzo(b)fluoranthene										
Phenanthrene										
Pyrene										
Pesticides										
delta-BHC	0.039	0.07	0.1	0.07	0.0115	0.0115	0.11	1.3	1.2	0.048
4,4'-DDD	0.025	0.11	0.16	0.069	0.01	0.011	0.26	0.28	2.4	0.039
4,4'-DDE	0.08	0.14	0.205	0.14	0.0235	0.022	0.215	2.55	2.4	0.095
4,4'-DDT	0.031	0.14	0.205	0.17	0.018	0.022	0.38	2.55	2.4	0.095
Aldrin	0.019	0.51	0.094	0.065	0.022	0.034	2.6	1.1	10	0.041
alpha-Chlordane	0.11	1	2.2	0.58	0.046	0.038	1.8	3	1	0.4
gamma-Chlordane	0.098	0.89	2.1	0.44	0.041	0.04	1.8	3.6	1.1	0.38
Dieldrin	0.56	17	1.4	2.3	0.28	0.45	8.1	15	7.9	0.55
Endosulfan sulfate	0.08	0.046	0.205	0.14	0.0235	0.022	0.215	2.55	2.4	0.095
Endosulfan II	0.08	0.14	0.205	0.14	0.0235	0.022	0.215	2.55	2.4	0.095
Endrin ketone	0.097	0.29	0.205	0.093	0.066	0.022	0.68	2.55	2.4	0.069
Heptachlor	0.039	0.07	0.038	0.07	0.0115	0.011	0.073	1.3	1.2	0.028
Heptachlor epoxide	0.039	0.07	0.1	0.07	0.0115	0.011	0.11	1.3	1.2	0.048
Methoxychlor	0.39	0.7	1	0.7	0.115	0.11	1.1	13	12	0.048
MCPP (Mecoprop)	0.0235	0.017	0.012	0.017	0.014	0.028	0.047	0.06	0.055	0.017
2,4,5-T	0.000025	0.000015	0.00001	0.000015	0.000015	0.000015	0.000015	0.00006	0.00006	0.00001
2,4-D	0.000235	0.00017	0.00012	0.00017	0.00014	0.00014	0.000185	0.0006	0.00055	0.000115
Dioxins										
2,3,7,8-TCDD	0.000019	0.0000215	0.000045	0.0000205	0.000032	0.000015	0.000032	0.0000225	0.0000335	0.0000215
Inorganics										
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Chromium										
Cobalt										
Copper										
Cyanide										
Lead										
Magnesium										
Manganese										
Mercury										
Nickel										
Selenium										
Vanadium										
Zinc										

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Capped OU4 Data
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OU4 Risk Assessment

Location Depth	Surface Soil OG-32	Surface Soil OG-33	Surface Soil OG-34	Surface Soil OG-35	Surface Soil SB-47	Surface Soil SB-48	Surface Soil SB-49	Surface Soil SB-50	Surface Soil SB-51	Surface Soil SB-52
Analyte (all in PPM)										
Volatiles										
1,1,1-Trichloroethane										
1,2-Dichloroethane										
2-Butanone										
Acetone										
Carbon Disulfide										
Ethylbenzene										
Methylene Chloride										
Tetrachloroethene										
Toluene										
Trichloroethene										
Vinyl Chloride										
Xylenes										
Semi-volatile organics										
2,4,6-Trichlorophenol										
2,4-Dichlorophenol										
2-Methylnaphthalene										
Benzo(g,h,i)perylene										
Benzo(k)fluoranthene										
Benzoic Acid										
Chrysene										
Di-nbutylphthalate										
Dibenzofuran										
Fluoranthene										
Fluorene										
Indeno(1,2,3-cd)pyrene										
Naphthene										
Acenaphthene										
Anthracene										
Benzo(a)anthracene										
Benzo(a)pyrene										
Benzo(b)fluoranthene										
Phenanthrene										
Pyrene										
Pesticides										
delta-BHC	0.055	1.55	1.35	1.05	0.0045	0.0011	0.0076	0.0225	0.0465	0.44
4,4'-DDD	0.11	1.3	0.12	0.12	0.068	0.066	0.01	0.088	0.37	0.3
4,4'-DDE	0.11	3.1	2.7	2.15	0.017	0.007	0.0025	0.044	0.09	0.018
4,4'-DDT	0.11	3.1	2.7	2.15	0.0057	0.074	0.0025	0.044	0.008	0.85
Aldrin	0.047	0.3	0.28	1.1	0.12	0.0011	0.034	0.41	2.8	0.35
alpha-Chlordane	0.46	14	7.3	2	0.51	0.0049	0.13	0.72	3.1	5.5
gamma-Chlordane	0.39	13	6.1	1.8	0.9	0.0052	0.2	1	2.8	4.3
Dieldrin	1.2	12	10	14	1.6	0.009	0.34	5.9	0.95	0.37
Endosulfan sulfate	0.11	3.1	2.7	2.15	0.0085	0.0021	0.0036	0.044	0.09	0.85
Endosulfan II	0.11	3.1	2.7	2.15						
Endrin ketone	0.11	0.73	2.7	2.15	0.097	0.0032	0.028	0.17	0.38	0.02
Heptachlor	0.055	1.55	1.35	1.05	0.076	0.0011	0.011	0.062	0.51	1.4
Heptachlor epoxide	0.055	1.55	1.35	1.05	0.069	0.00054	0.0013	0.225	0.0465	0.44
Methoxychlor	0.55	15.5	13.5	10.5	0.045	0.011	0.013	2.25	0.17	0.072
MCPP (Mecoprop)	0.055	0.075	0.065	0.013						
2,4,5-T	0.000055	0.000075	0.000065	0.000015						
2,4-D	0.00055	0.00075	0.00065	0.00013						
Dioxins										
2,3,7,8-TCDD	0.000049	0.000093	0.00006	0.000021						
Inorganics										
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Cadmium										
Chromium										
Cobalt										
Copper										
Cyanide										
Lead										
Magnesium										
Manganese										
Mercury										
Nickel										
Selenium										
Vanadium										
Zinc										

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Capped OU4 Data
With Exposure Point Concentrations
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OU4 Risk Assessment

Location Depth	Surface Soil SB-53	Surface Soil SB-54	Surface Soil SB-55	Subsurface Soil DB-17 8-10'	Subsurface Soil DB-32 4-6'	Subsurface Soil DB-32 8-10'	Subsurface Soil DB-33 6-8'	Subsurface Soil DB-33 8-10'	Subsurface Soil DB-34 8-10'
Analyte (all in PPM)									
Volatiles									
1,1,1-Trichloroethene				0.0035	0.002	0.002	0.0035	0.0035	0.0035
1,2-Dichloroethene				0.05	0.003	0.003	0.012	0.003	0.0035
2-Butanone				0.05	0.006	0.047	0.062	0.059	0.033
Acetone				0.26	0.058	0.23	0.22	0.23	0.13
Carbon Disulfide				0.006	0.003	0.003	0.004	0.0035	0.0035
Ethylbenzene				0.0035	0.003	0.003	0.0035	0.0035	0.0035
Methylene Chloride				0.02	0.005	0.007	0.007	0.002	0.0035
Tetrachloroethene				0.0035	0.003	0.003	0.0035	0.0035	0.0035
Toluene				0.0035	0.003	0.003	0.003	0.002	0.0035
Trichloroethene				0.008	0.003	0.003	0.002	0.0035	0.0035
Vinyl Chloride				0.022	0.006	0.006	0.007	0.007	0.009
Xylenes				0.0035	0.003	0.003	0.001	0.0035	0.0035
Semi-volatile organics									
2,4,6-Trichlorophenol									
2,4-Dichlorophenol									
2-Methylnaphthalene									
Benzo(g,h,i)perylene									
Benzo(k)fluoranthene									
Benzoic Acid									
Chrysene									
Di-nbutylphthalate									
Dibenzofuran									
Fluoranthene									
Fluorene									
Indeno(1,2,3-cd)pyrene									
Naphthene									
Acenaphthene									
Anthracene									
Benzo(a)anthracene									
Benzo(a)pyrene									
Benzo(b)fluoranthene									
Phenanthrene									
Pyrene									
Pesticides									
delta-BHC	0.00095	0.0075	0.0009						
4,4'-DDD	0.0028	0.066	0.0094		0.019	0.02	1.2	0.021	0.0225
4,4'-DDE	0.0023	0.015	0.00175						
4,4'-DDT	0.00185	0.067	0.00088		0.019	0.02	1.1	0.021	0.0225
Aldrin	0.00095	0.52	0.023		0.0095	0.01	0.065	0.0105	0.011
alpha-Chlordane	0.0071	0.7	0.024		0.095	0.1	0.65	0.105	0.11
gamma-Chlordane	0.0076	1.3	0.0052		0.095	0.1	0.65	0.105	0.11
Dieldrin	0.00185	1.6	0.41		0.019	0.02	0.13	0.021	0.0225
Endosulfan sulfate	0.015	0.015	0.007						
Endosulfan II									
Endrin ketone	0.0071	0.038	0.045						
Heptachlor	0.00095	0.59	0.0009		0.0095	0.01	0.065	0.0105	0.011
Heptachlor epoxide	0.00095	0.033	0.0009						
Methoxychlor	0.0095	0.0085	0.016						
MCPP (Mecoprop)									
2,4,5-T									
2,4-D									
Dioxins									
2,3,7,8-TCDD									
Inorganics									
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Cadmium									
Chromium									
Cobalt									
Copper									
Cyanide									
Lead									
Magnesium									
Manganese									
Mercury									
Nickel									
Selenium									
Vanadium									
Zinc									

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Capped OU4 Data
With Exposure Point Concentrations
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OU4 Risk Assessment

Location Depth	Subsurface Soil DB-34 10-12'	Subsurface Soil DB-35 10-12'	Subsurface Soil DB-36 4-6'	Subsurface Soil DB-36 8-10'	Subsurface Soil DB-37 8-10'	Surface Soil DB-38 0-0.5'	Subsurface Soil DB-38 2-4'	Subsurface Soil DB-38 4-6'
Analyte (all in PPM)								
Volatiles								
1,1,1-Trichloroethane	0.003	0.003	0.003	0.0035	0.0035		0.003	0.009
1,2-Dichloroethene	0.003	0.003	0.003	0.0035	0.009		0.003	0.009
2-Butanone	0.025	0.025	0.051	0.022	0.005		0.006	0.036
Acetone	0.13	0.14	0.39	0.15	0.095		0.02	1.2
Carbon Disulfide	0.003	0.003	0.005	0.0035	0.008		0.003	0.009
Ethylbenzene	0.003	0.003	0.003	0.0035	0.0035		0.003	0.009
Methylene Chloride	0.002	0.003	0.002	0.0035	0.023		0.02	0.044
Tetrachloroethene	0.003	0.003	0.003	0.0035	0.0035		0.003	0.009
Toluene	0.003	0.003	0.003	0.0035	0.004		0.003	0.009
Trichloroethene	0.003	0.003	0.003	0.0035	0.007		0.005	0.009
Vinyl Chloride	0.0065	0.0065	0.006	0.0065	0.007		0.006	0.018
Xylenes	0.003	0.003	0.003	0.0035	0.0035		0.003	0.009
Semi-volatile organics								
2,4,6-Trichlorophenol								
2,4-Dichlorophenol								
2-Methylnaphthalene								
Benzo(g,h,i)perylene								
Benzo(k)fluoranthene								
Benzoic Acid								
Chrysene								
Di-nbutylphthalate								
Dibenzofuran								
Fluoranthene								
Fluorene								
Indeno(1,2,3-cd)pyrene								
Naphthene								
Acenaphthene								
Anthracene								
Benzo(a)anthracene								
Benzo(a)pyrene								
Benzo(b)fluoranthene								
Phenanthrene								
Pyrene								
Pesticides								
delta-BHC								
4,4'-DDD	0.02	0.0195	0.0225	0.0225	0.16	0.65	0.19	0.22
4,4'-DDE								
4,4'-DDT	0.02	0.0195	0.0225	0.0225	0.0225	0.65	0.19	0.023
Aldrin	0.01	0.0095	0.011	0.011	0.011	1.3	0.095	0.0115
alpha-Chlordane	0.1	0.095	0.11	0.11	0.11	3.2	0.95	0.115
gamma-Chlordane	0.1	0.095	0.11	0.11	0.11	3.2	0.95	0.115
Dieldrin	0.02	0.0195	0.0225	0.0225	0.0225	3	0.19	0.023
Endosulfan sulfate								
Endosulfan II								
Endrin ketone								
Heptachlor	0.01	0.0095	0.011	0.011	0.011	0.32	0.095	0.0115
Heptachlor epoxide								
Methoxychlor								
MCPP (Mecoprop)								
2,4,5-T								
2,4-D								
Dioxins								
2,3,7,8-TCDD								
Inorganics								
Aluminum						3180		
Antimony						0.5		
Arsenic						3.7		
Barium						47		
Beryllium						0.3		
Cadmium						1.8		
Chromium						8.2		
Cobalt						5.9		
Copper						10.1		
Cyanide						0.005		
Lead						18.7		
Magnesium						19900		
Manganese						1360		
Mercury						0.035		
Nickel						11.6		
Selenium						0.49		
Vanadium						13.6		
Zinc						64.1		

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Subsurface Soil DB-38 6-8'	Subsurface Soil DB-39 8-10'	Subsurface Soil DB-39 10-12'	Subsurface Soil DB-40 6-8'	Subsurface Soil DB-40 8-10'	Surface Soil DB-41 0-0.5'	Subsurface Soil DB-41 2-4'	Subsurface Soil DB-41 4-6'
Analyte (all in PPM)								
Volatiles								
1,1,1-Trichloroethene	0.0035	0.003	0.0035	0.0035	0.003		0.003	0.005
1,2-Dichloroethene	0.002	0.002	0.017	0.0035	0.003		0.011	0.005
2-Butanone	0.017	0.014	0.02	0.032	0.018		0.032	0.063
Acetone	0.097	0.15	0.1	0.31	0.19		0.19	0.65
Carbon Disulfide	0.0035	0.002	0.0035	0.0035	0.003		0.003	0.005
Ethylbenzene	0.0035	0.003	0.0035	0.0035	0.003		0.003	0.005
Methylene Chloride	0.0035	0.025	0.021	0.006	0.002		0.021	0.005
Tetrachloroethene	0.0035	0.003	0.0035	0.0035	0.003		0.003	0.005
Toluene	0.002	0.003	0.0035	0.0035	0.003		0.01	0.005
Trichloroethene	0.0035	0.004	0.0035	0.0035	0.003		0.003	0.005
Vinyl Chloride	0.0065	0.006	0.007	0.002	0.006		0.006	0.011
Xylenes	0.0035	0.003	0.0035	0.0035	0.003		0.018	0.005
Semi-volatile organics								
2,4,6-Trichlorophenol	0.22						1.05	
2,4-Dichlorophenol	0.22						1.05	
2-Methylnaphthalene	0.22						1.05	
Benzo(g,h,i)perylene	0.18						1	
Benzo(k)fluoranthene	0.38						1.05	
Benzoic Acid	3						0.87	
Chrysene	0.38						3	
Di-nbutylphthalate	0.22						0.21	
Dibenzofuran	0.22						0.21	
Fluoranthene	0.68						5.3	
Fluorene	0.22						0.44	
Indeno(1,2,3-cd)pyrene	0.18						1.1	
Naphthene	0.22						0.18	
Acenaphthene	0.22						0.38	
Anthracene	0.14						1	
Benzo(a)anthracene	0.32						2.8	
Benzo(a)pyrene	0.26						2.2	
Benzo(b)fluoranthene	0.21						1.05	
Phenanthrene	0.58						4.3	
Pyrene	0.67						5.6	
Pesticides								
delta-BHC								
4,4'-DDD	0.097					1.15	0.0195	0.021
4,4'-DDE								
4,4'-DDT	0.022					1.15	0.0195	0.021
Aldrin	0.011					0.6	0.023	0.011
alpha-Chlordane	0.11					6	0.1	0.11
gamma-Chlordane	0.11					6	0.1	0.11
Dieldrin	0.022					7.9	0.19	0.021
Endosulfan sulfate								
Endosulfan II								
Endrin ketone								
Heptachlor	0.011					0.8	0.01	0.011
Heptachlor epoxide								
Methoxychlor								
MCPP (Mecoprop)								
2,4,5-T								
2,4-D								
Dioxins								
2,3,7,8-TCDD								
Inorganics								
Aluminum	9500					2500	6910	
Antimony	0.65					0.55	3.8	
Arsenic	7.5					4.4	25.3	
Barium	203					55.1	450	
Beryllium	0.92					0.18	2.7	
Cadmium	1					0.9	6.2	
Chromium	88.9					9.6	2.5	
Cobalt	14.6					4.7	13.8	
Copper	46.3					12.1	355	
Cyanide	0.01					0.005	0.32	
Lead	146					36.5	1770	
Magnesium	3480					9990	2760	
Manganese	594					452	665	
Mercury	0.15					0.015	0.28	
Nickel	88.6					6.8	28.8	
Selenium	1.4					0.36	0.85	
Vanadium	20.2					7.9	11.8	
Zinc	228					64.1	2410	

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Subsurface Soil DB-42 6-8'	Surface Soil DB-43 0-0.5'	Surface Soil DB-43 0-2'	Subsurface Soil DB-43 8-10'	Subsurface Soil DB-44 2-4'	Subsurface Soil DB-44 4-6'	Subsurface Soil DB-45 10-12'	Subsurface Soil DB-46 10-12'	Subsurface Soil DB-47 6-8'
Analyte (all in PPM)									
Volatiles									
1,1,1-Trichloroethane	0.003		0.003	0.003	0.003	0.003	0.003	0.003	0.003
1,2-Dichloroethene	0.004		0.003	0.003	0.003	0.003	0.003	0.005	0.003
2-Butanone	0.078		0.0055	0.025	0.006	0.003	0.004	0.004	0.008
Acetone	0.39		0.006	0.14	0.006	0.007	0.025	0.14	0.083
Carbon Disulfide	0.005		0.001	0.003	0.003	0.003	0.003	0.004	0.004
Ethylbenzene	0.003		0.003	0.003	0.003	0.003	0.003	0.002	0.003
Methylene Chloride	0.005		0.001	0.003	0.003	0.009	0.003	0.004	0.007
Tetrachloroethene	0.003		0.003	0.003	0.003	0.003	0.003	0.005	0.003
Toluene	0.003		0.003	0.003	0.003	0.003	0.003	0.005	0.003
Trichloroethene	0.019		0.003	0.003	0.003	0.003	0.003	0.003	0.003
Vinyl Chloride	0.0065		0.006	0.006	0.006	0.007	0.006	0.001	0.006
Xylenes	0.003		0.002	0.003	0.003	0.003	0.003	0.012	0.003
Semi-volatile organics									
2,4,6-Trichlorophenol			0.195						0.2
2,4-Dichlorophenol			0.195						0.2
2-Methylnaphthalene			0.195						0.91
Benzo(g,h,i)perylene			0.195						0.2
Benzo(k)fluoranthene			0.195						0.2
Benzoic Acid			0.95						1
Chrysene			0.195						0.061
Di-n-butylphthalate			0.195						0.2
Dibenzofuran			0.195						0.2
Fluoranthene			0.195						0.12
Fluorene			0.195						0.2
Indeno(1,2,3-cd)pyrene			0.195						0.2
Naphthene			0.195						0.13
Acenaphthene			0.195						0.2
Anthracene			0.195						0.2
Benzo(a)anthracene			0.195						0.05
Benzo(a)pyrene			0.195						0.2
Benzo(b)fluoranthene			0.195						0.046
Phenanthrene			0.195						0.11
Pyrene			0.195						0.1
Pesticides									
delta-BHC									
4,4'-DDD	0.021	0.018	0.018	0.019	0.0185	0.021	0.019	0.0195	0.021
4,4'-DDE									
4,4'-DDT	0.021	0.018	0.018	0.019	0.03	0.021	0.019	0.0195	0.021
Aldrin	0.01	0.009	0.009	0.0095	0.0095	0.011	0.0095	0.0095	0.01
alpha-Chlordane	0.1	0.09	0.09	0.095	0.095	0.11	0.095	0.095	0.1
gamma-Chlordane	0.1	0.09	0.09	0.095	0.095	0.11	0.095	0.095	0.1
Dieldrin	0.021	0.18	0.018	0.019	0.026	0.021	0.019	0.0195	0.021
Endosulfan sulfate									
Endosulfan II									
Endrin ketone									
Heptachlor	0.01	0.009	0.009	0.0095	0.0095	0.011	0.0095	0.0095	0.01
Heptachlor epoxide									
Methoxychlor									
MCPP (Mecoprop)									
2,4,5-T									
2,4-D									
Dioxins									
2,3,7,8-TCDD									
Inorganics									
Aluminum	10100	7080	6910	7020	7370	11100	5930		11800
Antimony	0.95	0.8	0.9	0.9	0.8	0.95	0.85		0.5
Arsenic	8.5	0.155	5.7	3.5	7	2.8	2.9		5.2
Barium	177	137	79.8	88.1	118	175	94.4		88.1
Beryllium	0.8	0.56	0.1	0.49	0.42	0.73	0.35		0.56
Cadmium	0.7	0.65	0.69	0.52	0.22	0.26	0.23		0.115
Chromium	17.1	13.8	11.9	14.3	12.4	14.5	10.2		14.5
Cobalt	7.7	6.5	4.7	6.1	5.2	7.4	6.6		9.1
Copper	18.6	15.7	16.9	14	18.4	17.7	12.1		18.2
Cyanide	0.005	0.005	0.005	0.08	0.085	0.085	0.085		0.005
Lead	33.1	56.2	41.6	23.3	24.5	26.9	0.075		27.4
Magnesium	2860	2750	16000	2020	10800	2720	1990		3730
Manganese	735	800	545	647	479	1280	598		466
Mercury	0.04	0.04	0.09	0.025	0.025	0.025	0.04		0.035
Nickel	17	17.5	13.1	13.9	13.4	16.4	14.8		14.2
Selenium	1.5	0.31	0.1	0.1	0.17	0.13	0.14		0.13
Vanadium	25.1	24.6	17.6	19.6	22.1	24.7	17.1		25.3
Zinc	85	82.5	61.6	72.8	48.1	54	34.6		61.2

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Subsurface Soil DB-48 6-8'	Subsurface Soil DB-49 10-12'	Subsurface Soil DB-50 8-10'	Subsurface Soil DB-51 6-8'	Subsurface Soil DB-51 8-10'	Surface Soil DB-52 0-2'	Subsurface Soil DB-52 8-10'	Surface Soil DB-53 2'-4'
Analyte (all in PPM)								
Volatiles								
1,1,1-Trichloroethene	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
1,2-Dichloroethene	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
2-Butanone	0.006	0.007	0.006	0.006	0.0065	0.0055	0.0065	0.002
Acetone	0.006	0.12	0.006	0.006	0.0065	0.0055	0.0065	0.006
Carbon Disulfide	0.003	0.002	0.003	0.003	0.003	0.002	0.003	0.003
Ethylbenzene	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Methylene Chloride	0.007	0.003	0.007	0.006	0.012	0.005	0.003	0.003
Tetrachloroethene	0.003	0.003	0.003	0.003	0.003	0.005	0.003	0.003
Toluene	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Trichloroethene	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Vinyl Chloride	0.006	0.006	0.006	0.006	0.0065	0.0055	0.0065	0.006
Xylenes	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Semi-volatile organics								
2,4,6-Trichlorophenol								
2,4-Dichlorophenol								
2-Methylnaphthalene								
Benzo(g,h,i)perylene								
Benzo(k)fluoranthene								
Benzoic Acid								
Chrysene								
Di-n-butylphthalate								
Dibenzofuran								
Fluoranthene								
Fluorene								
Indeno(1,2,3-cd)pyrene								
Naphthene								
Acenaphthene								
Anthracene								
Benzo(a)anthracene								
Benzo(a)pyrene								
Benzo(b)fluoranthene								
Phenanthrene								
Pyrene								
Pesticides								
delta-BHC								
4,4'-DDD	0.02	0.019	0.019	0.019	0.021	0.11	0.02	0.022
4,4'-DDE								
4,4'-DDT	0.02	0.019	0.019	0.019	0.021	0.53	0.02	0.022
Aldrin	0.01	0.021	0.0095	0.0095	0.01	0.03	0.01	0.12
alpha-Chlordane	0.1	0.09	0.095	0.095	0.1	0.1	0.1	0.11
gamma-Chlordane	0.1	0.09	0.095	0.095	0.1	0.1	0.1	0.11
Dieldrin	0.02	0.13	0.019	0.019	0.021	0.055	0.02	0.19
Endosulfan sulfate								
Endosulfan II								
Endrin ketone								
Heptachlor	0.01	0.009	0.0095	0.0095	0.01	0.01	0.01	0.032
Heptachlor epoxide								
Methoxychlor								
MCPP (Mecoprop)								
2,4,5-T								
2,4-D								
Dioxins								
2,3,7,8-TCDD								
Inorganics								
Aluminum	9970		6910	7510	10400	6070	9560	
Antimony	0.95		0.85	0.9	0.9	3.1	1	
Arsenic	2.2		5.6	5.8	3.3	5.6	2.4	
Barium	133		122	122	126	105	127	
Beryllium	0.94		0.53	0.58	0.69	1.3	0.69	
Cadmium	0.255		0.56	0.66	0.49	1.6	0.27	
Chromium	16.8		14.1	12.4	15.8	16.8	15.7	
Cobalt	7.8		5.7	6.1	8.5	7	8.4	
Copper	12		13.2	14.6	17.9	200	12	
Cyanide	0.01		0.06	0.075	0.095	0.005	0.01	
Lead	17.5		233	22.3	19.1	86.6	16.7	
Magnesium	3520		4010	3770	3380	6430	2620	
Manganese	640		607	430	827	687	480	
Mercury	0.06		0.015	0.03	0.02	0.41	0.025	
Nickel	19.6		14.3	13.3	18.7	21.2	19.4	
Selenium	0.165		0.46	0.15	0.135	1.2	0.44	
Vanadium	30.1		21.2	20.1	26	22.7	28.5	
Zinc	67.5		104	58.3	55.3	391	58.1	

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Subsurface Soil DB-53 4-6'	Subsurface Soil DB-54 4-6'	Subsurface Soil DB-54 8'-10'	Subsurface Soil DB-55 0'-.5'	Subsurface Soil DB-55 6'-8'	Subsurface Soil DB-55 8'-10'	Subsurface Soil DB-56 6'-8'	Subsurface Soil DB-56 8'-10'
Analyte (all in PPM)								
Volatiles								
1,1,1-Trichloroethene	0.003	0.003	0.0065		0.003	0.003	0.0155	0.016
1,2-Dichloroethene	0.003	0.003	0.0065		0.003	0.003	0.0155	0.016
2-Butanone	0.004	0.004	0.086		0.006	0.007	0.053	0.061
Acetone	0.033	0.052	0.54		0.042	0.085	1	0.66
Carbon Disulfide	0.003	0.003	0.0065		0.003	0.003	0.0155	0.016
Ethylbenzene	0.003	0.003	0.0065		0.003	0.003	0.0155	0.016
Methylene Chloride	0.007	0.003	0.005		0.003	0.004	0.061	0.033
Tetrachloroethene	0.003	0.003	0.0065		0.003	0.003	0.0155	0.016
Toluene	0.003	0.003	0.0065		0.003	0.003	0.016	0.016
Trichloroethene	0.003	0.003	0.0065		0.003	0.003	0.0155	0.016
Vinyl Chloride	0.0065	0.006	0.0125		0.006	0.0065	0.0315	0.032
Xylenes	0.003	0.003	0.0065		0.003	0.003	0.022	0.016
Semi-volatile organics								
2,4,6-Trichlorophenol					0.29			
2,4-Dichlorophenol					4			
2-Methylnaphthalene					0.195			
Benzo(g,h,i)perylene					0.195			
Benzo(k)fluoranthene					0.195			
Benzoic Acid					0.95			
Chrysene					0.195			
Di-n-butylphthalate					0.195			
Dibenzofuran					0.195			
Fluoranthene					0.195			
Fluorene					0.195			
Indeno(1,2,3-cd)pyrene					0.195			
Naphthene					0.14			
Acenaphthene					0.195			
Anthracene					0.195			
Benzo(a)anthracene					0.195			
Benzo(a)pyrene					0.195			
Benzo(b)fluoranthene					0.195			
Phenanthrene					0.195			
Pyrene					0.195			
Pesticides								
delta-BHC								
4,4'-DDD	0.021	0.0195	0.02	0.0175	0.055	0.0185	0.335	0.02
4,4'-DDE								
4,4'-DDT	0.021	0.0195	0.02	0.0175	0.055	0.0185	0.335	0.02
Aldrin	0.01	0.01	0.01	0.0085	0.0275	0.0095	5.5	0.25
alpha-Chlordane	0.1	0.1	0.1	0.085	4.1	0.095	7.9	0.1
gamma-Chlordane	0.1	0.1	0.1	0.085	3.2	0.095	1.65	0.1
Dieldrin	0.021	0.0195	0.02	0.072	0.055	0.0185	0.335	0.02
Endosulfan sulfate								
Endosulfan II								
Endrin ketone								
Heptachlor	0.01	0.01	0.01	0.0085	0.34	0.018	5	0.094
Heptachlor epoxide								
Methoxychlor								
MCPP (Mecoprop)								
2,4,5-T								
2,4-D								
Dioxins								
2,3,7,8-TCDD								
Inorganics								
Aluminum	10800	10400	7990	6620	10000	10500	13700	9360
Antimony	0.85	0.9	0.95	0.85	0.9	0.95	1	1
Arsenic	6.7	4.1	3.2	0.15	0.185	4	3.1	2.9
Barium	106	119	107	99.6	127	106	103	83.9
Beryllium	0.72	0.75	0.56	0.53	0.62	0.63	0.94	0.71
Cadmium	0.23	0.59	0.0265	0.225	0.245	0.255	1	0.265
Chromium	16.8	15.7	12.3	10.7	13.5	14.4	32.6	16.9
Cobalt	6.8	7.8	7.4	5.3	7	8.5	5.9	7.6
Copper	19	17.7	13.3	14.6	10.9	17.2	20.7	16.6
Cyanide	0.085	0.095	0.08	0	0	0.2	0.45	0.25
Lead	76	23	15.2	24.5	20.9	18.6	29.1	27.6
Magnesium	2270	3220	2630	10100	2230	2600	8790	2880
Manganese	463	431	617	535	496	689	569	609
Mercury	0.025	0.03	0.03	0.06	0.015	0.02	0.03	0.03
Nickel	20.1	17.5	14.9	14.6	12.9	19.6	17.4	18.2
Selenium	0.46	0.57	0.14	0.15	1.4	0.18	0.175	0.165
Vanadium	31.8	25	20.8	21.2	24.4	22.3	33.7	25.1
Zinc	68.2	67.3	40	77.9	42.6	49.4	78.7	51.3

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Subsurface Soil DB-59 4'-6'	Subsurface Soil DB-59 6'-8'	Subsurface Soil DB-60 2'-4'	Subsurface Soil DB-63 4'-6'	Subsurface Soil DB-63 6'-8'	Sediment SP-A 0.5-1.0'	Sediment SP-C 0.5-1.0'	Sediment SP-E 0.5-1.0'
Analyte (all in PPM)								
Volatiles								
1,1,1-Trichloroethane	0.003		5.5	0.0055	0.0055			
1,2-Dichloroethene	0.003		5.5	0.0055	0.0055			
2-Butanone	0.006		10.5	0.1	0.1			
Acetone	0.006		10.5	0.47	0.48			
Carbon Disulfide	0.003		5.5	0.0055	0.0055			
Ethylbenzene	0.003		62	0.0035	0.007			
Methylene Chloride	0.007		6.6	0.007	0.01			
Tetrachloroethene	0.003		5.5	0.0055	0.0055			
Toluene	0.003		62	0.0055	0.0055			
Trichloroethene	0.003		5.5	0.0055	0.0055			
Vinyl Chloride	0.006		10.5	0.011	0.011			
Xylenes	0.003		580	0.29	0.069			
Semi-volatile organics								
2,4,6-Trichlorophenol								
2,4-Dichlorophenol								
2-Methylnaphthalene								
Benzo(g,h,i)perylene								
Benzo(k)fluoranthene								
Benzoic Acid								
Chrysene								
Di-nbutylphthalate								
Dibenzofuran								
Fluoranthene								
Fluorene								
Indeno(1,2,3-cd)pyrene								
Naphthene								
Acenaphthene								
Anthracene								
Benzo(a)anthracene								
Benzo(a)pyrene								
Benzo(b)fluoranthene								
Phenanthrene								
Pyrene								
Pesticides								
delta-BHC						0.12	0.018	0.066
4,4'-DDD		0.045	0.04	0.021	0.018	0.25	0.014	0.24
4,4'-DDE						0.85	0.049	0.045
4,4'-DDT		0.045	0.04	0.021	0.018	0.12	0.049	0.074
Aldrin		0.023	0.02	0.011	0.009	0.83	0.022	0.68
alpha-Chlordane		0.225	0.2	0.105	0.09	1.1	0.18	1.1
gamma-Chlordane		0.225	0.2	0.105	0.09	3.8	0.25	1.3
Dieldrin		0.23	0.18	0.021	0.096	20	1	6
Endosulfan sulfate						0.085	0.0047	0.038
Endosulfan II								
Endrin ketone						0.6	0.014	0.025
Heptachlor		0.023	0.02	0.011	0.009	0.18	0.0064	0.23
Heptachlor epoxide						0.73	0.0079	0.23
Methoxychlor								
MCPP (Mecoprop)								
2,4,5-T								
2,4-D								
Dioxins								
2,3,7,8-TCDD								
Inorganics								
Aluminum	4098		3720					
Antimony	0.7		0.65					
Arsenic	3		3.5					
Barium	285		339					
Beryllium	0.41		0.3					
Cadmium	2		0.84					
Chromium	8.4		8.5					
Cobalt	3.2		6.1					
Copper	21.5		2060					
Cyanide	0.115		0.22					
Lead	259		351					
Magnesium	10600		4880					
Manganese	365		328					
Mercury	0.2		0.18					
Nickel	6.9		10.4					
Selenium	0.88		0.5					
Vanadium	7.9		6.2					
Zinc	280		1040					

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Location	SP-F	SP-G	SP-H	SP-I	SP-J	SS-1	SS-2	SS-3	SS-4
Depth	0.5-1.0'	0.5-1.0'	0.5-1.0'	0.5-1.0'	0.5-1.0'	0.0-0.5'	0.0-0.5'	0.0-0.5'	0.0-0.5'
Analyte (all in PPM)									
Volatiles									
1,1,1-Trichloroethene									
1,2-Dichloroethene									
2-Butanone						0.0075	0.0065	0.002	0.006
Acetone						0.0075	0.0065	0.0065	0.018
Carbon Disulfide						0.004	0.003	0.002	0.007
Ethylbenzene									
Methylene Chloride						0.002	0.001	0.004	0.01
Tetrachloroethene									
Toluene									
Trichloroethene									
Vinyl Chloride									
Xylenes									
Semi-volatile organics									
2,4,6-Trichlorophenol									
2,4-Dichlorophenol									
2-Methylnaphthalene									
Benzo(g,h,i)perylene									
Benzo(k)fluoranthene									
Benzoic Acid									
Chrysene									
Di-nbutylphthalate									
Dibenzofuran									
Fluoranthene									
Fluorene									
Indeno(1,2,3-cd)pyrene									
Naphthene									
Acenaphthene									
Anthracene									
Benzo(a)anthracene									
Benzo(a)pyrene									
Benzo(b)fluoranthene									
Phenanthrene									
Pyrene									
Pesticides									
delta-BHC	0.43	0.26	0.00091	0.041	40	0.07	0.0245	0.05	0.155
4,4'-DDD	1.3	2.5	0.0018	0.034	75	0.145	0.0495	0.1	0.3
4,4'-DDE	0.55	0.8	0.0012	0.135	75	0.145	0.0495	0.1	0.3
4,4'-DDT	0.55	3.5	0.0058	0.135	75	0.145	0.0495	0.1	0.3
Aldrin	9.4	0.11	0.002	0.021	820	0.07	0.0245	0.05	0.23
alpha-Chlordane	6.5	2.7	0.001	0.32	40	0.7	0.245	0.5	1.55
gamma-Chlordane	7.2	2.2	0.0027	0.26	40	0.7	0.245	0.5	1.55
Dieldrin	7.2	17	0.015	1.6	110	0.4	1.1	0.1	0.3
Endosulfan sulfate	0.13	0.12	0.00195	0.012	75	0.145	0.0495	0.1	0.3
Endosulfan II									
Endrin ketone	0.048	0.098	0.0007	0.019	75	0.145	0.0495	0.1	0.3
Heptachlor	0.295	0.036	0.001	0.07	40	0.07	0.0245	0.05	0.155
Heptachlor epoxide	0.295	0.043	0.001	0.07	40	0.07	0.0245	0.05	0.155
Methoxychlor									
MCPP (Mecoprop)									
2,4,5-T									
2,4-D									
Dioxins									
2,3,7,8-TCDD									
Inorganics									
Aluminum									
Antimony									
Arsenic						9.4	6.6	3.7	8.6
Barium						332	133	114	197
Beryllium						1.7	0.79	0.81	0.73
Cadmium						1.8	1.2	1.2	3.3
Chromium						105	32.4	49.3	157
Cobalt						14.8	8.2	8.3	11.3
Copper						59.7	37.1	39.5	78.4
Cyanide						0.49	0.185	0.275	0.99
Lead						1580	236	264	578
Magnesium						8120	5370	3820	7710
Manganese						878	637	292	882
Mercury						0.06	0.24	0.09	0.29
Nickel						43	20.8	29.6	28.3
Selenium						1.8	0.33	1.5	2
Vanadium						72.1	27.6	30.5	35.6
Zinc						391	232	254	728

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
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Location Depth	Sediment SS-5 0.0-0.5'	South Pond Sediment 001 BV	South Pond Sediment 002 BV	Surface Soil SS1-10 BM	Surface Soil SS11-20 BM	Surface Soil SS21-30 BM	Surface Soil SS31-40 BM	Surface Soil SS41-50 BM	Surface Soil SS51-60 BM
Analyte (all in PPM)									
Volatiles									
1,1,1-Trichloroethene									
1,2-Dichloroethene									
2-Butanone	0.0115								
Acetone	0.0115								
Carbon Disulfide	0.006								
Ethylbenzene									
Methylene Chloride	0.005								
Tetrachloroethene									
Toluene									
Trichloroethene									
Vinyl Chloride									
Xylenes									
Semi-volatile organics									
2,4,6-Trichlorophenol									
2,4-Dichlorophenol									
2-Methylnaphthalene									
Benzo(g,h,i)perylene									
Benzo(k)fluoranthene									
Benzoic Acid									
Chrysene									
Di-nbutylphthalate									
Dibenzofuran									
Fluoranthene									
Fluorene									
Indeno(1,2,3-cd)pyrene									
Naphthene									
Acenaphthene									
Anthracene									
Benzo(a)anthracene									
Benzo(a)pyrene									
Benzo(b)fluoranthene									
Phenanthrene									
Pyrene									
Pesticides									
delta-BHC	1.3	0.12	0.099	0.0009	0.0105	0.0105	0.012	0.01	0.01
4,4'-DDD	2.75	0.31	0.29	0.0033	0.032	0.031	0.023	0.07	0.019
4,4'-DDE	2.75	0.16	0.21	0.0089	0.032	0.051	0.051	0.046	0.075
4,4'-DDT	2.75	0.27	0.22	0.017	0.04	0.02	0.023	0.07	0.1
Aldrin	1.3	7.3	1.5	0.018	0.054	0.13	0.14	0.081	0.19
alpha-Chlordane	13	2	2.1	0.083	0.22	0.48	0.49	0.3	0.71
gamma-Chlordane	13	3.3	2.8	0.13	0.33	0.72	0.82	0.44	1.1
Dieldrin	4	0.18	0.19	0.5	1.4	3.2	2.2	1.5	3.9
Endosulfan sulfate	2.75	0.0435	0.0435	0.00175	0.02	0.02	0.023	0.02	0.019
Endosulfan II		0.059	0.15	0.00175	0.02	0.02	0.023	0.02	0.019
Endrin ketone	2.75	0.015	0.0435	0.018	0.049	0.11	0.086	0.041	0.11
Heptachlor	1.3	0.0225	0.0225	0.0042	0.0013	0.0048	0.0054	0.026	0.097
Heptachlor epoxide	1.3	0.072	0.088	0.0072	0.0105	0.056	0.051	0.03	0.085
Methoxychlor		0.225	0.225	0.009	0.105	0.105	0.12	0.1	0.1
MCPP (Mecoprop)		0.0495	0.055	2.5	2.5	2.5	2.5	2.5	2.5
2,4,5-T		0.0495	0.055	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
2,4-D				0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Dioxins									
2,3,7,8-TCDD		0.000072	0.00028	0.0000225	0.0000205	0.0000325	0.0000205	0.0000335	0.00003
Inorganics									
Aluminum									
Antimony									
Arsenic	7.6								
Barium	208								
Beryllium	1								
Cadmium	2.7								
Chromium	48.4								
Cobalt	11.1								
Copper	68.8								
Cyanide	0.14								
Lead	481								
Magnesium	7370								
Manganese	572								
Mercury	0.5								
Nickel	29.5								
Selenium	1								
Vanadium	35.6								
Zinc	544								

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Surface Soil SS61-70 BM	Surface Soil SS71-80 BM	Surface Soil SS-81-90 BM	Surface Soil SS91-100 BM	Surface Soil SS101-110 BM	Surface Soil Soil Pile OG-107	Surface Soil Soil Pile OG-108	Surface Soil Soil Pile OG-109
Analyte (all in PPM)								
Volatiles								
1,1,1-Trichloroethane								
1,2-Dichloroethene								
2-Butanone								
Acetone								
Carbon Disulfide								
Ethylbenzene								
Methylene Chloride								
Tetrachloroethene								
Toluene								
Trichloroethene								
Vinyl Chloride								
Xylenes								
Semi-volatile organics								
2,4,6-Trichlorophenol								
2,4-Dichlorophenol								
2-Methylnaphthalene								
Benzo(g,h,i)perylene								
Benzo(k)fluoranthene								
Benzoic Acid								
Chrysene								
Di-n-butylphthalate								
Dibenzofuran								
Fluoranthene								
Fluorene								
Indeno(1,2,3-cd)pyrene								
Naphthene								
Acenaphthene								
Anthracene								
Benzo(a)anthracene								
Benzo(a)pyrene								
Benzo(b)fluoranthene								
Phenanthrene								
Pyrene								
Pesticides								
delta-BHC	0.0125	0.125	0.012	0.0125	0.00125			
4,4'-DDD	0.021	0.24	0.035	0.023	0.0048			
4,4'-DDE	0.11	0.17	0.036	0.023	0.0073			
4,4'-DDT	0.0245	0.24	0.023	0.0245	0.0029			
Aldrin	0.2	0.125	0.053	0.048	0.0087	0.18	1.4	0.059
alpha-Chlordane	1.5	2	0.4	0.31	0.11			
gamma-Chlordane	2.2	3.1	0.42	0.31	0.1			
Dieldrin	5.1	7	2.1	2.8	0.84	1.5	2.1	1.3
Endosulfan sulfate	0.0245	0.24	0.023	0.0245	0.00245			
Endosulfan II	0.0245	0.24	0.023	0.0245	0.00245			
Endrin ketone	0.052	0.24	0.023	0.0096	0.0021			
Heptachlor	0.035	0.125	0.012	0.0125	0.00059			
Heptachlor epoxide	0.068	0.125	0.0063	0.0125	0.0027			
Methoxychlor	0.125	1.25	0.12	0.125	0.0125			
MCPP (Mecoprop)	2.5	2.5	2.5	2.5	2.5			
2,4,5-T	0.0071	0.0073	0.0025	0.0025	0.0025			
2,4-D	0.0125	0.026	0.0125	0.0125	0.0125			
Dioxins								
2,3,7,8-TCDD	0.0000215	0.00005	0.000046	0.0000205	0.0000485			
Inorganics								
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Chromium								
Cobalt								
Copper								
Cyanide								
Lead								
Magnesium								
Manganese								
Mercury								
Nickel								
Selenium								
Vanadium								
Zinc								

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Surface Soil Soil Pile OG-110	Surface Soil Soil Pile OG-111	Surface Soil EE-037	Surface Soil EE-038	Surface Soil EE-039	Surface Soil EE-040	Surface Soil EE-041	Surface Soil EE-042
Analyte (all in PPM)								
Volatiles								
1,1,1-Trichloroethene								
1,2-Dichloroethene								
2-Butanone								
Acetone								
Carbon Disulfide								
Ethylbenzene								
Methylene Chloride								
Tetrachloroethene								
Toluene								
Trichloroethene								
Vinyl Chloride								
Xylenes								
Semi-volatile organics								
2,4,6-Trichlorophenol								
2,4-Dichlorophenol								
2-Methylnaphthalene								
Benzo(g,h,i)perylene								
Benzo(k)fluoranthene								
Benzoic Acid								
Chrysene								
Di-nbutylphthalate								
Dibenzofuran								
Fluoranthene								
Fluorene								
Indeno(1,2,3-cd)pyrene								
Naphthene								
Acenaphthene								
Anthracene								
Benzo(a)anthracene								
Benzo(a)pyrene								
Benzo(b)fluoranthene								
Phenanthrene								
Pyrene								
Pesticides								
delta-BHC								
4,4'-DDD			0.017					
4,4'-DDE				0.011				
4,4'-DDT			0.018					
Aldrin	0.068	0.055				0.06		
alpha-Chlordane			0.019	0.0154	0.0245	0.918	0.506	4.24
gamma-Chlordane			0.021	0.0152	0.0305	1.06	0.839	5.47
Dieldrin	1.4	3.1	0.03	0.04	0.049	1.5	3.4	16.5
Endosulfan sulfate						0.038		
Endosulfan II								
Endrin ketone						0.075		
Heptachlor								
Heptachlor epoxide						0.011		0.159
Methoxychlor								
MCPP (Mecoprop)								
2,4,5-T								
2,4-D								
Dioxins								
2,3,7,8-TCDD						0.000144		
Inorganics								
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Chromium								
Cobalt								
Copper								
Cyanide								
Lead								
Magnesium								
Manganese								
Mercury								
Nickel								
Selenium								
Vanadium								
Zinc								

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location	Surface Soil	Surface Soil	Surface Soil	Sediment	Surface Soil SB-1	Surface Soil SB-1	Surface Soil SB-2	Surface Soil SB-2
Depth	EE-057	EE-058	EE-059	EE-105	2'-4'	4'-6'	4'-6'	6'-8'
Analyte (all in PPM)								
Volatiles								
1,1,1-Trichloroethene								
1,2-Dichloroethene								
2-Butanone								
Acetone								
Carbon Disulfide								
Ethylbenzene								
Methylene Chloride								
Tetrachloroethene								
Toluene								
Trichloroethene								
Vinyl Chloride								
Xylenes								
Semi-volatile organics								
2,4,6-Trichlorophenol								
2,4-Dichlorophenol								
2-Methylnaphthalene								
Benzo(g,h,i)perylene								
Benzo(k)fluoranthene								
Benzoic Acid								
Chrysene								
Di-n-butylphthalate								
Dibenzofuran								
Fluoranthene								
Fluorene								
Indeno(1,2,3-cd)pyrene								
Naphthene								
Acenaphthene								
Anthracene								
Benzo(a)anthracene								
Benzo(a)pyrene								
Benzo(b)fluoranthene								
Phenanthrene								
Pyrene								
Pesticides								
delta-BHC								
4,4'-DDD				3.6				
4,4'-DDE				3.6				
4,4'-DDT	0.03	0.1	0.076	3.6				
Aldrin	0.036		0.03	5.3				
alpha-Chlordane	0.57	0.012	1.2	32				
gamma-Chlordane	0.69	0.013	1.51	31				
Dieldrin	0.53	0.07	4.1	32				
Endosulfan sulfate				3.6				
Endosulfan II	0.041							
Endrin ketone								
Heptachlor				4.8				
Heptachlor epoxide	0.028							
Methoxychlor								
MCPP (Mecoprop)								
2,4,5-T			0.00006		0.05	0.12	0.91	0.78
2,4-D			7E-08		0.64	0.46	1.6	2.2
Dioxins								
2,3,7,8-TCDD				0.00003				
Inorganics								
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Chromium								
Cobalt								
Copper								
Cyanide								
Lead								
Magnesium								
Manganese								
Mercury								
Nickel								
Selenium								
Vanadium								
Zinc								

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Surface Soil SB-3 2'-4'	Surface Soil SB-3 4'-6'	Surface Soil SB-4 2'-4'	Surface Soil SB-4 4'-6'	Surface Soil SB-5 2'-4'	Surface Soil SB-5 4'-6'
Analyte (all in PPM)						
Volatiles						
1,1,1-Trichloroethene						
1,2-Dichloroethene						
2-Butanone						
Acetone						
Carbon Disulfide						
Ethylbenzene						
Methylene Chloride						
Tetrachloroethene						
Toluene						
Trichloroethene						
Vinyl Chloride						
Xylenes						
Semi-volatile organics						
2,4,6-Trichlorophenol						
2,4-Dichlorophenol						
2-Methylnaphthalene						
Benzo(g,h,i)perylene						
Benzo(k)fluoranthene						
Benzoic Acid						
Chrysene						
Di-nbutylphthalate						
Dibenzofuran						
Fluoranthene						
Fluorene						
Indeno(1,2,3-cd)pyrene						
Naphthene						
Acenaphthene						
Anthracene						
Benzo(a)anthracene						
Benzo(a)pyrene						
Benzo(b)fluoranthene						
Phenanthrene						
Pyrene						
Pesticides						
delta-BHC						
4,4'-DDD						
4,4'-DDE						
4,4'-DDT						
Aldrin						
alpha-Chlordane						
gamma-Chlordane						
Dieldrin						
Endosulfan sulfate						
Endosulfan II						
Endrin ketone						
Heptachlor						
Heptachlor epoxide						
Methoxychlor						
MCPP (Mecoprop)						
2,4,5-T	0.05	0.05	0.05	0.42	0.05	0.05
2,4-D	0.12	0.27	0.05	7.4	0.05	0.05
Dioxins						
2,3,7,8-TCDD						
Inorganics						
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Cadmium						
Chromium						
Cobalt						
Copper						
Cyanide						
Lead						
Magnesium						
Manganese						
Mercury						
Nickel						
Selenium						
Vanadium						
Zinc						

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Capped OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	N	Mean	95% UCL	Maximum Concent-ration	Exposure Point Concent-ration
Analyte (all in PPM)					
Volatiles					
1,1,1-Trichloroethene	47	1.21E-01	3.18E-01	5.50E+00	3.18E-01
1,2-Dichloroethene	47	1.23E-01	3.20E-01	5.50E+00	3.20E-01
2-Butanone	52	2.26E-01	5.65E-01	1.05E+01	5.65E-01
Acetone	52	3.81E-01	7.20E-01	1.05E+01	7.20E-01
Carbon Disulfide	52	1.10E-01	2.88E-01	5.50E+00	2.88E-01
Ethylbenzene	47	1.32E+00	3.54E+00	6.20E+01	3.54E+00
Methylene Chloride	52	1.36E-01	3.49E-01	6.60E+00	3.49E-01
Tetrachloroethene	47	1.21E-01	3.18E-01	5.50E+00	3.18E-01
Toluene	47	1.32E+00	3.54E+00	6.20E+01	3.54E+00
Trichloroethene	47	1.21E-01	3.18E-01	5.50E+00	3.18E-01
Vinyl Chloride	47	2.31E-01	6.07E-01	1.05E+01	6.07E-01
Xylenes	47	1.24E+01	3.31E+01	5.80E+02	3.31E+01
Semi-volatile organics					
2,4,6-Trichlorophenol	5	3.91E-01	N/A	1.05E+00	1.05E+00
2,4-Dichlorophenol	5	1.13E+00	N/A	4.00E+00	1.05E+00
2-Methylnaphthalene	5	5.14E-01	N/A	1.05E+00	1.05E+00
Benzo(g,h,i)perylene	5	3.50E-01	N/A	1.00E+00	1.00E+00
Benzo(k)fluoranthene	5	4.04E-01	N/A	1.05E+00	1.05E+00
Benzoic Acid	5	1.35E+00	N/A	3.00E+00	3.00E+00
Chrysene	5	7.66E-01	N/A	3.00E+00	3.00E+00
Di-nbutylphthalate	5	2.04E-01	N/A	2.20E-01	2.20E-01
Dibenzofuran	5	2.04E-01	N/A	2.20E-01	2.20E-01
Fluoranthene	5	1.30E+00	N/A	5.30E+00	5.30E+00
Fluorene	5	2.50E-01	N/A	4.40E-01	4.40E-01
Indeno(1,2,3-cd)pyrene	5	3.70E-01	N/A	1.10E+00	1.10E+00
Naphthene	5	1.73E-01	N/A	2.20E-01	2.20E-01
Acenaphthene	5	2.38E-01	N/A	3.80E-01	3.80E-01
Anthracene	5	3.46E-01	N/A	1.00E+00	1.00E+00
Benzo(a)anthracene	5	6.72E-01	N/A	2.60E+00	2.60E+00
Benzo(a)pyrene	5	6.10E-01	N/A	2.20E+00	2.20E+00
Benzo(b)fluoranthene	5	3.39E-01	N/A	1.05E+00	1.05E+00
Phenanthrene	5	1.08E+00	N/A	4.30E+00	4.30E+00
Pyrene	5	1.35E+00	N/A	5.60E+00	5.60E+00
Pesticides					
delta-BHC	70	7.86E-01	1.74E+00	4.00E+01	1.74E+00
4,4'-DDD	117	8.66E-01	1.94E+00	7.50E+01	1.94E+00
4,4'-DDE	92	1.17E+00	2.54E+00	7.50E+01	2.54E+00
4,4'-DDT	120	9.58E-01	2.00E+00	7.50E+01	2.00E+00
Aldrin	124	7.14E+00	1.81E+01	8.20E+02	1.81E+01
alpha-Chlordane	125	1.71E+00	2.45E+00	4.00E+01	2.45E+00
gamma-Chlordane	125	1.71E+00	2.43E+00	4.00E+01	2.43E+00
Dieldrin	130	3.95E+00	5.68E+00	1.10E+02	5.68E+00
Endosulfan sulfate	71	1.51E+00	3.27E+00	7.50E+01	3.27E+00
Endosulfan II	60	3.94E-01	5.71E-01	3.10E+00	5.71E-01
Endrin ketone	70	1.46E+00	3.25E+00	7.50E+01	3.25E+00
Heptachlor	116	6.02E-01	1.18E+00	4.00E+01	1.18E+00
Heptachlor epoxide	72	7.78E-01	1.70E+00	4.00E+01	1.70E+00
Methoxychlor	70	1.71E+00	2.48E+00	1.55E+01	2.48E+00
MCPP (Mecoprop)	57	5.01E-01	7.20E-01	2.50E+00	7.20E-01
2,4,5-T	68	3.93E-02	7.01E-02	9.10E-01	7.01E-02
2,4-D	57	2.28E-01	4.57E-01	7.40E+00	4.57E-01
Dioxins					
2,3,7,8-TCDD	52	7.36E-05	1.11E-04	8.80E-04	1.11E-04
Inorganics					
Aluminum	28	8.18E+03	9.06E+03	1.37E+04	9.06E+03
Antimony	28	1.02E+00	1.25E+00	3.80E+00	1.25E+00
Arsenic	33	5.10E+00	6.38E+00	2.53E+01	6.38E+00
Barium	33	1.49E+02	1.75E+02	4.50E+02	1.75E+02
Beryllium	33	7.35E-01	8.73E-01	2.70E+00	8.73E-01
Cadmium	33	1.00E+00	1.36E+00	6.20E+00	1.36E+00
Chromium	33	2.58E+01	3.53E+01	1.57E+02	3.53E+01
Cobalt	33	7.73E+00	8.53E+00	1.48E+01	8.53E+00
Copper	33	1.01E+02	2.08E+02	2.08E+03	2.08E+02
Cyanide	33	1.38E-01	1.96E-01	9.90E-01	1.96E-01
Lead	33	1.99E+02	3.20E+02	1.77E+03	3.20E+02
Magnesium	33	5.62E+03	6.87E+03	1.99E+04	6.87E+03
Manganese	33	6.26E+02	6.94E+02	1.36E+03	6.94E+02
Mercury	33	9.58E-02	1.32E-01	5.00E-01	1.32E-01
Nickel	33	2.02E+01	2.44E+01	8.86E+01	2.44E+01
Selenium	33	5.84E-01	7.50E-01	2.00E+00	7.50E-01
Vanadium	33	2.42E+01	2.75E+01	7.21E+01	2.75E+01
Zinc	33	2.41E+02	3.73E+02	2.41E+03	3.73E+02

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APPENDIX B

EXPOSED SOIL DATA
WITH EXPOSURE POINT CONCENTRATION CALCULATIONS

Exposed Soils OU4 Data
With Exposure Point Concentrations
For Current and Future Exposures
OU4 Risk Assessment

Location Depth	Sediment SP-B 0.5-1.0'	Sediment SP-D 0.5-1.0'	Surface Soil SS111-120	Exposure Point Concent-ration (Maximum)
Analyte (all in PPM)				
Pesticides				
delta-BHC	0.001	0.0012	0.00115	1.20E-03
4,4'-DDD	0.0014	0.0019	0.0011	1.85E-03
4,4'-DDE	0.0038	0.0019	0.0045	4.50E-03
4,4'-DDT	0.01	0.0019	0.00099	1.00E-02
Aldrin	0.0058	0.0012	0.0115	1.15E-02
alpha-Chlordane	0.001	0.001	0.0047	4.70E-03
gamma-Chlordane	0.001	0.0016	0.005	5.00E-03
Dieldrin	0.011	0.015	0.0038	1.50E-02
Endrin ketone	0.0036	0.0029	0.00225	3.60E-03
Heptachlor epoxide	0.001	0.001	0.00066	1.00E-03

File: DICODA09.WK3

APPENDIX C

TOXICITY DATA FOR CHEMICALS OF POTENTIAL CONCERN

Table A
Chemical-Specific Toxicity Values
Ingestion Exposures
OU4 Risk Assessment

Contaminants or Chemicals	Ingestion Exposures					
	Oral Slope Factor (SF) mg/kg day	Wt of Ev	Oral Reference Dose (RfD) mg/kg day	Ref	Reference Date	Target Organ or System
Volatiles						
1,1,1-Trichloroethane		D	9.0E-02	I	10/15/93	liver/liver
1,2-Dichloroethene(mixture)			9.0E-03	I	10/15/93	kidney / liver
2-Butanone (MEK)		D	6.0E-01	I	10/15/93	liver
Acetone		D	1.0E-01	I	10/15/93	fetotoxic
Carbon Disulfide			1.0E-01	I	10/15/93	adrenal/liver
Ethylbenzene		D	1.0E-01	I	10/15/93	lung/liver,RBCs
Methylene Chloride	7.5E-03	B2	6.0E-02	I	10/15/93	liver,kidney
Tetrachloroethene	5.2E-02		1.0E-02	EI	10/15/93	liver
Toluene		D	2.0E-01	I	10/15/93	liver, kidney
Trichloroethene	1.1E-02	B2	6.0E-03	HE	10/15/93	liver
Vinyl Chloride	1.9E+00	A		H	10/15/93	
Xylene (mixed)		D	2.0E+00	I	10/15/93	fetotoxic
Semi-volatile organics						
2,4,6-Trichlorophenol	1.1E-02	B2		I	10/15/93	kidney,liver
2,4-Dichlorophenol			3.0E-03	I	10/15/93	porphyria
2-Methylnaphthalene					10/15/93	GI tract
Benzo(g,h,i)Perylene		D		I	10/15/93	lungs
Benzo(k)Fluoranthene	7.3E-02	B2		M	10/15/93	NA
Benzoic Acid		D	4.0E+00	I	10/15/93	
Chrysene	7.3E-03	B2		M	10/15/93	liver/liver
Di-n-Butylphthalate		D	1.0E-01	I	10/15/93	liver,kidney,blood
Dibenzofuran		D	4.0E-03	I	10/15/93	dec growth rate
Fluoranthene		D	4.0E-02	I	10/15/93	kidney
Fluorene		D	4.0E-02	I	10/15/93	
Indeno(1,2,3-cd)Pyrene	7.3E-01	B2		M	10/15/93	NA
Naphthalene		D	4.0E-02	H	10/15/93	splenic capsule
Acenaphthylene		D		H	10/15/93	
Anthracene		D	3.0E-01	I	10/15/93	inc mortality
Benzo(a)Anthracene	7.3E-01	B2		M	10/15/93	NA
Benzo(a)Pyrene	7.3E+00	B2		I	10/15/93	NA
Benzo(b)Fluoranthene	7.3E-01	B2		M	10/15/93	NA
Phenanthrene		D		I	10/15/93	NA
Pyrene		D	3.0E-02	I	10/15/93	liver
Pesticides						
Delta-BHC				I	10/15/93	liver,kidney
4,4'-DDD	2.4E-01	B2		I	10/15/93	
4,4'-DDE	3.4E-01	B2		I	10/15/93	liver,CNS
4,4'-DDT	3.4E-01	B2	5.0E-04	I	10/15/93	fetotoxic
Aldrin	1.7E+01	B2	3.0E-05	I	10/15/93	liver
Alpha-Chlordane	1.3E+00	B2	6.0E-05	I	10/15/93	liver
Gamma-Chlordane	1.3E+00	B2	6.0E-05	I	10/15/93	liver
Dieldrin	1.6E+01	B2	5.0E-05	I	10/15/93	liver
Endosulfan Sulfate						liver/liver
Endosulfan II						liver
Endrin Ketone						liver
Heptachlor	4.5E+00	B2	5.0E-04	I	10/15/93	liver
Heptachlor Epoxide	9.1E+00	B2	1.3E-05	I	10/15/93	kidney
Methoxychlor		D	5.0E-03	I	10/15/93	
MCPP			1.0E-03	H	10/15/93	blood
2,4,5-T			1.0E-02	I	10/15/93	Liver
2,4-D			1.0E-02	I	10/15/93	internal hemorrhage
Dioxins						
2,3,7,8-Tetra-CDD	1.5E+05	B2		H	10/15/93	several
Inorganics						
Aluminum			1.0E+00	EPA	10/15/93	serum chemistry
Antimony			4.0E-04	I	10/15/93	skin
Arsenic	1.8E+00	A	3.0E-04	C/I	10/15/93	increased BP
Barium			7.0E-02	I	10/15/93	NA
Beryllium	4.3E+00	B2	5.0E-03	I	10/15/93	kidney
Cadmium (food)		B1	5.0E-03	I	10/15/93	
Chromium (III)			1.0E+00	I	10/15/93	
Cobalt			6.0E-02		09/02/92	
Copper		D	3.7E-02	G	10/15/93	
Cyanide		D	2.0E-02	I	10/15/93	liver
Lead		B2				
Magnesium					10/15/93	CNS
Manganese (food)		D	1.4E-01	I	10/15/93	kidney
Mercury		D	3.0E-04	H	10/15/93	dec body wt
Nickel			2.0E-02	I	10/15/93	
Selenium		D	5.0E-03	I	10/15/93	argyria
Vanadium			7.0E-03	H	10/15/93	red blood cells
Zinc		D	3.0E-01	I	10/15/93	thyroid,neurotoxin

NOTES:
I - Integrated Risk Information System
H - Health Effects Assessment Summary Tables
H2 - Health Effects Assessment Summary Tables, table 2
A - Predicted value listed in "EPA Research and Development, Interim Guidance for Dermal Exposure Assessment," March, 1991
B - Modeled value listed in "EPA Research and Development, Interim Guidance for Dermal Exposure Assessment," March, 1991
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D - Memo on noncarcinogenic effects of Otto Fuel, Anderson, 1992
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F - Risk Assessment Forum, Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and Dibenzofurans, USEPA, March 1991
G - Based on an MCLG of 1.3 mg/L
M - Memo on Carcinogenicity of Benzo(a)pyrene and PAHs, Pei-Fung Hurst, MAR 22, 1991
R - Absorption factors from Ryan, et. al., 1987
X - Region X value
RfD = Reference Dose RfC = Reference Concentration
WT OF EV = Weight of Evidence Classification
3 - EPA Region III TEF Approach
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Table B
Chemical-Specific Toxicity Values
Dermal Exposures
OU4 Risk Assessment

Contaminants or Chemicals	Oral Absorption Efficiency percent	Oral Absorption Efficiency Reference	Dermal Exposures: Dermal Extrapolated Reference Dose (RfD) mg/kg day	Dermal Extrapolated Slope Factor (SF) kg day/mg	Perm-eability Constant (PC) cm/hr	Soil Absorp-tion Factor (unitless)	Ref
1,1,1-Trichloroethane	Unknown	ATSDR, 1989	4.5E-03		1.8E-02	2.5E-01	B
1,2-Dichloroethene(mixture)	Unknown	ATSDR, 1989	4.5E-04		1.7E-02	2.5E-01	B
2-Butanone (MEK)			3.0E-02		5.0E-03	2.5E-01	A
Acetone			5.0E-03			2.5E-01	
Carbon Disulfide			5.0E-03		5.3E-01	2.5E-01	A
Ethylbenzene	9.2E+01	ATSDR, 1989	9.2E-02		1.4E+00	2.5E-01	A
Methylene Chloride	5.5E+01	ATSDR, 1987	3.3E-02	1.4E-02	5.1E-03	2.5E-01	B
Tetrachloroethene	1.0E+02	ATSDR, 1987	1.0E-02	5.2E-02	4.5E-02	2.5E-01	B
Toluene			1.0E-02		1.0E+00	2.5E-01	A
Trichloroethene	9.8E+01	ATSDR, 1988	5.9E-03	1.1E-02	1.6E-02	2.5E-01	B
Vinyl Chloride	1.0E+02	ATSDR, 1988		1.9E+00	8.3E-03	2.5E-01	B
Xylene (mixed)	9.2E+01	ATSDR, 1989	1.8E+00		5.5E-04	2.5E-01	B
Semi-volatile organics							
2,4,6-Trichlorophenol	Unknown	ATSDR, 1989		3.2E-01	5.9E-02	1.0E-01	A
2,4-Dichlorophenol			1.5E-04		6.0E-02	1.0E-01	A
2-Methylnaphthalene	Unknown	ATSDR, 1989				1.0E-01	
Benzo(g,h,i)Perylene						1.0E-01	
Benzo(k)Fluoranthene						1.0E-01	
Benzoic Acid			2.0E-01		7.1E-01	1.0E-01	B
Chrysene	4.1E+01	ATSDR, 1987			6.2E-01	1.0E-01	B
Di-n-Butylphthalate	9.7E+01	ATSDR, 1989	9.7E-02		1.9E+00	1.0E-01	B
Dibenzofuran			2.0E-04			1.0E-01	
Fluoranthene			2.0E-03		3.0E-01	1.0E-01	B
Fluorene			2.0E-03			1.0E-01	
Indeno(1,2,3-cd)Pyrene					1.3E+00	1.0E-01	B
Naphthalene	Unknown	ATSDR, 1989	2.0E-03		6.6E-02	1.0E-01	B
Acenaphthylene						1.0E-01	
Anthracene			1.5E-02			1.0E-01	
Benzo(a)Anthracene	1.0E+02	ATSDR, 1987			7.9E-03	1.0E-01	B
Benzo(a)Pyrene	8.5E+01	ATSDR, 1987			9.0E-01	1.0E-01	B
Benzo(b)Fluoranthene	Unknown	ATSDR, 1987			6.2E-01	1.0E-01	B
Phenanthrene					2.3E-01	1.0E-01	B
Pyrene			1.5E-03			1.0E-01	
Pesticides							
Delta-BHC						1.0E-01	
4,4'-DDD				4.8E+00	2.1E-01	1.0E-01	B
4,4'-DDE				6.8E+00	1.8E-01	1.0E-01	B
4,4'-DDT			2.5E-05	6.8E+00	3.1E-01	1.0E-01	B
Aldrin	Unknown	ATSDR, 1987	1.5E-06	3.4E+02	1.5E-03	1.0E-01	B
Alpha-Chlordane			3.0E-06	2.6E+01	3.6E-02	1.0E-01	B
Gamma-Chlordane			3.0E-06	2.6E+01	3.6E-02	1.0E-01	B
Dieldrin	Unknown	ATSDR, 1987	2.5E-06	3.2E+02	1.1E-02	1.0E-01	B
Endosulfan Sulfate						1.0E-01	
Endosulfan II						1.0E-01	
Endrin Ketone						1.0E-01	
Heptachlor	1.0E+02	ATSDR, 1987	5.0E-04	4.5E+00	9.4E-03	1.0E-01	B
Heptachlor Epoxide	1.0E+02	ATSDR, 1987	1.3E-05	9.1E+00		1.0E-01	
Methoxychlor			2.5E-04			1.0E-01	
MCPP			5.0E-05			1.0E-01	
2,4,5-T			5.0E-04			1.0E-01	
2,4-D			5.0E-04			1.0E-01	
Dioxins							
2,3,7,8-Tetra-CDD	8.7E+01	ATSDR, 1989		1.7E+05	3.5E-01	1.0E-01	B
Inorganics							
Aluminum			5.0E-02			1.0E-02	
Antimony			2.0E-05			1.0E-02	
Arsenic	9.5E+01	ATSDR, 1987	2.9E-04	1.8E+00	8.8E-04	1.0E-02	B
Barium			3.5E-03			1.0E-02	
Beryllium	Unknown	ATSDR, 1987	2.5E-04	8.6E+01	2.2E-03	1.0E-02	B
Cadmium (food)			2.5E-04			1.0E-02	
Chromium (III)	4.0E-01	ATSDR, 1987	4.0E-03			1.0E-02	
Cobalt			3.0E-03		5.5E-04	1.0E-02	A
Copper	6.0E+01	ATSDR, 1989	2.2E-02		1.0E-03	1.0E-02	B
Cyanide	5.0E+01	ATSDR, 1988	1.0E-02		1.7E-03	1.0E-02	B
Lead	1.5E+01	ATSDR,88 Adult			1.3E-04	1.0E-02	B
Magnesium						1.0E-02	
Manganese (food)			7.0E-03			1.0E-02	
Mercury			1.5E-05		1.5E-04	1.0E-02	B
Nickel	3.0E+00	ATSDR, 1987	8.0E-04		1.1E-03	1.0E-02	B
Selenium			2.5E-04		8.1E-04	1.0E-02	B
Vanadium			3.5E-04			1.0E-02	
Zinc	Unknown	ATSDR, 1989	1.5E-02		9.8E-04	1.0E-01	B

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FILE DICOCAP.WK3

APPENDIX D

RISK AND CLEANUP LEVEL CALCULATIONS

Table 1
Incidental Ingestion of Soil
Onsite Child/Adult (Capped Data)
(Future Residential Scenario)
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Chronic Non-Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral RfD mg/kg-day	Hazard Quotient (HQ) unitless	Lifetime Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral Slope Factor kg-day/mg	Risk unitless
Volatiles									
1,1,1-Trichloroethane	3.18E-01	3.65E-06	1.16E-06	9.00E-02	1.29E-05	1.57E-06	4.98E-07		
1,2-Dichloroethene(mixture)	3.20E-01	3.65E-06	1.17E-06	9.00E-03	1.30E-04	1.57E-06	5.00E-07		
2-Butanone (MEK)	5.65E-01	3.65E-06	2.07E-06	6.00E-01	3.44E-06	1.57E-06	8.85E-07		
Acetone	7.20E-01	3.65E-06	2.63E-06	1.00E-01	2.63E-05	1.57E-06	1.13E-06		
Carbon Disulfide	2.88E-01	3.65E-06	1.05E-06	1.00E-01	1.05E-05	1.57E-06	4.51E-07		
Ethylbenzene	3.54E+00	3.65E-06	1.29E-05	1.00E-01	1.29E-04	1.57E-06	5.55E-06		
Methylene Chloride	3.49E-01	3.65E-06	1.28E-06	6.00E-02	2.13E-05	1.57E-06	5.47E-07	7.50E-03	4.10E-06
Tetrachloroethene	3.18E-01	3.65E-06	1.16E-06	1.00E-02	1.16E-04	1.57E-06	4.98E-07	5.20E-02	2.59E-06
Toluene	3.54E+00	3.65E-06	1.29E-05	2.00E-01	6.47E-05	1.57E-06	5.55E-06		
Trichloroethene	3.18E-01	3.65E-06	1.16E-06	6.00E-03	1.94E-04	1.57E-06	4.98E-07	1.10E-02	5.48E-06
Vinyl Chloride	6.07E-01	3.65E-06	2.22E-06			1.57E-06	9.51E-07	1.90E+00	1.81E-06
Xylene (mixed)	3.31E+01	3.65E-06	1.21E-04	2.00E+00	6.05E-05	1.57E-06	5.19E-05		
Semi-volatile organics									
2,4,6-Trichlorophenol	1.05E+00	3.65E-06	3.84E-06			1.57E-06	1.64E-06	1.10E-02	1.81E-06
2,4-Dichlorophenol	1.05E+00	3.65E-06	3.84E-06	3.00E-03	1.28E-03	1.57E-06	1.64E-06		
2-Methylnaphthalene	1.05E+00	3.65E-06	3.84E-06			1.57E-06	1.64E-06		
Benzo(g,h,i)Perylene	1.00E+00	3.65E-06	3.65E-06			1.57E-06	1.57E-06		
Benzo(k)Fluoranthene	1.05E+00	3.65E-06	3.84E-06			1.57E-06	1.64E-06	7.30E-02	1.20E-07
Benzoic Acid	3.00E+00	3.65E-06	1.10E-05	4.00E+00	2.74E-06	1.57E-06	4.70E-06		
Chrysene	3.00E+00	3.65E-06	1.10E-05			1.57E-06	4.70E-06	7.30E-03	3.43E-06
Di-n-Butylphthalate	2.20E-01	3.65E-06	8.04E-07	1.00E-01	8.04E-06	1.57E-06	3.44E-07		
Dibenzofuran	2.20E-01	3.65E-06	8.04E-07	4.00E-03	2.01E-04	1.57E-06	3.44E-07		
Fluoranthene	5.30E+00	3.65E-06	1.94E-05	4.00E-02	4.84E-04	1.57E-06	8.30E-06		
Fluorene	4.40E-01	3.65E-06	1.61E-06	4.00E-02	4.02E-05	1.57E-06	6.89E-07		
Indeno(1,2,3-cd)Pyrene	1.10E+00	3.65E-06	4.02E-06			1.57E-06	1.72E-06	7.30E-01	1.26E-06
Naphthalene	2.20E-01	3.65E-06	8.04E-07	4.00E-02	2.01E-05	1.57E-06	3.44E-07		
Acenaphthylene	3.80E-01	3.65E-06	1.39E-06			1.57E-06	5.95E-07		
Anthracene	1.00E+00	3.65E-06	3.65E-06	3.00E-01	1.22E-05	1.57E-06	1.57E-06		
Benzo(a)Anthracene	2.60E+00	3.65E-06	9.50E-06			1.57E-06	4.07E-06	7.30E-01	2.97E-06
Benzo(a)Pyrene	2.20E+00	3.65E-06	8.04E-06			1.57E-06	3.44E-06	7.30E+00	2.51E-05
Benzo(b)Fluoranthene	1.05E+00	3.65E-06	3.84E-06			1.57E-06	1.64E-06	7.30E-01	1.20E-06
Phenanthrene	4.30E+00	3.65E-06	1.57E-05			1.57E-06	6.73E-06		
Pyrene	5.60E+00	3.65E-06	2.05E-05	3.00E-02	6.82E-04	1.57E-06	8.77E-06		
Pesticides									
Delta-BHC	1.74E+00	3.65E-06	6.35E-06			1.57E-06	2.72E-06		
4,4'-DDD	1.94E+00	3.65E-06	7.08E-06			1.57E-06	3.03E-06	2.40E-01	7.28E-07
4,4'-DDE	2.54E+00	3.65E-06	9.27E-06			1.57E-06	3.97E-06	3.40E-01	1.35E-06
4,4'-DDT	2.00E+00	3.65E-06	7.31E-06	5.00E-04	1.46E-02	1.57E-06	3.13E-06	3.40E-01	1.07E-06
Aldrin	1.81E+01	3.65E-06	6.61E-05	3.00E-05	2.20E+00	1.57E-06	2.83E-05	1.70E+01	4.82E-04
Alpha-Chlordane	2.45E+00	3.65E-06	8.95E-06	6.00E-05	1.49E-01	1.57E-06	3.84E-06	1.30E+00	4.99E-06
Gamma-Chlordane	2.43E+00	3.65E-06	8.89E-06	6.00E-05	1.48E-01	1.57E-06	3.81E-06	1.30E+00	4.95E-06
Dieldrin	5.68E+00	3.65E-06	2.08E-05	5.00E-05	4.15E-01	1.57E-06	8.90E-06	1.60E+01	1.42E-04
Endosulfan Sulfate	3.27E+00	3.65E-06	1.20E-05			1.57E-06	5.12E-06		
Endosulfan II	5.71E-01	3.65E-06	2.09E-06			1.57E-06	8.95E-07		
Endrin Ketone	3.25E+00	3.65E-06	1.19E-05			1.57E-06	5.06E-06		
Heptachlor	1.18E+00	3.65E-06	4.33E-06	5.00E-04	8.66E-03	1.57E-06	1.85E-06	4.50E+00	8.35E-06
Heptachlor Epoxide	1.70E+00	3.65E-06	6.23E-06	1.30E-05	4.79E-01	1.57E-06	2.67E-06	9.10E+00	2.43E-05
Methoxychlor	2.48E+00	3.65E-06	9.07E-06	5.00E-03	1.81E-03	1.57E-06	3.89E-06		
MCPP	7.20E-01	3.65E-06	2.63E-06	1.00E-03	2.63E-03	1.57E-06	1.13E-06		
2,4,5-T	7.01E-02	3.65E-06	2.56E-07	1.00E-02	2.56E-05	1.57E-06	1.10E-07		
2,4-D	4.57E-01	3.65E-06	1.67E-06	1.00E-02	1.67E-04	1.57E-06	7.15E-07		
Dioxins									
2,3,7,8-Tetra-CDD	1.11E-04	3.65E-06	4.04E-10			1.57E-06	1.73E-10	1.50E+05	2.60E-05
Inorganics									
Aluminum	9.06E+03	3.65E-06	3.31E-02	1.00E+00	3.31E-02	1.57E-06	1.42E-02		
Antimony	1.25E+00	3.65E-06	4.56E-06	4.00E-04	1.14E-02	1.57E-06	1.96E-06		
Arsenic	6.38E+00	3.65E-06	2.33E-05	3.00E-04	7.77E-02	1.57E-06	9.99E-06	1.75E+00	1.75E-05
Barium	1.75E+02	3.65E-06	6.38E-04	7.00E-02	9.11E-03	1.57E-06	2.73E-04		
Beryllium	8.73E-01	3.65E-06	3.19E-06	5.00E-03	6.38E-04	1.57E-06	1.37E-06	4.30E+00	5.88E-06
Cadmium (food)	1.36E+00	3.65E-06	4.96E-06	5.00E-03	9.91E-04	1.57E-06	2.12E-06		
Chromium (III)	3.53E+01	3.65E-06	1.29E-04	1.00E+00	1.29E-04	1.57E-06	5.53E-05		
Cobalt	8.53E+00	3.65E-06	3.12E-05	6.00E-02	5.20E-04	1.57E-06	1.34E-05		
Copper	2.08E+02	3.65E-06	7.60E-04	3.70E-02	2.05E-02	1.57E-06	3.26E-04		
Cyanide	1.96E-01	3.65E-06	7.18E-07	2.00E-02	3.59E-05	1.57E-06	3.06E-07		
Lead	3.20E+02	3.65E-06	1.17E-03			1.57E-06	5.01E-04		
Magnesium	6.87E+03	3.65E-06	2.51E-02			1.57E-06	1.08E-02		
Manganese (food)	6.94E+02	3.65E-06	2.54E-03	1.40E-01	1.81E-02	1.57E-06	1.09E-03		
Mercury	1.32E-01	3.65E-06	4.81E-07	3.00E-04	1.60E-03	1.57E-06	2.06E-07		
Nickel	2.44E+01	3.65E-06	8.91E-05	2.00E-02	4.46E-03	1.57E-06	3.82E-05		
Selenium	7.50E-01	3.65E-06	2.74E-06	5.00E-03	5.48E-04	1.57E-06	1.17E-06		
Vanadium	2.75E+01	3.65E-06	1.01E-04	7.00E-03	1.44E-02	1.57E-06	4.31E-05		
Zinc	3.73E+02	3.65E-06	1.36E-03	3.00E-01	4.55E-03	1.57E-06	5.85E-04		
NA - Data Not Available		Total Pathway Hazard Index---->			3.6E+00		Total Pathway Risk---->		7.5E-04

INCIDENTAL INGESTION OF SOIL

CS = Concentration of chemical in soil (mg/kg)

1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)

2.00E+02 IRC = 200 mg/day - Ingestion Rate of soil by a child (0-6 yrs.), (OSWER, 1991)

1.00E+02 IRA = 100 mg/day - Ingestion Rate of soil by an adult (6-30 yrs.), (OSWER, 1991)

1.00E+00 FI = 1.0 - Fraction of intake from source, 100 percent (RAGS)

6.00E+00 EDC = 6 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.40E+01 EDA = 24 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

3.50E+02 EFC = 350 days/yr - Exposure Frequency for a child (0-6 yrs), (OSWER, 1991)

3.50E+02 EFA = 350 days/yr - Exposure Frequency for an adult (6-30 yrs), (OSWER, 1991)

1.50E+01 BWC = 15 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

7.00E+01 BWA = 70 kg - Body Weight for adult, (OSWER, 1991)

3.00E+01 ATN = 30 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)

7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--NON-CARCINOGENIC----> 3.65E-06 HIF = ((IRC * FI * EFC * EDC / BWC) + (IRA * FI * EFA * EDA / BWA))*CF / (ATN)(365)

HIF--CARCINOGENIC----> 1.57E-06 HIF = ((IRC * FI * EFC * EDC / BWC) + (IRA * FI * EFA * EDA / BWA))*CF / (ATC)(365)

DAILY INTAKE = (CS * HIF)

RISK (non-carcinogenic) = (INTAKE / RfD)

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 2
Dermal Contact with Soil
Onsite Child/Adult (Capped Data)
(Future Residential Scenario)
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Absorption Factor (ABS) unitless	Chronic Non-Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal RfD mg/kg-day	Hazard Quotient (HQ) unitless	Lifetime Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal Slope Factor kg-day/mg	Risk unitless
Volatiles										
1,1,1-Trichloroethane	3.18E-01	1.00E-01	8.68E-05	2.76E-06	4.50E-03	6.13E-04	3.72E-05	1.18E-06		
1,2-Dichloroethene(mixture)	3.20E-01	1.00E-01	8.68E-05	2.77E-06	4.50E-04	6.16E-03	3.72E-05	1.19E-06		
2-Butanone (MEK)	5.65E-01	1.00E-01	8.68E-05	4.91E-06	3.00E-02	1.64E-04	3.72E-05	2.10E-06		
Acetone	7.20E-01	1.00E-01	8.68E-05	6.25E-06	5.00E-03	1.25E-03	3.72E-05	2.68E-06		
Carbon Disulfide	2.88E-01	1.00E-01	8.68E-05	2.50E-06	5.00E-03	5.00E-04	3.72E-05	1.07E-06		
Ethylbenzene	3.54E+00	1.00E-01	8.68E-05	3.08E-05	9.20E-02	3.34E-04	3.72E-05	1.32E-05		
Methylene Chloride	3.49E-01	1.00E-01	8.68E-05	3.03E-06	3.30E-02	9.19E-05	3.72E-05	1.30E-06	1.36E-02	1.77E-08
Tetrachloroethene	3.18E-01	1.00E-01	8.68E-05	2.76E-06	1.00E-02	2.76E-04	3.72E-05	1.18E-06	5.20E-02	6.15E-08
Toluene	3.54E+00	1.00E-01	8.68E-05	3.08E-05	1.00E-02	3.08E-03	3.72E-05	1.32E-05		
Trichloroethene	3.18E-01	1.00E-01	8.68E-05	2.76E-06	5.88E-03	4.70E-04	3.72E-05	1.18E-06	1.12E-02	1.33E-08
Vinyl Chloride	6.07E-01	1.00E-01	8.68E-05	5.27E-06			3.72E-05	2.26E-06	1.90E+00	4.29E-06
Xylene (mixed)	3.31E+01	1.00E-01	8.68E-05	2.87E-04	1.84E+00	1.56E-04	3.72E-05	1.23E-04		
Semi-volatile organics										
2,4,6-Trichlorophenol	1.05E+00	1.00E-01	8.68E-05	9.11E-06			3.72E-05	3.90E-06	2.20E-01	8.59E-07
2,4-Dichlorophenol	1.05E+00	1.00E-01	8.68E-05	9.11E-06	1.50E-04	6.07E-02	3.72E-05	3.90E-06		
2-Methylnaphthalene	1.05E+00	1.00E-01	8.68E-05	9.11E-06			3.72E-05	3.90E-06		
Benzo(g,h,i)Perylene	1.00E+00	1.00E-01	8.68E-05	8.68E-06			3.72E-05	3.72E-06		
Benzo(k)Fluoranthene	1.05E+00	1.00E-01	8.68E-05	9.11E-06			3.72E-05	3.90E-06		
Benzoic Acid	3.00E+00	1.00E-01	8.68E-05	2.60E-05	2.00E-01	1.30E-04	3.72E-05	1.12E-05		
Chrysene	3.00E+00	1.00E-01	8.68E-05	2.60E-05			3.72E-05	1.12E-05		
Di-n-Butylphthalate	2.20E-01	1.00E-01	8.68E-05	1.91E-06	9.70E-02	1.97E-05	3.72E-05	8.18E-07		
Dibenzofuran	2.20E-01	1.00E-01	8.68E-05	1.91E-06	2.00E-04	9.54E-03	3.72E-05	8.18E-07		
Fluoranthene	5.30E+00	1.00E-01	8.68E-05	4.60E-05	2.00E-03	2.30E-02	3.72E-05	1.97E-05		
Fluorene	4.40E-01	1.00E-01	8.68E-05	3.82E-06	2.00E-03	1.91E-03	3.72E-05	1.64E-06		
Indeno(1,2,3-cd)Pyrene	1.10E+00	1.00E-01	8.68E-05	9.54E-06			3.72E-05	4.09E-06		
Naphthalene	2.20E-01	1.00E-01	8.68E-05	1.91E-06	2.00E-03	9.54E-04	3.72E-05	8.18E-07		
Acenaphthylene	3.80E-01	1.00E-01	8.68E-05	3.30E-06			3.72E-05	1.41E-06		
Anthracene	1.00E+00	1.00E-01	8.68E-05	8.68E-06	1.50E-02	5.78E-04	3.72E-05	3.72E-06		
Benzo(a)Anthracene	2.60E+00	1.00E-01	8.68E-05	2.26E-05			3.72E-05	9.67E-06		
Benzo(a)Pyrene	2.20E+00	1.00E-01	8.68E-05	1.91E-05			3.72E-05	8.18E-06		
Benzo(b)Fluoranthene	1.05E+00	1.00E-01	8.68E-05	9.11E-06			3.72E-05	3.90E-06		
Phenanthrene	4.30E+00	1.00E-01	8.68E-05	3.73E-05			3.72E-05	1.60E-05		
Pyrene	5.60E+00	1.00E-01	8.68E-05	4.86E-05	1.50E-03	3.24E-02	3.72E-05	2.08E-05		
Pesticides										
Delta-BHC	1.74E+00	1.00E-01	8.68E-05	1.51E-05			3.72E-05	6.47E-06		
4,4'-DDD	1.94E+00	1.00E-01	8.68E-05	1.68E-05			3.72E-05	7.20E-06	4.80E+00	3.46E-05
4,4'-DDE	2.54E+00	1.00E-01	8.68E-05	2.20E-05			3.72E-05	9.43E-06	6.80E+00	6.41E-05
4,4'-DDT	2.00E+00	1.00E-01	8.68E-05	1.74E-05	2.50E-05	6.95E-01	3.72E-05	7.44E-06	6.80E+00	5.06E-05
Aldrin	1.81E+01	1.00E-01	8.68E-05	1.57E-04	1.50E-06	1.05E+02	3.72E-05	6.73E-05	3.40E+02	2.29E-02
Alpha-Chlordane	2.45E+00	1.00E-01	8.68E-05	2.13E-05	3.00E-06	7.08E+00	3.72E-05	9.11E-06	2.60E+01	2.37E-04
Gamma-Chlordane	2.43E+00	1.00E-01	8.68E-05	2.11E-05	3.00E-06	7.04E+00	3.72E-05	9.05E-06	2.60E+01	2.35E-04
Dieldrin	5.68E+00	1.00E-01	8.68E-05	4.93E-05	2.50E-06	1.97E+01	3.72E-05	2.11E-05	3.20E+02	6.76E-03
Endosulfan Sulfate	3.27E+00	1.00E-01	8.68E-05	2.84E-05			3.72E-05	1.22E-05		
Endosulfan II	5.71E-01	1.00E-01	8.68E-05	4.96E-06			3.72E-05	2.12E-06		
Endrin Ketone	3.25E+00	1.00E-01	8.68E-05	2.82E-05			3.72E-05	1.21E-05		
Heptachlor	1.18E+00	1.00E-01	8.68E-05	1.03E-05	5.00E-04	2.06E-02	3.72E-05	4.40E-06	4.50E+00	1.98E-05
Heptachlor Epoxide	1.70E+00	1.00E-01	8.68E-05	1.48E-05	1.30E-05	1.14E+00	3.72E-05	6.34E-06	9.10E+00	5.77E-05
Methoxychlor	2.48E+00	1.00E-01	8.68E-05	2.15E-05	2.50E-04	8.61E-02	3.72E-05	9.23E-06		
MCPP	7.20E-01	1.00E-01	8.68E-05	6.24E-06	5.00E-05	1.25E-01	3.72E-05	2.68E-06		
2,4,5-T	7.01E-02	1.00E-01	8.68E-05	6.08E-07	5.00E-04	1.22E-03	3.72E-05	2.61E-07		
2,4-D	4.57E-01	1.00E-01	8.68E-05	3.96E-06	5.00E-04	7.93E-03	3.72E-05	1.70E-06		
Dioxins										
2,3,7,8-Tetra-CDD	1.11E-04	1.00E-01	8.68E-05	9.60E-10			3.72E-05	4.12E-10	1.72E+05	7.10E-05
Inorganics										
Aluminum	9.06E+03	1.00E-02	8.68E-05	7.86E-03	5.00E-02	1.57E-01	3.72E-05	3.37E-03		
Antimony	1.25E+00	1.00E-02	8.68E-05	1.08E-06	2.00E-05	5.42E-02	3.72E-05	4.64E-07		
Arsenic	6.38E+00	1.00E-02	8.68E-05	5.54E-06	2.85E-04	1.94E-02	3.72E-05	2.37E-06	1.84E+00	4.37E-06
Barium	1.75E+02	1.00E-02	8.68E-05	1.51E-04	3.50E-03	4.33E-02	3.72E-05	6.49E-05		
Beryllium	8.73E-01	1.00E-02	8.68E-05	7.58E-07	2.50E-04	3.03E-03	3.72E-05	3.25E-07	8.60E+01	2.79E-05
Cadmium (food)	1.36E+00	2.00E-01	8.68E-05	2.35E-05	2.50E-04	9.42E-02	3.72E-05	1.01E-05		
Chromium (III)	3.53E+01	1.00E-02	8.68E-05	3.06E-05	4.00E-03	7.66E-03	3.72E-05	1.31E-05		
Cobalt	8.53E+00	1.00E-02	8.68E-05	7.40E-06	3.00E-03	2.47E-03	3.72E-05	3.17E-06		
Copper	2.06E+02	1.00E-01	8.68E-05	1.80E-03	2.22E-02	8.13E-02	3.72E-05	7.73E-04		
Cyanide	1.96E-01	1.00E-02	8.68E-05	1.70E-07	1.00E-02	1.70E-05	3.72E-05	7.30E-06		
Lead	3.20E+02	1.00E-01	8.68E-05	2.77E-03			3.72E-05	1.19E-03		
Magnesium	6.87E+03	1.00E-02	8.68E-05	5.96E-03			3.72E-05	2.55E-03		
Manganese (food)	6.94E+02	1.00E-01	8.68E-05	6.02E-03	7.00E-03	8.60E-01	3.72E-05	2.58E-03		
Mercury	1.32E-01	1.00E-02	8.68E-05	1.14E-07	1.50E-05	7.62E-03	3.72E-05	4.90E-06		
Nickel	2.44E+01	1.00E-02	8.68E-05	2.12E-05	6.00E-04	3.53E-02	3.72E-05	9.07E-06		
Selenium	7.50E-01	1.00E-01	8.68E-05	6.51E-06	2.50E-04	2.60E-02	3.72E-05	2.79E-06		
Vanadium	2.75E+01	1.00E-02	8.68E-05	2.39E-05	3.50E-04	6.83E-02	3.72E-05	1.02E-05		
Zinc	3.73E+02	1.00E-01	8.68E-05	3.24E-03	1.50E-02	2.16E-01	3.72E-05	1.39E-03		
NA - Data Not Available			Total Pathway Hazard Index——>			1.4E+02		Total Pathway Risk——>		3.0E-02

DERMAL CONTACT WITH SOIL

CS = Concentration of chemical in soil (mg/kg)

ABS = Absorption Factor - Assumed to be 0.1 for organics, 0.1 for copper, lead, manganese, selinium and zinc, 0.2 for cadmium, and 0.01 for inorganics (CAPCOA values)

1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
2.50E+03 SAC = 2500 sq cm - Skin Surface Area Available (Child 0-6 yrs.), hands, arms, legs, (OHEA-E-367)
5.00E+03 SAA = 5000 sq cm - Skin Surface Area Available for Contact, (Adult), hands, arms, (OHEA-E-367)
1.00E+00 FI = 1.0 - Fraction of Intake from source, 100 percent (RAGS)
3.50E+02 EFC = 350 days/yr - Exposure Frequency, (Child: 0-6 yrs.) (OSWER, 1991)
3.50E+02 EFA = 350 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (OSWER, 1991)
6.00E+00 EDC = 6 yrs - Duration for child (1-6 yrs.), (OSWER, 1991)
2.40E+01 EDA = 24 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.50E+01 BWC = 15 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
7.00E+01 BWA = 70 kg - Body Weight for adult, (OSWER, 1991)
3.00E+01 ATN = 30 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)
1.00E+00 AF = 1.00 mg/sq cm - Adherence Factor, (EPA, Region X)

HIF--NON-CARCINOGENIC——————> 8.68E-05 HIF = [((SAC * FI * EFC * EDC * AF / BWC) + (SAA * FI * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]

HIF--CARCINOGENIC——————> 3.72E-05 HIF = [((SAC * FI * EFC * EDC * AF / BWC) + (SAA * FI * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]

DAILY INTAKE = (CS * ABS * HIF)

RISK (non-carcinogenic) = (INTAKE / RfD)

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 3
Cleanup Levels for Ingestion and Dermal Contact
Onsite Child/Adult (Capped Data)
(Future Residential Scenario)
OU4 Risk Assessment

Contaminants or Chemicals	Non-Carcinogenic Risk				Non-Carcinogenic Cleanup Level (HQ=0.1) mg/kg	Non-Carcinogenic Cleanup Level (HQ=1.0) mg/kg	Carcinogenic Risk				Carcinogenic Cleanup Level (Risk=1E-4) mg/kg	Carcinogenic Cleanup Level (Risk=1E-6) mg/kg
	Ingestion HQ	Dermal Contact HQ	Inhalation HQ	Total HQ			Ingestion Risk	Dermal Contact Risk	Inhalation Risk	Total Risk		
1,1,1-Trichloroethane	1.3E-05	6.1E-04		6.3E-04	5.1E+01	5.1E+02						
1,2-Dichloroethene(mixture)	1.3E-04	6.2E-03		6.3E-03	5.1E+00	5.1E+01						
2-Butanone (MEK)	3.4E-06	1.6E-04		1.7E-04	3.4E+02	3.4E+03						
Acetone	2.6E-05	1.2E-03		1.3E-03	5.6E+01	5.6E+02						
Carbon Disulfide	1.1E-05	5.0E-04		5.1E-04	5.6E+01	5.6E+02						
Ethylbenzene	1.3E-04	3.3E-04		4.6E-04	7.6E+02	7.6E+03						
Methylene Chloride	2.1E-05	9.2E-05		1.1E-04	3.1E+02	3.1E+03	4.1E-09	1.8E-08		2.2E-08	1.6E+03	1.6E+01
Tetrachloroethene	1.2E-04	2.8E-04		3.9E-04	8.1E+01	8.1E+02	2.6E-06	6.1E-06		8.7E-06	3.6E+02	3.6E+00
Toluene	6.5E-05	3.1E-03		3.1E-03	1.1E+02	1.1E+03						
Trichloroethene	1.9E-04	4.7E-04		6.6E-04	4.6E+01	4.6E+02	5.5E-09	1.3E-08		1.9E-08	1.7E+03	1.7E+01
Vinyl Chloride							1.6E-06	4.3E-06		6.1E-06	1.0E+01	1.0E-01
Xylene (mixed)	6.1E-05	1.6E-04		2.2E-04	1.5E+04	1.5E+05						
Semi-volatile organics												
2,4,6-Trichlorophenol							1.6E-06	6.6E-07		8.8E-07	1.2E+02	1.2E+00
2,4-Dichlorophenol	1.3E-03	6.1E-02		6.2E-02	1.7E+00	1.7E+01						
2-Methylnaphthalene												
Benzo(g,h,i)Perylene												
Benzo(k)Fluoranthene							1.2E-07			1.2E-07	8.8E+02	8.8E+00
Benzoic Acid	2.7E-06	1.3E-04		1.3E-04	2.3E+03	2.3E+04						
Chrysene							3.4E-08			3.4E-08	8.8E+03	8.8E+01
Di-n-Butylphthalate	8.0E-06	2.0E-05		2.8E-05	7.9E+02	7.9E+03						
Dibenzofuran	2.0E-04	9.5E-03		9.7E-03	2.3E+00	2.3E+01						
Fluoranthene	4.6E-04	2.3E-02		2.3E-02	2.3E+01	2.3E+02						
Fluorene	4.0E-05	1.9E-03		1.9E-03	2.3E+01	2.3E+02						
Indeno(1,2,3-cd)Pyrene							1.3E-06			1.3E-06	8.8E+01	8.8E-01
Naphthalene	2.0E-05	9.5E-04		9.7E-04	2.3E+01	2.3E+02						
Acenaphthylene												
Anthracene	1.2E-05	5.8E-04		5.9E-04	1.7E+02	1.7E+03						
Benzo(a)Anthracene							3.0E-06			3.0E-06	8.8E+01	8.7E-01
Benzo(a)Pyrene							2.5E-05			2.5E-05	8.8E+00	8.8E-02
Benzo(b)Fluoranthene							1.2E-06			1.2E-06	8.8E+01	8.7E-01
Phenanthrene												
Pyrene	6.8E-04	3.2E-02		3.3E-02	1.7E+01	1.7E+02						
Pesticides												
Delta-BHC												
4,4'-DDD							7.3E-07	3.5E-05		3.5E-05	5.5E+00	5.5E-02
4,4'-DDE							1.4E-06	6.4E-05		6.5E-05	3.9E+00	3.9E-02
4,4'-DDT	1.5E-02	6.9E-01		7.1E-01	2.8E-01	2.8E+00	1.1E-06	5.1E-05		5.2E-05	3.9E+00	3.9E-02
Aldrin	2.2E+00	1.0E+02		1.1E+02	1.7E-02	1.7E-01	4.8E-04	2.3E-02		2.3E-02	7.7E-02	7.7E-04
Alpha-Chlordane	1.5E-01	7.1E+00		7.2E+00	3.4E-02	3.4E-01	5.0E-06	2.4E-04		2.4E-04	1.0E+00	1.0E-02
Gamma-Chlordane	1.5E-01	7.0E+00		7.2E+00	3.4E-02	3.4E-01	5.0E-06	2.4E-04		2.4E-04	1.0E+00	1.0E-02
Dieldrin	4.2E-01	2.0E+01		2.0E+01	2.8E-02	2.8E-01	1.4E-04	6.8E-03		6.9E-03	8.2E-02	8.2E-04
Endosulfan Sulfate												
Endosulfan II												
Endrin Ketone												
Heptachlor	8.7E-03	2.1E-02		2.9E-02	4.1E+00	4.1E+01	6.3E-06	2.0E-05		2.8E-05	4.2E+00	4.2E-02
Heptachlor Epoxide	4.8E-01	1.1E+00		1.6E+00	1.1E-01	1.1E+00	2.4E-05	5.8E-05		8.2E-05	2.1E+00	2.1E-02
Methoxychlor	1.8E-03	8.6E-02		8.8E-02	2.8E+00	2.8E+01						
MCPP	2.6E-03	1.2E-01		1.3E-01	5.6E-01	5.6E+00						
2,4,5-T	2.6E-05	1.2E-03		1.2E-03	5.6E+00	5.6E+01						
2,4-D	1.7E-04	7.9E-03		8.1E-03	5.6E+00	5.6E+01						
Dioxins												
2,3,7,8-Tetra-CDD							2.6E-05	7.1E-05		9.7E-05	1.1E-04	1.1E-06
Inorganics												
Aluminum	3.3E-02	1.6E-01		1.9E-01	4.8E+03	4.8E+04						
Antimony	1.1E-02	5.4E-02		6.6E-02	1.9E+00	1.9E+01						
Arsenic	7.8E-02	1.9E-02		9.7E-02	6.6E+00	6.6E+01	1.7E-05	4.4E-06		2.2E-05	2.9E+01	2.9E-01
Barium	9.1E-03	4.3E-02		5.2E-02	3.3E+02	3.3E+03						
Beryllium	6.4E-04	3.0E-03		3.7E-03	2.4E+01	2.4E+02	5.9E-06	2.8E-05		3.4E-05	2.6E+00	2.6E-02
Cadmium (food)	9.9E-04	9.4E-02		9.5E-02	1.4E+00	1.4E+01						
Chromium (III)	1.3E-04	7.7E-03		7.8E-03	4.5E+02	4.5E+03						
Cobalt	5.2E-04	2.5E-03		3.0E-03	2.9E+02	2.9E+03						
Copper	2.1E-02	8.1E-02		1.0E-01	2.0E+02	2.0E+03						
Cyanide	3.6E-05	1.7E-05		5.3E-05	3.7E+02	3.7E+03						
Lead												
Magnesium												
Manganese (food)	1.8E-02	8.6E-01		8.8E-01	7.9E+01	7.9E+02						
Mercury	1.6E-03	7.8E-03		9.2E-03	1.4E+00	1.4E+01						
Nickel	4.5E-03	3.5E-02		4.0E-02	6.1E+01	6.1E+02						
Selenium	5.5E-04	2.6E-02		2.7E-02	2.8E+00	2.8E+01						
Vanadium	1.4E-02	6.8E-02		8.3E-02	3.3E+01	3.3E+02						
Zinc	4.5E-03	2.2E-01		2.2E-01	1.7E+02	1.7E+03						

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Table 4
Incidental Ingestion of Soil
Adult Worker (Capped Data)
(Future Worker Scenario)
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Chronic Non-Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral RfD mg/kg-day	Hazard Quotient (HQ) unitless	Lifetime Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral Slope Factor kg-day/mg	Risk unitless
Volatiles									
1,1,1-Trichloroethane	3.18E-01	9.39E-08	2.99E-08	9.00E-02	3.32E-07	3.35E-08	1.07E-08		
1,2-Dichloroethene(mixture)	3.20E-01	9.39E-08	3.00E-08	9.00E-03	3.34E-06	3.35E-08	1.07E-08		
2-Butanone (MEK)	5.65E-01	9.39E-08	5.31E-08	6.00E-01	8.85E-08	3.35E-08	1.90E-08		
Acetone	7.20E-01	9.39E-08	6.76E-08	1.00E-01	6.76E-07	3.35E-08	2.42E-08		
Carbon Disulfide	2.88E-01	9.39E-08	2.70E-08	1.00E-01	2.70E-07	3.35E-08	9.66E-09		
Ethylbenzene	3.54E+00	9.39E-08	3.33E-07	1.00E-01	3.33E-06	3.35E-08	1.19E-07		
Methylene Chloride	3.49E-01	9.39E-08	3.28E-08	6.00E-02	5.47E-07	3.35E-08	1.17E-08	7.50E-03	8.79E-11
Tetrachloroethene	3.18E-01	9.39E-08	2.99E-08	1.00E-02	2.99E-06	3.35E-08	1.07E-08	5.20E-02	5.55E-10
Toluene	3.54E+00	9.39E-08	3.33E-07	2.00E-01	1.66E-06	3.35E-08	1.19E-07		
Trichloroethene	3.18E-01	9.39E-08	2.99E-08	6.00E-03	4.98E-06	3.35E-08	1.07E-08	1.10E-02	1.17E-10
Vinyl Chloride	6.07E-01	9.39E-08	5.71E-08			3.35E-08	2.04E-08	1.90E+00	3.87E-08
Xylene (mixed)	3.31E+01	9.39E-08	3.11E-06	2.00E+00	1.56E-06	3.35E-08	1.11E-06		
Semi-volatile organics									
2,4,6-Trichlorophenol	1.05E+00	9.39E-08	9.86E-08			3.35E-08	3.52E-08	1.10E-02	3.87E-10
2,4-Dichlorophenol	1.05E+00	9.39E-08	9.86E-08	3.00E-03	3.29E-05	3.35E-08	3.52E-08		
2-Methylnaphthalene	1.05E+00	9.39E-08	9.86E-08			3.35E-08	3.52E-08		
Benzo(g,h,i)Perylene	1.00E+00	9.39E-08	9.39E-08			3.35E-08	3.35E-08		
Benzo(k)Fluoranthene	1.05E+00	9.39E-08	9.86E-08			3.35E-08	3.52E-08	7.30E-02	2.57E-09
Benzoic Acid	3.00E+00	9.39E-08	2.82E-07	4.00E+00	7.05E-08	3.35E-08	1.01E-07		
Chrysene	3.00E+00	9.39E-08	2.82E-07			3.35E-08	1.01E-07	7.30E-03	7.35E-10
Di-n-Butylphthalate	2.20E-01	9.39E-08	2.07E-08	1.00E-01	2.07E-07	3.35E-08	7.38E-09		
Dibenzofuran	2.20E-01	9.39E-08	2.07E-08	4.00E-03	5.17E-06	3.35E-08	7.38E-09		
Fluoranthene	5.30E+00	9.39E-08	4.98E-07	4.00E-02	1.24E-05	3.35E-08	1.78E-07		
Fluorene	4.40E-01	9.39E-08	4.13E-08	4.00E-02	1.03E-06	3.35E-08	1.48E-08		
Indeno(1,2,3-cd)Pyrene	1.10E+00	9.39E-08	1.03E-07			3.35E-08	3.69E-08	7.30E-01	2.69E-08
Naphthalene	2.20E-01	9.39E-08	2.07E-08	4.00E-02	5.17E-07	3.35E-08	7.38E-09		
Acenaphthylene	3.80E-01	9.39E-08	3.57E-08			3.35E-08	1.27E-08		
Anthracene	1.00E+00	9.39E-08	9.39E-08	3.00E-01	3.13E-07	3.35E-08	3.35E-08		
Benzo(a)Anthracene	2.60E+00	9.39E-08	2.44E-07			3.35E-08	8.72E-08	7.30E-01	6.37E-08
Benzo(a)Pyrene	2.20E+00	9.39E-08	2.07E-07			3.35E-08	7.38E-08	7.30E+00	5.39E-07
Benzo(b)Fluoranthene	1.05E+00	9.39E-08	9.86E-08			3.35E-08	3.52E-08	7.30E-01	2.57E-08
Phenanthrene	4.30E+00	9.39E-08	4.04E-07			3.35E-08	1.44E-07		
Pyrene	5.60E+00	9.39E-08	5.26E-07	3.00E-02	1.75E-05	3.35E-08	1.88E-07		
Pesticides									
Delta-BHC	1.74E+00	9.39E-08	1.63E-07			3.35E-08	5.83E-08		
4,4'-DDD	1.94E+00	9.39E-08	1.82E-07			3.35E-08	6.50E-08	2.40E-01	1.56E-08
4,4'-DDE	2.54E+00	9.39E-08	2.38E-07			3.35E-08	8.51E-08	3.40E-01	2.89E-08
4,4'-DDT	2.00E+00	9.39E-08	1.88E-07	5.00E-04	3.76E-04	3.35E-08	6.72E-08	3.40E-01	2.28E-08
Aldrin	1.81E+01	9.39E-08	1.70E-06	3.00E-05	5.67E-02	3.35E-08	6.07E-07	1.70E+01	1.03E-05
Alpha-Chlordane	2.45E+00	9.39E-08	2.30E-07	6.00E-05	3.84E-03	3.35E-08	8.22E-08	1.30E+00	1.07E-07
Gamma-Chlordane	2.43E+00	9.39E-08	2.28E-07	6.00E-05	3.81E-03	3.35E-08	8.16E-08	1.30E+00	1.06E-07
Dieldrin	5.68E+00	9.39E-08	5.34E-07	5.00E-05	1.07E-02	3.35E-08	1.91E-07	1.60E+01	3.05E-06
Endosulfan Sulfate	3.27E+00	9.39E-08	3.07E-07			3.35E-08	1.10E-07		
Endosulfan II	5.71E-01	9.39E-08	5.37E-08			3.35E-08	1.92E-08		
Endrin Ketone	3.25E+00	9.39E-08	3.05E-07			3.35E-08	1.09E-07		
Heptachlor	1.18E+00	9.39E-08	1.11E-07	5.00E-04	2.23E-04	3.35E-08	3.97E-08	4.50E+00	1.79E-07
Heptachlor Epoxide	1.70E+00	9.39E-08	1.60E-07	1.30E-05	1.23E-02	3.35E-08	5.72E-08	9.10E+00	5.20E-07
Methoxychlor	2.48E+00	9.39E-08	2.33E-07	5.00E-03	4.66E-05	3.35E-08	8.33E-08		
MCPP	7.20E-01	9.39E-08	6.76E-08	1.00E-03	6.76E-05	3.35E-08	2.41E-08		
2,4,5-T	7.01E-02	9.39E-08	6.58E-09	1.00E-02	6.58E-07	3.35E-08	2.35E-09		
2,4-D	4.57E-01	9.39E-08	4.29E-08	1.00E-02	4.29E-06	3.35E-08	1.53E-08		
Dioxins									
2,3,7,8-Tetra-CDD	1.11E-04	9.39E-08	1.04E-11			3.35E-08	3.71E-12	1.50E+05	5.57E-07
Inorganics									
Aluminum	9.06E+03	9.39E-08	8.51E-04	1.00E+00	8.51E-04	3.35E-08	3.04E-04		
Antimony	1.25E+00	9.39E-08	1.17E-07	4.00E-04	2.93E-04	3.35E-08	4.19E-08		
Arsenic	6.38E+00	9.39E-08	5.99E-07	3.00E-04	2.00E-03	3.35E-08	2.14E-07	1.75E+00	3.75E-07
Barium	1.75E+02	9.39E-08	1.64E-05	7.00E-02	2.34E-04	3.35E-08	5.86E-06		
Beryllium	8.73E-01	9.39E-08	8.20E-08	5.00E-03	1.64E-05	3.35E-08	2.93E-08	4.30E+00	1.26E-07
Cadmium (food)	1.36E+00	9.39E-08	1.27E-07	5.00E-03	2.55E-05	3.35E-08	4.55E-08		
Chromium (III)	3.53E+01	9.39E-08	3.32E-06	1.00E+00	3.32E-06	3.35E-08	1.18E-06		
Cobalt	8.53E+00	9.39E-08	8.02E-07	6.00E-02	1.34E-05	3.35E-08	2.86E-07		
Copper	2.08E+02	9.39E-08	1.95E-05	3.70E-02	5.26E-04	3.35E-08	6.98E-06		
Cyanide	1.96E-01	9.39E-08	1.85E-08	2.00E-02	9.23E-07	3.35E-08	6.59E-09		
Lead	3.20E+02	9.39E-08	3.00E-05			3.35E-08	1.07E-05		
Magnesium	6.87E+03	9.39E-08	6.45E-04			3.35E-08	2.30E-04		
Manganese (food)	8.94E+02	9.39E-08	8.52E-05	1.40E-01	4.66E-04	3.35E-08	2.33E-05		
Mercury	1.32E-01	9.39E-08	1.24E-08	3.00E-04	4.12E-05	3.35E-08	4.42E-09		
Nickel	2.44E+01	9.39E-08	2.29E-06	2.00E-02	1.15E-04	3.35E-08	8.18E-07		
Selenium	7.50E-01	9.39E-08	7.05E-08	5.00E-03	1.41E-05	3.35E-08	2.52E-08		
Vanadium	2.75E+01	9.39E-08	2.59E-06	7.00E-03	3.69E-04	3.35E-08	9.24E-07		
Zinc	3.73E+02	9.39E-08	3.51E-05	3.00E-01	1.17E-04	3.35E-08	1.25E-05		
NA - Data Not Available		Total Pathway Hazard Index——>			9.3E-02		Total Pathway Risk——>		1.6E-05

INCIDENTAL INGESTION OF SOIL

CS = Concentration of chemical in soil (mg/kg)

\# - Assumed Value

1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
5.00E+01 IR = 50 mg/day - Ingestion Rate of soil by an adult worker, (OSWER, 1991)
1.00E+00 FI = 1.0 - Fraction of intake from source, 100 percent (RAGS)
2.50E+01 ED = 25 yrs - Exposure Duration for an adult worker, (OSWER, 1991)
4.80E+01 EF = 48 days/yr - Exposure Frequency for an adult worker (1 day/wk for 48 wks) #
7.00E+01 BW = 70 kg - Body Weight for adult worker, (OSWER, 1991)
2.50E+01 ATN = 25 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF–NON-CARCINOGENIC——> 9.39E-08 HIF = ((CF * IR * FI * ED * EF / BW)) / (ATN)(365)
HIF–CARCINOGENIC——> 3.35E-08 HIF = ((CF * IR * FI * ED * EF / BW)) / (ATC)(365)
DAILY INTAKE = (CS * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 5
Dermal Contact with Soil
Adult Worker (Capped Data)
(Future Worker Scenario)
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Absorption Factor (ABS) unitless	Chronic Non-Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal RfD mg/kg-day	Hazard Quotient (HQ) unitless	Lifetime Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal Slope Factor kg-day/mg	Risk unitless
1,1,1-Trichloroethane	3.18E-01	1.00E-01	5.86E-06	1.86E-07	4.50E-03	4.14E-05	2.09E-06	6.65E-08		
1,2-Dichloroethene(mixture)	3.20E-01	1.00E-01	5.86E-06	1.87E-07	4.50E-04	4.16E-04	2.09E-06	6.69E-08		
2-Butanone (MEK)	5.65E-01	1.00E-01	5.86E-06	3.31E-07	3.00E-02	1.10E-05	2.09E-06	1.18E-07		
Acetone	7.20E-01	1.00E-01	5.86E-06	4.22E-07	5.00E-03	8.44E-05	2.09E-06	1.51E-07		
Carbon Disulfide	2.88E-01	1.00E-01	5.86E-06	1.69E-07	5.00E-03	3.37E-05	2.09E-06	6.03E-08		
Ethylbenzene	3.54E+00	1.00E-01	5.86E-06	2.08E-06	9.20E-02	2.26E-05	2.09E-06	7.42E-07		
Methylene Chloride	3.49E-01	1.00E-01	5.86E-06	2.05E-07	3.30E-02	6.21E-06	2.09E-06	7.31E-08	1.36E-02	9.97E-10
Tetrachloroethene	3.18E-01	1.00E-01	5.86E-06	1.86E-07	1.00E-02	1.86E-05	2.09E-06	6.66E-08	5.20E-02	3.46E-09
Toluene	3.54E+00	1.00E-01	5.86E-06	2.08E-06	1.00E-02	2.08E-04	2.09E-06	7.42E-07		
Trichloroethene	3.18E-01	1.00E-01	5.86E-06	1.87E-07	5.88E-03	3.17E-05	2.09E-06	6.67E-08	1.12E-02	7.48E-10
Vinyl Chloride	6.07E-01	1.00E-01	5.86E-06	3.56E-07			2.09E-06	1.27E-07	1.90E+00	2.42E-07
Xylene (mixed)	3.31E+01	1.00E-01	5.86E-06	1.94E-05	1.84E+00	1.06E-05	2.09E-06	6.94E-06		
Semi-volatile organics										
2,4,6-Trichlorophenol	1.05E+00	1.00E-01	5.86E-06	6.15E-07			2.09E-06	2.20E-07	2.20E-01	4.84E-08
2,4-Dichlorophenol	1.05E+00	1.00E-01	5.86E-06	6.15E-07	1.50E-04	4.10E-03	2.09E-06	2.20E-07		
2-Methylnaphthalene	1.05E+00	1.00E-01	5.86E-06	6.15E-07			2.09E-06	2.20E-07		
Benzo(g,h,i)Perylene	1.00E+00	1.00E-01	5.86E-06	5.86E-07			2.09E-06	2.09E-07		
Benzo(k)Fluoranthene	1.05E+00	1.00E-01	5.86E-06	6.15E-07			2.09E-06	2.20E-07		
Benzoic Acid	3.00E+00	1.00E-01	5.86E-06	1.76E-06	2.00E-01	8.79E-06	2.09E-06	6.28E-07		
Chrysene	3.00E+00	1.00E-01	5.86E-06	1.76E-06			2.09E-06	6.28E-07		
Di-n-Butylphthalate	2.20E-01	1.00E-01	5.86E-06	1.29E-07	9.70E-02	1.33E-06	2.09E-06	4.61E-08		
Dibenzofuran	2.20E-01	1.00E-01	5.86E-06	1.29E-07	2.00E-04	6.45E-04	2.09E-06	4.61E-08		
Fluoranthene	5.30E+00	1.00E-01	5.86E-06	3.11E-06	2.00E-03	1.55E-03	2.09E-06	1.11E-06		
Fluorene	4.40E-01	1.00E-01	5.86E-06	2.58E-07	2.00E-03	1.29E-04	2.09E-06	9.21E-08		
Indeno(1,2,3-cd)Pyrene	1.10E+00	1.00E-01	5.86E-06	6.45E-07			2.09E-06	2.30E-07		
Naphthalene	2.20E-01	1.00E-01	5.86E-06	1.29E-07	2.00E-03	6.45E-05	2.09E-06	4.61E-08		
Acenaphthylene	3.80E-01	1.00E-01	5.86E-06	2.23E-07			2.09E-06	7.95E-08		
Anthracene	1.00E+00	1.00E-01	5.86E-06	5.86E-07	1.50E-02	3.91E-05	2.09E-06	2.09E-07		
Benzo(a)Anthracene	2.60E+00	1.00E-01	5.86E-06	1.52E-06			2.09E-06	5.44E-07		
Benzo(a)Pyrene	2.20E+00	1.00E-01	5.86E-06	1.29E-06			2.09E-06	4.61E-07		
Benzo(b)Fluoranthene	1.05E+00	1.00E-01	5.86E-06	6.15E-07			2.09E-06	2.20E-07		
Phenanthrene	4.30E+00	1.00E-01	5.86E-06	2.52E-06			2.09E-06	9.00E-07		
Pyrene	5.60E+00	1.00E-01	5.86E-06	3.28E-06	1.50E-03	2.19E-03	2.09E-06	1.17E-06		
Pesticides										
Delta-BHC	1.74E+00	1.00E-01	5.86E-06	1.02E-06			2.09E-06	3.64E-07		
4,4'-DDD	1.94E+00	1.00E-01	5.86E-06	1.14E-06			2.09E-06	4.06E-07	4.80E+00	1.95E-06
4,4'-DDE	2.54E+00	1.00E-01	5.86E-06	1.49E-06			2.09E-06	5.31E-07	6.80E+00	3.61E-06
4,4'-DDT	2.00E+00	1.00E-01	5.86E-06	1.17E-06	2.50E-05	4.69E-02	2.09E-06	4.19E-07	6.80E+00	2.85E-06
Aldrin	1.81E+01	1.00E-01	5.86E-06	1.06E-05	1.50E-06	7.07E+00	2.09E-06	3.79E-06	3.40E+02	1.29E-03
Alpha-Chlordane	2.45E+00	1.00E-01	5.86E-06	1.44E-06	3.00E-06	4.79E-01	2.09E-06	5.13E-07	2.60E+01	1.33E-05
Gamma-Chlordane	2.43E+00	1.00E-01	5.86E-06	1.43E-06	3.00E-06	4.75E-01	2.09E-06	5.09E-07	2.60E+01	1.32E-05
Dieldrin	5.68E+00	1.00E-01	5.86E-06	3.33E-06	2.50E-06	1.33E+00	2.09E-06	1.19E-06	3.20E+02	3.81E-04
Endosulfan Sulfate	3.27E+00	1.00E-01	5.86E-06	1.92E-06			2.09E-06	6.85E-07		
Endosulfan II	5.71E-01	1.00E-01	5.86E-06	3.35E-07			2.09E-06	1.20E-07		
Endrin Ketone	3.25E+00	1.00E-01	5.86E-06	1.90E-06			2.09E-06	6.80E-07		
Heptachlor	1.18E+00	1.00E-01	5.86E-06	6.94E-07	5.00E-04	1.39E-03	2.09E-06	2.48E-07	4.50E+00	1.12E-06
Heptachlor Epoxide	1.70E+00	1.00E-01	5.86E-06	9.99E-07	1.30E-05	7.69E-02	2.09E-06	3.57E-07	9.10E+00	3.25E-06
Methoxychlor	2.48E+00	1.00E-01	5.86E-06	1.46E-06	2.50E-04	5.82E-03	2.09E-06	5.20E-07		
MCPP	7.20E-01	1.00E-01	5.86E-06	4.22E-07	5.00E-05	8.44E-03	2.09E-06	1.51E-07		
2,4,5-T	7.01E-02	1.00E-01	5.86E-06	4.11E-08	5.00E-04	8.21E-05	2.09E-06	1.47E-08		
2,4-D	4.57E-01	1.00E-01	5.86E-06	2.68E-07	5.00E-04	5.36E-04	2.09E-06	9.57E-08		
Dioxins										
2,3,7,8-Tetra-CDD	1.11E-04	1.00E-01	5.86E-06	6.49E-11			2.09E-06	2.32E-11	1.72E+05	4.00E-06
Inorganics										
Aluminum	9.06E+03	1.00E-02	5.86E-06	5.31E-04	5.00E-02	1.06E-02	2.09E-06	1.90E-04		
Antimony	1.25E+00	1.00E-02	5.86E-06	7.32E-08	2.00E-05	3.66E-03	2.09E-06	2.61E-08		
Arsenic	6.38E+00	1.00E-02	5.86E-06	3.74E-07	2.85E-04	1.31E-03	2.09E-06	1.34E-07	1.84E+00	2.46E-07
Barium	1.75E+02	1.00E-02	5.86E-06	1.02E-05	3.50E-03	2.92E-03	2.09E-06	3.65E-06		
Beryllium	8.73E-01	1.00E-02	5.86E-06	5.12E-08	2.50E-04	2.05E-04	2.09E-06	1.83E-08	8.60E+01	1.57E-06
Cadmium (food)	1.38E+00	2.00E-01	5.86E-06	1.59E-06	2.50E-04	6.36E-03	2.09E-06	5.66E-07		
Chromium (III)	3.53E+01	1.00E-02	5.86E-06	2.07E-06	4.00E-03	5.17E-04	2.09E-06	7.39E-07		
Cobalt	8.53E+00	1.00E-02	5.86E-06	5.00E-07	3.00E-03	1.67E-04	2.09E-06	1.79E-07		
Copper	2.08E+02	1.00E-01	5.86E-06	1.22E-04	2.22E-02	5.49E-03	2.09E-06	4.35E-05		
Cyanide	1.96E-01	1.00E-02	5.86E-06	1.15E-08	1.00E-02	1.15E-06	2.09E-06	4.11E-09		
Lead	3.20E+02	1.00E-01	5.86E-06	1.87E-04			2.09E-06	6.69E-05		
Magnesium	6.87E+03	1.00E-02	5.86E-06	4.03E-04			2.09E-06	1.44E-04		
Manganese (food)	6.94E+02	1.00E-01	5.86E-06	4.07E-04	7.00E-03	5.81E-02	2.09E-06	1.45E-04		
Mercury	1.32E-01	1.00E-02	5.86E-06	7.72E-09	1.50E-05	5.15E-04	2.09E-06	2.76E-09		
Nickel	2.44E+01	1.00E-02	5.86E-06	1.43E-06	6.00E-04	2.38E-03	2.09E-06	5.11E-07		
Selenium	7.50E-01	1.00E-01	5.86E-06	4.40E-07	2.50E-04	1.76E-03	2.09E-06	1.57E-07		
Vanadium	2.75E+01	1.00E-02	5.86E-06	1.61E-06	3.50E-04	4.61E-03	2.09E-06	5.76E-07		
Zinc	3.73E+02	1.00E-01	5.86E-06	2.19E-04	1.50E-02	1.46E-02	2.09E-06	7.82E-05		
NA - Data Not Available			Total Pathway Hazard Index——>			9.6E+00		Total Pathway Risk——>		1.7E-03

DERMAL CONTACT WITH SOIL
CS = Concentration of chemical in soil (mg/kg)
ABS = Absorption Factor - Assumed to be 0.1 for organics, 0.1 for copper, lead, manganese, selinium and zinc, 0.2 for cadmium, and 0.01 for inorganics (CAPCOA values)

\# - Assumed Value

1.00E-06 CF = 0.000001 kg/mg - Conversion Facor, (EPA, 1989a)
3.12E+03 SA = 3120 sq cm - Skin Surface Area Available for Contact, hands, arms, (EPA, 1989a)
1.00E+00 FI = 1.0 - Fraction of Intake from source, 100 percent (RAGS)
4.80E+01 EF = 48 days/yr - Exposure Frequency for an adult worker (1 day/wk for 48 wks) #
2.50E+01 ED = 25 yrs - Exposure Duration for adult, (OSWER, 1991)
7.00E+01 BW = 70 kg - Body Weight for adult, (OSWER, 1991)
2.50E+01 ATN = 25 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)
1.00E+00 AF = 1.00 mg/sq cm - Adherence Factor, (EPA, Region X)

HIF--NON-CARCINOGENIC——————> 5.86E-06 HIF = (CF * SA * FI * EF * ED * AF / BW)) / (ATN)(365)]
HIF--CARCINOGENIC——————> 2.09E-06 HIF = (CF * SA * FI * EF * ED * AF / BW)) / (ATC)(365)]

DAILY INTAKE = (CS * ABS * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 6
Cleanup Levels for Ingestion and Dermal Contact
Adult Worker (Capped Data)
(Future Worker Scenario)
OU4 Risk Assessment

Contaminants or Chemicals	Non-Carcinogenic Risk				Non-Carcinogenic Cleanup Level (HQ=0.1) mg/kg	Non-Carcinogenic Cleanup Level (HQ=1.0) mg/kg	Carcinogenic Risk				Carcinogenic Cleanup Level (Risk=1E-4) mg/kg	Carcinogenic Cleanup Level (Risk=1E-6) mg/kg
	Ingestion HQ	Dermal Contact HQ	Inhalation HQ	Total HQ			Ingestion Risk	Dermal Contact Risk	Inhalation Risk	Total Risk		
1,1,1-Trichloroethane	3.3E-07	4.1E-05		4.2E-05	7.6E+02	7.6E+03						
1,2-Dichloroethene(mixture)	3.3E-06	4.2E-04		4.2E-04	7.6E+01	7.6E+02						
2-Butanone (MEK)	8.9E-08	1.1E-05		1.1E-05	5.1E+03	5.1E+04						
Acetone	6.8E-07	8.4E-05		8.5E-05	8.5E+02	8.5E+03						
Carbon Disulfide	2.7E-07	3.4E-05		3.4E-05	8.5E+02	8.5E+03						
Ethylbenzene	3.3E-06	2.3E-05		2.6E-05	1.4E+04	1.4E+05						
Methylene Chloride	5.5E-07	6.2E-06		6.8E-06	5.2E+03	5.2E+04	8.8E-11	1.0E-09		1.1E-09	3.2E+04	3.2E+02
Tetrachloroethene	3.0E-06	1.9E-05		2.2E-05	1.5E+03	1.5E+04	5.5E-10	3.5E-09		4.0E-09	7.9E+03	7.9E+01
Toluene	1.7E-06	2.1E-04		2.1E-04	1.7E+03	1.7E+04						
Trichloroethene	5.0E-06	3.2E-05		3.7E-05	8.7E+02	8.7E+03	1.2E-10	7.5E-10		8.7E-10	3.7E+04	3.7E+02
Vinyl Chloride							3.9E-08	2.4E-07		2.8E-07	2.2E+02	2.2E+00
Xylene (mixed)	1.6E-06	1.1E-05		1.2E-05	2.7E+05	2.7E+06						
Semi-volatile organics												
2,4,6-Trichlorophenol							3.9E-10	4.8E-08		4.9E-08	2.2E+03	2.2E+01
2,4-Dichlorophenol	3.3E-05	4.1E-03		4.1E-03	2.5E+01	2.5E+02						
2-Methylnaphthalene												
Benzo(g,h,i)Perylene												
Benzo(k)Fluoranthene							2.6E-09			2.6E-09	4.1E+04	4.1E+02
Benzoic Acid	7.0E-06	8.8E-06		8.9E-06	3.4E+04	3.4E+05						
Chrysene							7.3E-10			7.3E-10	4.1E+05	4.1E+03
Di-n-Butylphthalate	2.1E-07	1.3E-06		1.5E-06	1.4E+04	1.4E+05						
Dibenzofuran	5.2E-06	6.4E-04		6.5E-04	3.4E+01	3.4E+02						
Fluoranthene	1.2E-05	1.6E-03		1.6E-03	3.4E+02	3.4E+03						
Fluorene	1.0E-06	1.3E-04		1.3E-04	3.4E+02	3.4E+03						
Indeno(1,2,3-cd)Pyrene							2.7E-08			2.7E-08	4.1E+03	4.1E+01
Naphthalene	5.2E-07	6.4E-05		6.5E-05	3.4E+02	3.4E+03						
Acenaphthylene												
Anthracene	3.1E-07	3.9E-05		3.9E-05	2.5E+03	2.5E+04						
Benzo(a)Anthracene							6.4E-08			6.4E-08	4.1E+03	4.1E+01
Benzo(a)Pyrene							5.4E-07			5.4E-07	4.1E+02	4.1E+00
Benzo(b)Fluoranthene							2.6E-08			2.6E-08	4.1E+03	4.1E+01
Phenanthrene												
Pyrene	1.8E-05	2.2E-03		2.2E-03	2.5E+02	2.5E+03						
Pesticides												
Delta-BHC												
4,4'-DDD							1.6E-06	1.9E-06		2.0E-06	9.9E+01	9.9E-01
4,4'-DDE							2.9E-08	3.6E-06		3.6E-06	7.0E+01	7.0E-01
4,4'-DDT	3.8E-04	4.7E-02		4.7E-02	4.2E+00	4.2E+01	2.3E-06	2.8E-06		2.9E-06	7.0E+01	7.0E-01
Aldrin	5.7E-02	7.1E+00		7.1E+00	2.5E-01	2.5E+00	1.0E-05	1.3E-03		1.3E-03	1.4E+00	1.4E-02
Alpha-Chlordane	3.8E-03	4.8E-01		4.8E-01	5.1E-01	5.1E+00	1.1E-07	1.3E-05		1.3E-05	1.8E+01	1.8E-01
Gamma-Chlordane	3.8E-03	4.8E-01		4.8E-01	5.1E-01	5.1E+00	1.1E-07	1.3E-05		1.3E-05	1.8E+01	1.8E-01
Dieldrin	1.1E-02	1.3E+00		1.3E+00	4.2E-01	4.2E+00	3.1E-06	3.8E-04		3.8E-04	1.5E+00	1.5E-02
Endosulfan Sulfate												
Endosulfan II												
Endrin Ketone												
Heptachlor	2.2E-04	1.4E-03		1.6E-03	7.4E+01	7.4E+02	1.8E-07	1.1E-06		1.3E-06	9.1E+01	9.1E-01
Heptachlor Epoxide	1.2E-02	7.7E-02		8.9E-02	1.9E+00	1.9E+01	5.2E-07	3.2E-06		3.8E-06	4.5E+01	4.5E-01
Methoxychlor	4.7E-05	5.8E-03		5.9E-03	4.2E+01	4.2E+02						
MCPP	6.8E-05	8.4E-03		8.5E-03	8.5E+00	8.5E+01						
2,4,5-T	6.6E-07	8.2E-05		8.3E-05	8.5E+01	8.5E+02						
2,4-D	4.3E-06	5.4E-04		5.4E-04	8.5E+01	8.5E+02						
Dioxins												
2,3,7,8-Tetra-CDD							5.6E-07	4.0E-06		4.6E-06	2.4E-03	2.4E-05
Inorganics												
Aluminum	8.5E-04	1.1E-02		1.1E-02	7.9E+04	7.9E+05						
Antimony	2.9E-04	3.7E-03		4.0E-03	3.2E+01	3.2E+02						
Arsenic	2.0E-03	1.3E-03		3.3E-03	1.9E+02	1.9E+03	3.7E-07	2.5E-07		6.2E-07	1.0E+03	1.0E+01
Barium	2.3E-04	2.9E-03		3.2E-03	5.5E+03	5.5E+04						
Beryllium	1.6E-05	2.0E-04		2.2E-04	3.9E+02	3.9E+03	1.3E-07	1.6E-06		1.7E-06	5.1E+01	5.1E-01
Cadmium (food)	2.5E-05	6.4E-03		6.4E-03	2.1E+01	2.1E+02						
Chromium (III)	3.3E-06	5.2E-04		5.2E-04	6.8E+03	6.8E+04						
Cobalt	1.3E-05	1.7E-04		1.8E-04	4.7E+03	4.7E+04						
Copper	5.3E-04	5.5E-03		6.0E-03	3.5E+03	3.5E+04						
Cyanide	9.2E-07	1.2E-06		2.1E-06	9.5E+03	9.5E+04						
Lead												
Magnesium												
Manganese (food)	4.7E-04	5.8E-02		5.8E-02	1.2E+03	1.2E+04						
Mercury	4.1E-05	5.1E-04		5.6E-04	2.4E+01	2.4E+02						
Nickel	1.1E-04	2.4E-03		2.5E-03	9.8E+02	9.8E+03						
Selenium	1.4E-05	1.8E-03		1.8E-03	4.2E+01	4.2E+02						
Vanadium	3.7E-04	4.6E-03		5.0E-03	5.5E+02	5.5E+03						
Zinc	1.2E-04	1.5E-02		1.5E-02	2.5E+03	2.5E+04						

Table 7
Incidental Ingestion of Soil
Onsite Child/Adult
(Future Residential Scenario)
Exposed Soils
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Chronic Non-Carcinogenic Effects				Lifetime Carcinogenic Effects			
		Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral RfD mg/kg-day	Hazard Quotient (HQ) unitless	Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral Slope Factor kg-day/mg	Risk unitless
Pesticides									
Delta-BHC	1.20E-03	3.65E-06	4.38E-09			1.57E-06	1.88E-09		
4,4'-DDD	1.65E-03	3.65E-06	6.76E-09			1.57E-06	2.90E-09	2.40E-01	6.95E-10
4,4'-DDE	4.50E-03	3.65E-06	1.64E-08			1.57E-06	7.05E-09	3.40E-01	2.40E-09
4,4'-DDT	1.00E-02	3.65E-06	3.65E-08	5.00E-04	7.31E-05	1.57E-06	1.57E-08	3.40E-01	5.32E-09
Aldrin	1.50E-02	3.65E-06	5.48E-08	3.00E-05	1.83E-03	1.57E-06	2.35E-08	1.70E+01	3.99E-07
Alpha-Chlordane	4.70E-03	3.65E-06	1.72E-08	6.00E-05	2.86E-04	1.57E-06	7.38E-09	1.30E+00	9.57E-09
Gamma-Chlordane	5.00E-03	3.65E-06	1.83E-08	6.00E-05	3.04E-04	1.57E-06	7.83E-09	1.30E+00	1.02E-08
Dieldrin	1.50E-02	3.65E-06	5.48E-08	5.00E-05	1.10E-03	1.57E-06	2.35E-08	1.60E+01	3.76E-07
Endrin Ketone	3.60E-03	3.65E-06	1.32E-08			1.57E-06	5.64E-09		
Heptachlor Epoxide	1.00E-03	3.65E-06	3.65E-09	1.30E-05	2.81E-04	1.57E-06	1.57E-09	9.10E+00	1.42E-08
NA - Data Not Available		Total Pathway Hazard Index——>			3.9E-03	Total Pathway Risk——>			8.2E-07

INCIDENTAL INGESTION OF SOIL
CS = Concentration of chemical in soil (mg/kg)
1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
2.00E+02 IRC = 200 mg/day - Ingestion Rate of soil by a child (0-6 yrs.), (OSWER, 1991)
1.00E+02 IRA = 100 mg/day - Ingestion Rate of soil by an adult (6-30 yrs.), (OSWER, 1991)
1.00E+00 FI = 1.0 - Fraction of Intake from source, 100 percent (RAGS)
6.00E+00 EDC = 6 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)
2.40E+01 EDA = 24 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
3.50E+02 EFC = 350 days/yr - Exposure Frequency for a child (0-6 yrs), (OSWER, 1991)
3.50E+02 EFA = 350 days/yr - Exposure Frequency for an adult (6-30 yrs), (OSWER, 1991)
1.50E+01 BWC = 15 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
7.00E+01 BWA = 70 kg - Body Weight for adult, (OSWER, 1991)
3.00E+01 ATN = 30 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--NON-CARCINOGENIC——> 3.65E-06 HIF = ((IRC * FI * EFC * EDC / BWC) + (IRA * FI * EFA * EDA / BWA))*CF / (ATN)(365)
HIF--CARCINOGENIC——> 1.57E-06 HIF = ((IRC * FI * EFC * EDC / BWC) + (IRA * FI * EFA * EDA / BWA))*CF / (ATC)(365)
DAILY INTAKE = (CS * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 8
Dermal Contact with Soil
Onsite Child/Adult
(Future Residential Scenario)
Exposed Soils
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Absorption Factor (ABS) unitless	Chronic Non-Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal RfD mg/kg-day	Hazard Quotient (HQ) unitless	Lifetime Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal Slope Factor kg-day/mg	Risk unitless
Pesticides										
Delta-BHC	1.20E-03	1.00E-01	8.68E-05	1.04E-08			3.72E-05	4.46E-09		
4,4'-DDD	1.85E-03	1.00E-01	8.68E-05	1.61E-08			3.72E-05	6.88E-09	4.60E+00	3.30E-08
4,4'-DDE	4.50E-03	1.00E-01	8.68E-05	3.90E-08			3.72E-05	1.67E-08	6.80E+00	1.14E-07
4,4'-DDT	1.00E-02	1.00E-01	8.68E-05	8.68E-08	2.50E-05	3.47E-03	3.72E-05	3.72E-08	6.80E+00	2.53E-07
Aldrin	1.50E-02	1.00E-01	8.68E-05	1.30E-07	1.50E-06	8.68E-02	3.72E-05	5.58E-08	3.40E+02	1.90E-05
Alpha-Chlordane	4.70E-03	1.00E-01	8.68E-05	4.08E-08	3.00E-06	1.36E-02	3.72E-05	1.75E-08	2.60E+01	4.54E-07
Gamma-Chlordane	5.00E-03	1.00E-01	8.68E-05	4.34E-08	3.00E-06	1.45E-02	3.72E-05	1.86E-08	2.60E+01	4.83E-07
Dieldrin	1.50E-02	1.00E-01	8.68E-05	1.30E-07	2.50E-06	5.21E-02	3.72E-05	5.58E-08	3.20E+02	1.78E-05
Endrin Ketone	3.60E-03	1.00E-01	8.68E-05	3.12E-08			3.72E-05	1.34E-08		
Heptachlor Epoxide	1.00E-03	1.00E-01	8.68E-05	8.68E-09	1.30E-05	6.67E-04	3.72E-05	3.72E-09	9.10E+00	3.38E-08
NA - Data Not Available			Total Pathway Hazard Indix——>			1.7E-01		Total Pathway Risk——>		3.8E-05

DERMAL CONTACT WITH SOIL
CS = Concentration of chemical in soil (mg/kg)
ABS = Absorption Factor - Assumed to be 0.1 for organics, 0.1 for copper, lead, manganese, selenium and zinc, 0.2 for cadmium, and 0.01 for inorganics (CAPCOA values)

1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
2.50E+03 SAC = 2500 sq cm - Skin Surface Area Available (Child 0-6 yrs), hands, arms, legs, (OHEA-E-367)
5.00E+03 SAA = 5000 sq cm - Skin Surface Area Available for Contact, (Adult), hands, arms, (OHEA-E-367)
1.00E+00 FI = 1.0 - Fraction of Intake from source, 100 percent (RAGS)
3.50E+02 EFC = 350 days/yr - Exposure Frequency, (Child: 0-6 yrs.) (OSWER, 1991)
3.50E+02 EFA = 350 days/yr - Exposure Frequency, (Adult: 6-30 yrs), (OSWER, 1991)
6.00E+00 EDC = 6 yrs - Duration for child (1-6 yrs.), (OSWER, 1991)
2.40E+01 EDA = 24 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.50E+01 BWC = 15 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
7.00E+01 BWA = 70 kg - Body Weight for adult, (OSWER, 1991)
3.00E+01 ATN = 30 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)
1.00E+00 AF = 1.00 mg/sq cm - Adherence Factor, (EPA, Region X)

HIF--NON-CARCINOGENIC——————> 8.68E-05 HIF = [((SAC * FI * EFC * EDC * AF / BWC) + (SAA * FI * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]
HIF--CARCINOGENIC——————> 3.72E-05 HIF = [((SAC * FI * EFC * EDC * AF / BWC) + (SAA * FI * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]
DAILY INTAKE = (CS * ABS * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 9
Cleanup Levels for Ingestion and Dermal Contact
Onsite Child/Adult
(Future Residential Scenario)
Exposed Soils
OU4 Risk Assessment

Contaminants or Chemicals	Non-Carcinogenic Risk				Non-Carcinogenic Cleanup Level (HQ=0.1) mg/kg	Non-Carcinogenic Cleanup Level (HQ=1.0) mg/kg	Carcinogenic Risk				Carcinogenic Cleanup Level (Risk=1E-4) mg/kg	Carcinogenic Cleanup Level (Risk=1E-6) mg/kg
	Ing-estion HQ	Dermal Contact HQ	Inhal-ation HQ	Total HQ			Ingest-ion Risk	Dermal Contact Risk	Inhal-ation Risk	Total Risk		
Pesticides												
Delta-BHC												
4,4'-DDD							7.0E-10	3.3E-08		3.4E-08	5.5E+00	5.5E-02
4,4'-DDE							2.4E-09	1.1E-07		1.2E-07	3.9E+00	3.9E-02
4,4'-DDT	7.3E-05	3.5E-03		3.5E-03	2.8E-01	2.8E+00	5.3E-09	2.5E-07		2.6E-07	3.9E+00	3.9E-02
Aldrin	1.8E-03	8.7E-02		8.9E-02	1.7E-02	1.7E-01	4.0E-07	1.9E-05		1.9E-05	7.7E-02	7.7E-04
Alpha-Chlordane	2.9E-04	1.4E-02		1.4E-02	3.4E-02	3.4E-01	9.6E-09	4.5E-07		4.6E-07	1.0E+00	1.0E-02
Gamma-Chlordane	3.0E-04	1.4E-02		1.5E-02	3.4E-02	3.4E-01	1.0E-08	4.8E-07		4.9E-07	1.0E+00	1.0E-02
Dieldrin	1.1E-03	5.2E-02		5.3E-02	2.8E-02	2.8E-01	3.8E-07	1.8E-05		1.8E-05	8.2E-02	8.2E-04
Endrin Ketone												
Heptachlor Epoxide	2.8E-04	6.7E-04		9.5E-04	1.1E-01	1.1E+00	1.4E-08	3.4E-08		4.8E-08	2.1E+00	2.1E-02

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Table 10
Incidental Ingestion of Soil
Adult Worker
(Current and Future Worker Scenario)
Exposed Soils
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Chronic Non-Carcinogenic Effects				Lifetime Carcinogenic Effects			
		Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral RfD mg/kg-day	Hazard Quotient (HQ) unitless	Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral Slope Factor kg-day/mg	Risk unitless
Pesticides									
Delta-BHC	1.20E-03	9.39E-08	1.13E-10			3.35E-08	4.03E-11		
4,4'-DDD	1.85E-03	9.39E-08	1.74E-10			3.35E-08	6.21E-11	2.40E-01	1.49E-11
4,4'-DDE	4.50E-03	9.39E-08	4.23E-10			3.35E-08	1.51E-10	3.40E-01	5.13E-11
4,4'-DDT	1.00E-02	9.39E-08	9.39E-10	5.00E-04	1.88E-06	3.35E-08	3.35E-10	3.40E-01	1.14E-10
Aldrin	1.50E-02	9.39E-08	1.41E-09	3.00E-05	4.70E-05	3.35E-08	5.03E-10	1.70E+01	8.55E-09
Alpha-Chlordane	4.70E-03	9.39E-08	4.41E-10	6.00E-05	7.36E-06	3.35E-08	1.58E-10	1.30E+00	2.05E-10
Gamma-Chlordane	5.00E-03	9.39E-08	4.70E-10	6.00E-05	7.83E-06	3.35E-08	1.68E-10	1.30E+00	2.18E-10
Dieldrin	1.50E-02	9.39E-08	1.41E-09	5.00E-05	2.82E-05	3.35E-08	5.03E-10	1.60E+01	8.05E-09
Endrin Ketone	3.80E-03	9.39E-08	3.38E-10			3.35E-08	1.21E-10		
Heptachlor Epoxide	1.00E-03	9.39E-08	9.39E-11	1.30E-05	7.23E-06	3.35E-08	3.35E-11	9.10E+00	3.05E-10
NA - Data Not Available		Total Pathway Hazard Index---------->			9.9E-05	Total Pathway Risk---->			1.8E-08

INCIDENTAL INGESTION OF SOIL
CS = Concentration of chemical in soil (mg/kg)

- Assumed Value

1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
5.00E+01 IR = 50 mg/day - Ingestion Rate of soil by an adult worker, (OSWER, 1991)
1.00E+00 FI = 1.0 - Fraction of Intake from source, 100 percent (RAGS)
2.50E+01 ED = 25 yrs - Exposure Duration for an adult worker, (OSWER, 1991)
4.80E+01 EF = 48 days/yr - Exposure Frequency for an adult worker (1 day/wk for 48 wks) #
7.00E+01 BW = 70 kg - Body Weight for adult worker, (OSWER, 1991)
2.50E+01 ATN = 25 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF-NON-CARCINOGENIC----------> 9.39E-08 HIF = ((CF * IR * FI * ED * EF / BW)) / (ATN)(365)
HIF-CARCINOGENIC----------> 3.35E-08 HIF = ((CF * IR * FI * ED * EF / BW)) / (ATC)(365)
DAILY INTAKE = (CS * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 11
Dermal Contact with Soil
Adult Worker
(Current and Future Worker Scenario)
Exposed Soils
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Absorption Factor (ABS) unitless	Chronic Non-Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal RfD mg/kg-day	Hazard Quotient (HQ) unitless	Lifetime Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal Slope Factor kg-day/mg	Risk unitless
Pesticides										
Delta-BHC	1.20E-03	1.00E-01	5.86E-06	7.03E-10			2.09E-06	2.51E-10		
4,4'-DDD	1.85E-03	1.00E-01	5.86E-06	1.08E-09			2.09E-06	3.87E-10	4.80E+00	1.86E-09
4,4'-DDE	4.50E-03	1.00E-01	5.86E-06	2.64E-09			2.09E-06	9.42E-10	6.80E+00	6.41E-09
4,4'-DDT	1.00E-02	1.00E-01	5.86E-06	5.86E-09	2.50E-05	2.34E-04	2.09E-06	2.09E-09	6.80E+00	1.42E-08
Aldrin	1.50E-02	1.00E-01	5.86E-06	8.79E-09	1.50E-06	5.86E-03	2.09E-06	3.14E-09	3.40E+02	1.07E-06
Alpha-Chlordane	4.70E-03	1.00E-01	5.86E-06	2.75E-09	3.00E-06	9.16E-04	2.09E-06	9.84E-10	2.60E+01	2.56E-08
Gamma-Chlordane	5.00E-03	1.00E-01	5.86E-06	2.93E-09	3.00E-06	9.77E-04	2.09E-06	1.05E-09	2.60E+01	2.72E-08
Dieldrin	1.50E-02	1.00E-01	5.86E-06	8.79E-09	2.50E-06	3.52E-03	2.09E-06	3.14E-09	3.20E+02	1.00E-06
Endrin Ketone	3.60E-03	1.00E-01	5.86E-06	2.11E-09			2.09E-06	7.54E-10		
Heptachlor Epoxide	1.00E-03	1.00E-01	5.86E-06	5.86E-10	1.30E-05	4.51E-05	2.09E-06	2.09E-10	9.10E+00	1.90E-09
			Total Pathway Hazard Index——>			1.2E-02		Total Pathway Risk——>		2.1E-06

NA - Data Not Available

DERMAL CONTACT WITH SOIL
CS = Concentration of chemical in soil (mg/kg)
ABS = Absorption Factor - Assumed to be 0.1 for organics, 0.1 for copper, lead, manganese, selenium and zinc, 0.2 for cadmium, and 0.01 for inorganics (CAPCOA values)

- Assumed Value

1.00E-06 CF = 0.000001 kg/mg - Conversion Facor, (EPA, 1989a)
3.12E+03 SA = 3120 sq cm - Skin Surface Area Available for Contact, hands, arms, (EPA, 1989a)
1.00E+00 FI = 1.0 - Fraction of Intake from source, 100 percent (RAGS)
4.80E+01 EF = 48 days/yr - Exposure Frequency for an adult worker (1 day/wk for 48 wks) #
2.50E+01 ED = 25 yrs - Exposure Duration for adult, (OSWER, 1991)
7.00E+01 BW = 70 kg - Body Weight for adult, (OSWER, 1991)
2.50E+01 ATN = 25 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)
1.00E+00 AF = 1.00 mg/sq cm - Adherence Factor, (EPA, Region X)

HIF–NON-CARCINOGENIC——> 5.86E-06 HIF = (CF * SA * FI * EF * ED * AF / BW)) / (ATN)(365)]
HIF–CARCINOGENIC——> 2.09E-06 HIF = (CF * SA * FI * EF * ED * AF / BW)) / (ATC)(365)]
DAILY INTAKE = (CS * ABS * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 12
Cleanup Levels for Ingestion and Dermal Contact
Adult Worker
(Current and Future Worker Scenario)
Exposed Soils
OU4 Risk Assessment

Contaminants or Chemicals	Non-Carcinogenic Risk				Non-Carcinogenic Cleanup Level (HQ=0.1) mg/kg	Non-Carcinogenic Cleanup Level (HQ=1.0) mg/kg	Carcinogenic Risk				Carcinogenic Cleanup Level (Risk=1E-4) mg/kg	Carcinogenic Cleanup Level (Risk=1E-6) mg/kg
	Ing-estion HQ	Dermal Contact HQ	Inhal-ation HQ	Total HQ			Ingest-ion Risk	Dermal Contact Risk	Inhal-ation Risk	Total Risk		
Pesticides												
Delta-BHC												
4,4'-DDD							1.5E-11	1.9E-09		1.9E-09	9.9E+01	9.9E-01
4,4'-DDE							5.1E-11	6.4E-09		6.5E-09	7.0E+01	7.0E-01
4,4'-DDT	1.9E-06	2.3E-04		2.4E-04	4.2E+00	4.2E+01	1.1E-10	1.4E-08		1.4E-08	7.0E+01	7.0E-01
Aldrin	4.7E-05	5.9E-03		5.9E-03	2.5E-01	2.5E+00	8.6E-09	1.1E-06		1.1E-06	1.4E+00	1.4E-02
Alpha-Chlordane	7.4E-06	9.2E-04		9.3E-04	5.1E-01	5.1E+00	2.0E-10	2.6E-08		2.6E-08	1.8E+01	1.8E-01
Gamma-Chlordane	7.8E-06	9.8E-04		9.8E-04	5.1E-01	5.1E+00	2.2E-10	2.7E-08		2.7E-08	1.8E+01	1.8E-01
Dieldrin	2.8E-05	3.5E-03		3.5E-03	4.2E-01	4.2E+00	8.1E-09	1.0E-06		1.0E-06	1.5E+00	1.5E-02
Endrin Ketone												
Heptachlor Epoxide	7.2E-06	4.5E-05		5.2E-05	1.9E+00	1.9E+01	3.1E-10	1.9E-09		2.2E-09	4.5E+01	4.5E-01

Table 13
Incidental Ingestion of Soil
Onsite Child/Adult
(Current Recreational Scenario)
Exposed Soils
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Chronic Non-Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral RfD mg/kg-day	Hazard Quotient (HQ) unitless	Lifetime Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Oral Slope Factor kg-day/mg	Risk unitless
Pesticides									
Delta-BHC	1.20E-03	7.66E-08	9.19E-11			3.28E-08	3.94E-11		
4,4'-DDD	1.85E-03	7.66E-08	1.42E-10			3.28E-08	6.07E-11	2.40E-01	1.46E-11
4,4'-DDE	4.50E-03	7.66E-08	3.45E-10			3.28E-08	1.48E-10	3.40E-01	5.02E-11
4,4'-DDT	1.00E-02	7.66E-08	7.66E-10	5.00E-04	1.53E-06	3.28E-08	3.28E-10	3.40E-01	1.12E-10
Aldrin	1.50E-02	7.66E-08	1.15E-09	3.00E-05	3.83E-05	3.28E-08	4.92E-10	1.70E+01	8.37E-09
Alpha-Chlordane	4.70E-03	7.66E-08	3.60E-10	6.00E-05	6.00E-06	3.28E-08	1.54E-10	1.30E+00	2.01E-10
Gamma-Chlordane	5.00E-03	7.66E-08	3.83E-10	6.00E-05	6.38E-06	3.28E-08	1.64E-10	1.30E+00	2.13E-10
Dieldrin	1.50E-02	7.66E-08	1.15E-09	5.00E-05	2.30E-05	3.28E-08	4.92E-10	1.60E+01	7.88E-09
Endrin Ketone	3.60E-03	7.66E-08	2.76E-10			3.28E-08	1.18E-10		
Heptachlor Epoxide	1.00E-03	7.66E-08	7.66E-11	1.30E-05	5.89E-06	3.28E-08	3.28E-11	9.10E+00	2.99E-10

NA - Data Not Available

Total Pathway Hazard Index——> 8.1E-05

Total Pathway Risk——> 1.7E-08

INCIDENTAL INGESTION OF SOIL

CS = Concentration of chemical in soil (mg/kg)

1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)

2.00E+02 IRC = 200 mg/day - Ingestion Rate of soil by a child (0-6 yrs.), (OSWER, 1991)

1.00E+02 IRA = 100 mg/day - Ingestion Rate of soil by an adult (6-30 yrs.), (OSWER, 1991)

1.66E-01 FI = 0.166 - Fraction of Intake from source, 2 hrs/day (1 day = 12 hrs exposure)#

6.00E+00 EDC = 6 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.40E+01 EDA = 24 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

5.20E+01 EFC = 52 days/yr - Exposure Frequency for a child (0-6 yrs), 2 days/wk for 6 months/yr #

2.60E+01 EFA = 26 days/yr - Exposure Frequency for an adult (6-30 yrs), 1 day/wk for 6 months/yr #

1.50E+01 BWC = 15 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

7.00E+01 BWA = 70 kg - Body Weight for adult, (OSWER, 1991)

3.00E+01 ATN = 30 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)

7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF–NON-CARCINOGENIC——> 7.66E-08 HIF = ((IRC * FI * EFC * EDC / BWC) + (IRA * FI * EFA * EDA / BWA))*CF / (ATN)(365)

HIF–CARCINOGENIC——> 3.28E-08 HIF = ((IRC * FI * EFC * EDC / BWC) + (IRA * FI * EFA * EDA / BWA))*CF / (ATC)(365)

DAILY INTAKE = (CS * HIF)

RISK (non-carcinogenic) = (INTAKE / RfD)

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 14
Dermal Contact with Soil
Onsite Child/Adult
(Current Recreational Scenario)
Exposed Soils
OU4 Risk Assessment

Contaminants or Chemicals	RME Conc (CS) mg/kg	Absorption Factor (ABS) unitless	Chronic Non-Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal RfD mg/kg-day	Hazard Quotient (HQ) unitless	Lifetime Carcinogenic Effects: Human Intake Factor (HIF) kg/kg-day	Daily Intake mg/kg-day	Adjusted Dermal Slope Factor kg-day/mg	Risk unitless
Pesticides										
Delta-BHC	1.20E-03	1.00E-01	1.46E-06	1.76E-10			6.27E-07	7.53E-11		
4,4'-DDD	1.85E-03	1.00E-01	1.46E-06	2.71E-10			6.27E-07	1.16E-10	4.80E+00	5.57E-10
4,4'-DDE	4.50E-03	1.00E-01	1.46E-06	6.59E-10			6.27E-07	2.82E-10	6.80E+00	1.92E-09
4,4'-DDT	1.00E-02	1.00E-01	1.46E-06	1.46E-09	2.50E-05	5.86E-05	6.27E-07	6.27E-10	6.80E+00	4.27E-09
Aldrin	1.50E-02	1.00E-01	1.46E-06	2.20E-09	1.50E-06	1.46E-03	6.27E-07	9.41E-10	3.40E+02	3.20E-07
Alpha-Chlordane	4.70E-03	1.00E-01	1.46E-06	6.88E-10	3.00E-06	2.29E-04	6.27E-07	2.95E-10	2.60E+01	7.67E-09
Gamma-Chlordane	5.00E-03	1.00E-01	1.46E-06	7.32E-10	3.00E-06	2.44E-04	6.27E-07	3.14E-10	2.60E+01	8.16E-09
Dieldrin	1.50E-02	1.00E-01	1.46E-06	2.20E-09	2.50E-06	8.78E-04	6.27E-07	9.41E-10	3.20E+02	3.01E-07
Endrin Ketone	3.60E-03	1.00E-01	1.46E-06	5.27E-10			6.27E-07	2.26E-10		
Heptachlor Epoxide	1.00E-03	1.00E-01	1.46E-06	1.46E-10	1.30E-05	1.13E-05	6.27E-07	6.27E-11	9.10E+00	5.71E-10
NA - Data Not Available			Total Pathway Hazard Index——>			2.9E-03	Total Pathway Risk——>			6.4E-07

DERMAL CONTACT WITH SOIL
CS = Concentration of chemical in soil (mg/kg)
ABS = Absorption Factor - Assumed to be 0.1 for organics, 0.1 for copper, lead, manganese, selenium, zinc, 0.2 for cadmium, and 0.01 for inorganics (CAPCOA values)

1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
2.50E+03 SAC = 2500 sq cm - Skin Surface Area Available (Child 0-6 yrs.), hands, arms, legs, (OHEA-E-367)
5.00E+03 SAA = 5000 sq cm - Skin Surface Area Available for Contact, (Adult), hands, arms, (OHEA-E-367)
1.66E-01 FI = 0.166 - Fraction of Intake from source, 2 hrs/day (1 day = 12 hrs exposure)#
5.20E+01 EFC = 52 days/yr - Exposure Frequency for a child (0-6 yrs), 2 days/wk for 6 months/yr #
2.60E+01 EFA = 26 days/yr - Exposure Frequency for an adult (6-30 yrs), 1 day/wk for 6 months/yr #
6.00E+00 EDC = 6 yrs - Duration for child (1-6 yrs.), (OSWER, 1991)
2.40E+01 EDA = 24 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.50E+01 BWC = 15 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
7.00E+01 BWA = 70 kg - Body Weight for adult, (OSWER, 1991)
3.00E+01 ATN = 30 yrs - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01 ATC = 70 yrs - Averaging Time for carcinogenic compounds, (OSWER, 1991)
1.00E+00 AF = 1.00 mg/sq cm - Adherence Factor, (EPA, Region X)

HIF–NON-CARCINOGENIC——> 1.46E-06 HIF = [((SAC * FI * EFC * EDC * AF / BWC) + (SAA * FI * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]
HIF–CARCINOGENIC——> 6.27E-07 HIF = [((SAC * FI * EFC * EDC * AF / BWC) + (SAA * FI * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]
DAILY INTAKE = (CS * ABS * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

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Table 15
Cleanup Levels for Ingestion and Dermal Contact
Onsite Child/Adult
(Current Recreational Scenario)
Exposed Soils
OU4 Risk Assessment

Contaminants or Chemicals	Non-Carcinogenic Risk				Non-Carcinogenic Cleanup Level (HQ=0.1) mg/kg	Non-Carcinogenic Cleanup Level (HQ=1.0) mg/kg	Carcinogenic Risk				Carcinogenic Cleanup Level (Risk=1E-4) mg/kg	Carcinogenic Cleanup Level (Risk=1E-6) mg/kg
	Ing-estion HQ	Dermal Contact HQ	Inhal-ation HQ	Total HQ			Ingest-ion Risk	Dermal Contact Risk	Inhal-ation Risk	Total Risk		
Pesticides												
Delta-BHC												
4,4'-DDD							1.5E-11	5.6E-10		5.7E-10	3.2E+02	3.2E+00
4,4'-DDE							5.0E-11	1.9E-09		2.0E-09	2.3E+02	2.3E+00
4,4'-DDT	1.5E-06	5.9E-05		6.0E-05	1.7E+01	1.7E+02	1.1E-10	4.3E-09		4.4E-09	2.3E+02	2.3E+00
Aldrin	3.8E-05	1.5E-03		1.5E-03	1.0E+00	1.0E+01	8.4E-09	3.2E-07		3.3E-07	4.6E+00	4.6E-02
Alpha-Chlordane	6.0E-06	2.3E-04		2.4E-04	2.0E+00	2.0E+01	2.0E-10	7.7E-09		7.9E-09	6.0E+01	6.0E-01
Gamma-Chlordane	6.4E-06	2.4E-04		2.5E-04	2.0E+00	2.0E+01	2.1E-10	8.2E-09		8.4E-09	6.0E+01	6.0E-01
Dieldrin	2.3E-05	8.8E-04		9.0E-04	1.7E+00	1.7E+01	7.9E-09	3.0E-07		3.1E-07	4.9E+00	4.9E-02
Endrin Ketone												
Heptachlor Epoxide	5.9E-06	1.1E-05		1.7E-05	5.8E+00	5.8E+01	3.0E-10	5.7E-10		8.7E-10	1.1E+02	1.1E+00

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